

V.S.B.ENGINEERING COLLEGE, KARUR.

(An Autonomous Institution)

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai.

NH – 67, Covai Road, Karudayampalayam PO, Karur - 639 111.



SYLLABI REGULATIONS – 2023

**Department of
Mechanical Engineering**

23IP101	INDUCTION PROGRAMME	Category: -			
		L	T	P	C
		-	-	-	0
This is a mandatory 2 weekprogramme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.					
The induction programme has been introduced by AICTE with the following objective:					
1.“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”					
2. “One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. “					
3. Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.					
	Physical Activity				
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.					
	Creative Arts				
Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.					
	Universal Human Values				
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.					
	Literary Activity				
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.					
	Proficiency Modules				
This would address some lacunas that students might have, for example, English, computer familiarity etc.					
	Lectures by Eminent People				
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.					
	Visits to Local Area				
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.					
	Familiarization to Dept./Branch & Innovations				
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.					
	Department Specific Activities				
About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering /Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational					

thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.
References:
Guide to Induction program from AICTE

23HST101	PROFESSIONAL ENGLISH -I	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic school-level English grammar, vocabulary, reading and writing skills.					
Course Objectives: - To improve the communicative competence of learners - To learn to use basic grammatic structures in suitable contexts - To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text - To help learners use language effectively in professional contexts - To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.					
Unit I	Introduction to fundamentals of communication				9
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails, Letter of introducing oneself, Grammar - Present Tense (simple and progressive); Question types: Wh / Yes or No questions Question Tags, Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).					
Unit II	Narration And Summation				9
Reading-Readingbiographies,travelogues,newspaperreports, Excerptsfromliterature,and travel&technicalblogs. Writing - Guided writing-- Paragraph writing, Short Report on an event (field trip), Grammar–Pasttense(simple); Subject-Verb Agreement, Prepositions, Vocabulary-Wordforms(prefixes&suffixes) Synonymsand Antonyms, Phrasalverbs.					
Unit III	Description of a Product/Process				9
Reading – Reading advertisements, gadget reviews; user manuals. Writing definitions; instructions; and Product /Process description, Grammar - Imperatives; Adjectives, Degrees of comparison, Present & Past Perfect Tenses, Compound Nouns, Homonyms; and Homophones, Discourse markers (connectives & sequence words)					
Unit IV	Classification And Recommendations				9
Reading – Newspaper articles, Journal reports –and Non Verbal Communication (tables, pie chartsetc,.). Writing– Note-making/Note-taking(*Studyskills to be taught, not tested, Writing recommendations; Transferring information from Non-verbal (chart, graph, etc, to verbal mode), Articles, Pronouns, Possessive &Relativepronouns, Vocabulary– Collocations, Fixed/Semifixedexpressions.					
Unit V	Expression				9
Reading – Reading editorials, Opinion Blogs, Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation, Negation (Statements & Questions); Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions, Content vs Function words					
Total periods: 45 Periods					
Text Books:					
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).					
2. English for Science & Technology Cambridge University Press, 2021.					
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.					
References:					
1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.					
2. A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.					
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education,					

ISBN : 0070264244															
4. Effective Communication Skill, Kulbhusan Kumar, R S Salaria, Khanna Publishing House.															
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.															
Course Outcomes:													Blooms Taxonomy		
CO1: Use appropriate words in a professional context.													Remember(K1)		
CO2: Gain understanding of basic grammatical structures and use them in right context.													Understand (K2)		
CO3: Read and infer the denotative and connotative meanings of technical texts.													Apply(K3)		
CO4: Write definitions, descriptions, narrations and essays on various topics.													Apply(K3)		
CO5: Read and comprehend different types of reading materials.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	3	3	1	3	-	3	3	1	3
CO2	1	1	1	1	1	3	3	3	1	3	-	3	3	1	3
CO3	2	3	2	3	2	3	3	3	2	3	3	3	3	2	3
CO4	2	3	2	3	2	3	3	3	2	3	3	3	3	2	3
CO5	2	3	3	3	-	3	3	3	2	3	-	3	3	2	3
1 - Low, 2 - Medium, 3 - High, - ' - no correlation															

23MAT101	MATRICES AND CALCULUS	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites Basic Mathematical Knowledge					
Course Objectives: - To develop the use of matrix algebra techniques that is needed by engineers for practical applications. - To familiarize the students with differential calculus. - To familiarize the student with functions of several variables. This is needed in many branches of engineering. - To make the students understand various techniques of integration. - To understand various techniques of multiple integrals.					
Unit I	MATRICES				12
Characteristic equation - Eigenvalues and Eigenvectors of a real matrix - Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms- Applications of Eigen value and Eigen vector in Engineering (for classroom discussion, assignments and term paperwork).					
Unit II	DIFFERENTIAL CALCULUS				12
Derivatives – Differentiation rules (Sum, Product, Quotient, Chain rules) – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variables- Role of derivatives in Engineering Problems (for classroom discussion, assignments and term paperwork).					
Unit III	FUNCTIONS OF SEVERAL VARIABLES				12
Partial differentiation – Total derivative - Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables –Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers-Engineering Problems using Partial derivatives (for classroom discussion, assignments and term paperwork).					
Unit IV	INTEGRAL CALCULUS				12
The Definite and Indefinite integral – Integration techniques - Substitution Methods-Integration by parts –Reduction formula ($\sin^n x$, $\cos^n x$) - Integration of rational functions (Partial fraction method) -Improper Integrals. Role of Integrations in Engineering Problems (for classroom discussion, assignments and term paperwork.).					
Unit V	MULTIPLE INTEGRALS				12

Double integrals– Double integrals in polar coordinates – Change of order of integration– Area enclosed by plane curves- Triple integrals – Volume of solids – Change of variable in double and triple integrals. Double integral models in Engineering (for classroom discussion, assignments and term paper work).															
Total periods: 60 Periods															
Textbooks:															
1. Kreyszig E, “Advanced Engineering Mathematics” John Wiley and 10th Edition, New Delhi, 2016.															
2. Grewal B. S, “Higher Engineering Mathematics, New Delhi, 44th Edition, 2018.															
3. James Stewart, “Calculus: Early Transcendentals “, Cengage Learning 8th Edition, New Delhi, 2015.															
References:															
1. Jain R. K and Iyengar S.R.K, “Advanced Engineering Mathematics”, Narasa Publications, New Delhi, 5th Edition, 2016.															
2. Narayanan S, and Manicavachagam Pillai T. K, “Calculus: Volume I and II”, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.															
3. Ramana B. V, “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd., New Delhi, 2016.															
4. Daniel T. Fink Beiger, “Introduction to matrices and Linear transformations”, Dover publications, 3rd Edition, January 2011.															
Course Outcomes:													Blooms Taxonomy		
CO1: Use the matrix algebra methods for solving practical problems.													Apply(K3)		
CO2: Apply differential calculus tools in solving various application problems.													Apply(K3)		
CO3: Able to use differential calculus ideas on several variable functions.													Understand(K1)		
CO4: Apply different methods of integration in solving practical problems.													Apply(K3)		
CO5: Apply various techniques in multiple integrals.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								1	3	3	3
CO2	3	2	1	1								1	3	3	3
CO3	3	2	1	1								1	3	3	3
CO4	3	2	1	1								1	3	3	3
CO5	3	2	1	1								1	3	3	3
1 - Low, 2 - Medium, 3 - High, -‘ No correlation															

23PHT101	ENGINEERING PHYSICS	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic Science Knowledge					
Course Objectives: - To make students understand the fundamental principles of mechanics effectively. - To enable students to acquire knowledge of electromagnetic waves and their applications. - To introduce the basics of oscillations, optics, and lasers. - To equip students with a clear understanding of the importance of quantum physics. - To motivate students toward the applications of quantum mechanics in modern technology.					
Unit I	MECHANICS				9
Multiparticle dynamics: Center of mass (CM) – center of mass of continuous bodies – motion of the center of mass – kinetic energy of a system of particles – rotation of rigid bodies: Rotational kinematics – rotational kinetic energy – moment of inertia – theorems of moment of inertia – moment of inertia of continuous bodies – moment of inertia of a diatomic molecule – torque – rotational dynamics of rigid bodies – conservation of angular momentum – applications and oscillations: Rotational energy states of a rigid diatomic molecule – gyroscope – torsional pendulum – double pendulum – introduction to nonlinear oscillations.					

Unit II	ELECTROMAGNETIC WAVES												9		
The Maxwell's equations – electromagnetic wave equation – plane electromagnetic waves in vacuum – conditions on the wave field – properties of electromagnetic waves: speed, amplitude, phase, orientation – electromagnetic waves in matter – polarization – production of electromagnetic waves – energy and momentum in electromagnetic waves: intensity – waves from localized sources – momentum and radiation pressure – cell-phone reception – reflection and transmission of electromagnetic waves at a non-conducting medium–vacuum interface for normal incidence.															
Unit III	OSCILLATIONS, OPTICS AND LASERS												9		
Simple harmonic motion – resonance – analogy between electrical and mechanical oscillating systems – waves on a string – standing waves – travelling waves – energy transfer in a wave – sound waves – Doppler effect – reflection and refraction of light waves – total internal reflection – interference – Michelson interferometer – theory of air wedge and experiment – theory of laser – characteristics of laser – spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd:YAG laser – CO ₂ laser – semiconductor laser – basic applications of lasers in industry.															
Unit IV	BASIC QUANTUM MECHANICS												9		
Photons and light waves – electrons and matter waves – Compton effect – the Schrödinger equation (time-dependent and time-independent forms) – physical meaning of the wave function – normalization – free particle – particle in an infinite potential well: one-, two-, and three-dimensional boxes – normalization of wave functions – probability interpretation – correspondence principle.															
Unit V	APPLIED QUANTUM MECHANICS												9		
The harmonic oscillator (qualitative) – barrier penetration and quantum tunneling (qualitative) – tunneling microscope – resonant diode – finite potential wells (qualitative) – Bloch's theorem for particles in a periodic potential – basics of the Kronig–Penney model – origin of energy bands.															
Total periods: 45 Periods															
Text Books:															
1.D. Kleppner and R. Kolenkow, An Introduction to Mechanics , McGraw-Hill Education (Indian Edition), 2017.															
2. E. M. Purcell and D. J. Morin, Electricity and Magnetism , Cambridge University Press, 2013.															
3.Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, Concepts of Modern Physics , McGraw-Hill (Indian Edition), 2017.															
References:															
1. R. Wolfson – Essential University Physics, Volume 1 & 2 – Pearson Education (Indian Edition) – 2009.															
2. Paul A. Tipler – Physics, Volume 1 & 2 – CBS Publishers (Indian Edition) – 2004.															
3. K. Thyagarajan – Lasers: Fundamentals and Applications – Laxmi Publications (Indian Edition) – 2019.															
4. D. Halliday – Principles of Physics – Wiley (Indian Edition) – 2015.															
5. N. Garcia – Physics for Computer Science Students – Springer-Verlag – 2012.															
Course Outcomes: Students are able to													Blooms Taxonomy		
CO1: Understand the importance and fundamental principles of mechanics.													Understand (K2)		
CO2: Explain and apply the concepts of electromagnetic waves.													Understand (K2)		
CO3: Demonstrate strong foundational knowledge in oscillations, optics, and lasers.													Understand (K2)		
CO4: Understand the significance of quantum physics in modern science and technology.													Remember(K1)		
CO5: Comprehend and apply quantum mechanical principles toward the formation of energy bands.													Apply(K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1							3	3	3
CO2	3	3	2	1	2	1							3	3	3
CO3	3	3	2	2	2	1							3	3	3
CO4	3	3	1	1	2	1						1	3	3	3
CO5	3	3	1	1	2	1							3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CYT101	ENGINEERING CHEMISTRY	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic chemistry knowledge.					
Course Objectives: - To understand water quality parameters, treatment processes, and corrosion. - To understand adsorption and phase rule concepts. - To evaluate engineering materials and the nature of polymers. - To apply recent advances in energy sources and battery technologies. - To analyze chemical composition in fuels and apply the principles of shock waves.					
Unit I	Universal Solvent (Water) and Corrosion				9
Water quality parameters: color – odour – turbidity – pH – hardness – total dissolved solids (TDS) – chemical oxygen demand (COD) – biochemical oxygen demand (BOD) – municipal water treatment: primary treatment and disinfection methods (UV, ozonation, break-point chlorination) – desalination by reverse osmosis – boiler troubles: scale and sludge formation – boiler corrosion – internal treatment methods (phosphate conditioning, colloidal conditioning, sodium aluminate conditioning, calgon conditioning) – external treatment methods: ion-exchange demineralization and zeolite process – corrosion: causes and influencing factors – types of corrosion: chemical corrosion and electrochemical corrosion (galvanic corrosion, differential aeration corrosion) – corrosion control methods: anodic protection, cathodic protection, and corrosion inhibitors.					
Unit II	Surface Chemistry and Phase Rule				9
Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms. Langmuir’s adsorption isotherm –Catalysis: Catalyst – types of catalysis – criteria – autocatalysis acid base catalysis – enzyme catalysis– Michaelis – Menten equation. Phase rule: Introduction, definition of terms with examples. One component system – water system; Reduced phase rule;– Thermal analysis; Two component system: lead-silver system – Pattinson process.					
Unit III	Polymers and Alloys				9
Introduction- Definition- Properties of alloys- Significance and Functions and Ferrous alloys. Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze. Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.					
Unit IV	Batteries and Energy Sources				9
Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles. Advanced Energy Sources-Recent developments in solar cell materials. Fuel cells: H2-O2 fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples					
Unit V	Analytical Chemistry and Shock Wave				9

Proximate and ultimate analysis of coal. Accuracy, precision, sensitivity, detection limits, significant figures, rounding off. Types of errors, determinate and indeterminate errors. Petroleum process. Shock Wave- Description of a shock wave and its applications. Methods of creating shock waves in the laboratory using a shock tube, description of hand operated Reddy shock tube and its characteristics.

Total periods:25 Periods

Text Books:

1.P.C.JainandMonicaJain,“EngineeringChemistry”,17thEdition,DhanpatRai,Publishing Company (P) Ltd, New Delhi, 2018.

2. SivasankarB.,“EngineeringChemistry”,TataMcGraw-HillPublishingCompanyLtd,New Delhi, 2008.

3.S.S.Dara,“AtextbookofEngineeringChemistry”,S.ChandPublishing,12thEdition,2018.

4. Skoog, D.A.; West, D.M.; Holler, F.J.; Crouch, S.R. (2014), *Fundamentals of Analytical Chemistry*, Cengage Learning.

References:

1. O.G.Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017

2. FriedrichEmich, “EngineeringChemistry”, ScientificInternationalPVT,LTD, NewDelhi, 2014.

3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.

4. O.V.Roussak and H.D.Gesser, Applied Chemistry-A Textbook for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

5. Shockwavesmade simple-ChintooSKumar,KTakayamaandKPJReddy:WilleyIndiaPvt. Ltd. New Delhi 2014.

Course Outcomes:

Blooms Taxonomy

C01: Understand water quality parameters and the corrosive nature of metals.

Remember(K1)

CO2: Explain adsorption, its types, phases, and the phase rule.

Understand (K2)

CO3:Apply the knowledge of alloys and polymers in day-to-day applications.

Apply(K3)

CO4: Understand the advantages and applications of batteries, supercapacitors, and solar cell fabrication.

Understand(K3)

CO5:Analyze the chemical composition of coal, understand petroleum processes, and explain the uses of shock waves in real-life applications.

Analyze(K4)

CO - PO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1	1				1	1	3	1	3
CO2	3	1				1	1				-	1	3	1	3
CO3	3	1			1	1	1				1	1	3	2	3
CO4	3	1			1	1	1				1	1	1	2	3
CO5	3	1			1	1	1				1	1	1	2	3

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23GET101	PROGRAMMING IN C	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic programming skill and knowledge.					
Course Objectives: - To understand the constructs of C Language. - To develop C Programs using basic programming constructs - To develop C programs using arrays and strings - To develop modular applications in C using functions - To develop applications in C using pointers and structures - To do input/output and file handling in C					
Unit I	BASICS OF C PROGRAMMING				9
Introduction to programming paradigms –Applications of C Language - Structure of Cprogram - C programming: Data Types - Constants –Enumeration Constants -Keywords –Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements –Decision making statements - Switch statement- Looping statements –Preprocessor directives - Compilation process					
Unit II	ARRAYS AND STRINGS				9
Introduction to Arrays: Declaration, Initialization –One dimensional array –Two dimensional arrays – String operations: length, compare, concatenate, copy –Selection sort, linear and binary search.					
Unit III	FUNCTIONS AND POINTERS				9
Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) –Recursion, Binary Search using recursive functions –Pointers –Pointer operators –Pointer arithmetic –Arrays and pointers –Array of pointers –Parameter passing: Pass by value, Pass by reference.					
Unit IV	STRUCTURES AND UNION				9
Structure - Nested structures –Pointer and Structures –Array of structures –Self referential structures –Dynamic memory allocation - Singly linked list –typedef –Union- Storage classes and Visibility.					
Unit V	FILE PROCESSING				9
Files –Types of file processing: Sequential access, Random access –Sequential access file - Random access file - Command line arguments.					
Total periods:45 Periods					
Text Books:					
1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.					
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.					
References:					
1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.					
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.					
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.					
4. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.					
6. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.					
Course Outcomes:					Blooms Taxonomy
CO1: Demonstrate knowledge on C Programming constructs					Understand (K2)
CO2: Develop simple applications in C using basic constructs					Apply(K3)
CO3: Design and implement applications using arrays and strings					Apply(K3)
CO4: Develop and implement modular applications in C using functions.					Apply(K3)
CO5: Develop applications in C using structures and pointers.					Understand (K2)

23GEP101	PROGRAMMING IN C LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites • Basic knowledge of computer operations and problem-solving. • Fundamental understanding of algorithms and flowcharts					
Course Objectives: • To understand and implement the fundamental constructs of C such as data types, I/O operations, operators and control structures. • To develop programs using one-dimensional and two-dimensional arrays for data handling and perform basic operations on given strings. • To develop modular C programs using functions and recursion, and to understand pointer operations, including pointers to arrays. • To develop applications using user-defined data types like structures, nested structures, unions, and pointers to structures. • To perform file operations including reading, writing, sequential and random access file processing and command line argument usage in C programs.					
LIST OF EXPERIMENTS					
1	I/O statements, operators, expressions				
2	Decision-making constructs: if-else, goto, switch-case, break-continue				
3	Loops: for, while, do-while				
4	Arrays: 1D and 2D, Multi-dimensional arrays, traversal				
5	Strings: operations				
6	Functions: call, return, passing parameters by (value, reference), passing arrays to function.				
7	Recursion				
8	Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers				
9	Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.				
10	Files: reading and writing, File pointers, file operations, random access, processor directives.				
Total periods: 60 Periods					
Text Books:					
1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.					
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.					
References:					
1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.					
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.					
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.					
4. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.					
5. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.					
Course Outcomes:					Blooms Taxonomy
CO1: Understand and apply core C programming concepts such as data types, I/O operations, operators, and control structures to solve computational problems.					Understand (K2)
CO2: Design and implement programs using one-dimensional and two-dimensional arrays for data processing, and apply standard string functions on given strings.					Analyze (K4)

CO3: Understand and implement modular C programs using functions and recursion, and understand pointer operations, including pointers to arrays.													Understand (K2)		
CO4: Create applications using user-defined data types such as structures, nested structures, unions, and pointers to structures for complex data management.													Apply(K3)		
CO5: Perform file operations in C such as reading, writing, and handling sequential and random access files, using command line arguments where applicable.													Apply(K3)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2				2	1		2	2	2	
CO2	3	3	2	2	2				2	1		2	2	3	
CO3	3	3	3	3	2				2	2		2	2	3	1
CO4	3	3	3	3	2				2	2		2	2	3	1
CO5	3	3	3	3	2				2	2		2	2	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

[illegible]

23GEP102	ENGLISH LABORATORY	Category: EEC			
		L	T	P	C
		0	0	2	1
Prerequisites English communicationg knowledge and grammers.					
Course Objectives: - To identify varied group discussion skills and apply them to take part in effective discussions in a professional context. - Toanalyze concepts and problems and make effective presentations explaining them clearly and precisely. - To be able to communicate effectively through formal and informal writing. - To be able to use appropriate language structures to write emails, reports and essays - To give instructions and recommendations that are clear and relevant to the context					
LIST OF EXPERIMENTS					
1	Speaking-Role Play Exercises Based on Workplace Contexts				
2	Talking about competition- discussing progress toward goals-talking about experiences-				
3	Talking about events in life- discussing past events-Writing: writing emails (formal& semi-formal).				
4	Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems				
5	Making arrangements-describing arrangements-discussing plans and decisions-				
6	Discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.				
7	Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages				
8	Making comparisons- discussing likes and dislikes- discussing feelings about experiences-				
9	Discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.				
10	Speaking: discussing the natural environment-describing systems-describing position and movement-				
11	Explaining rules-(example-discussing rental arrangements)- understanding technical instructions-				
12	Writing: Writing instructions-writing a short article.				
13	Speaking: describing things relatively-describing clothing				
14	Discussing safety issues (making recommendations) talking about electrical devices				
15	Describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.				
Total periods: 60 Periods					
Text Books:					
1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.					
2. English for Science & Technology Cambridge University Press 2021.					
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.					
References:					
1. Raman. Meenakshi, Sharma. Sangeeta (2019).ProfessionalEnglish.Oxford university press. New Delhi.					
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi					
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003					
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.					
5.Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.					
Course Outcomes:					Blooms Taxonomy
CO1: Speak effectively in group discussions held in a formal/semi formal contexts.					Remember (K1)

CO2: Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions													Apply (K3)		
CO3: Write emails, letters and effective job applications													Understand (K2)		
CO4: Write critical reports to convey data and information with clarity and precision													Apply (K3)		
CO5: Give appropriate instructions and recommendations for safe execution of tasks													Apply (K3)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1						2	2	2	3	2	3	3	3	3
CO2	1						2	2	2	3	2	3	3	3	3
CO3	1						2	2	2	3	2	3	3	3	3
CO4	1						2	2	2	3	2	3	3	3	3
CO5	1						2	2	2	3	2	3	3	3	3
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation															

23HST201	PROFESSIONAL ENGLISH – II	Category: HSMC			
		L	T	P	C
		2	0	0	2
Prerequisites - Basic proficiency in English (Professional English – I or equivalent) - Ability to read and write simple technical and non-technical texts					
Course Objectives: - To engage learners in meaningful language activities to improve their reading and writing skills - To learn various reading strategies and apply in comprehending documents in professional context. - To help learners understand the purpose, audience, contexts of different types of writing - To develop analytical thinking skills for problem solving in communicative contexts - To demonstrate an understanding of job applications and interviews for internship and placements					
Unit I	MAKING COMPARISONS				6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases					
Unit II	EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING				6
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds					
Unit III	PROBLEM SOLVING				6
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences					
Unit IV	REPORTING OF EVENTS AND RESEARCH				6
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions					
Unit V	THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY				6
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.					
Total periods:30					
Text Books:					
1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University					
2. English for Science & Technology Cambridge University Press 2021.					
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.					
References:					
1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi					
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.					

[illegible]

23PHT205	MATERIALS SCIENCE	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic Science Knowledge					
Course Objectives: - To understand the basics of crystallography and its importance in determining material properties.. - To acquire knowledge of the electrical and magnetic properties of materials and their applications. - To understand semiconductor physics and the functioning of semiconductor devices. - To gain knowledge of the optical properties of materials and the working principles of various optical devices. - To understand the importance of functional nanoelectronic devices.					
Unit I	CRYSTALLOGRAPHY				9
Crystal structures: simple cubic (SC), body-centered cubic (BCC), face-centered cubic (FCC), and hexagonal close-packed (HCP) structures – crystallographic directions and planes – linear and planar densities – crystal imperfections: edge and screw dislocations – grain boundaries and twin boundaries – Burgers vector and elastic strain energy – slip systems and plastic deformation of materials – polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation (qualitative) – growth of single crystals: solution growth and melt growth techniques.					
Unit II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS				9
Classical free electron theory – expression for electrical conductivity – thermal conductivity and its expression – quantum free electron theory – tunneling – degenerate states – Fermi–Dirac statistics – density of energy states – electron in a periodic potential – energy bands in solids – tight-binding approximation – effective mass of an electron – concept of a hole – magnetic materials: diamagnetic, paramagnetic, and ferromagnetic effects – paramagnetism of conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices.					
Unit III	SEMICONDUCTORS AND TRANSPORT PHYSICS				9
Intrinsic semiconductors – energy band diagram – direct and indirect band gap semiconductors – carrier concentration in intrinsic semiconductors – extrinsic semiconductors – carrier concentration in n-type and p-type semiconductors – variation of carrier concentration with temperature – carrier transport in semiconductors: drift, mobility, and diffusion – Hall effect and Hall devices – ohmic contacts – Schottky diode.					
Unit IV	OPTICAL PROPERTIES OF MATERIALS				9
Classification of optical materials – optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain – optical processes in quantum wells – optoelectronic devices: light detectors and solar cells – light-emitting diode – laser diode – optical processes in organic semiconductor devices – excitonic state – electro-optics and nonlinear optics: modulators and switching devices – plasmonics.					
Unit V	NANOELECTRONIC DEVICES				9
Quantum confinement – quantum structures: quantum wells, quantum wires, and quantum dots – Zener–Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures – single-electron phenomena – single-electron transistor – semiconductor photonic structures – one-, two-, and three-dimensional photonic crystals – active and passive optoelectronic devices – photoprocesses – spintronics – carbon nanotubes: properties and applications.					
Total periods:45					
Text Books:					
1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.					
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.					
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.					
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)					
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.					
References:					
1. R.Balasubramaniam, Callister’s Materials Science and Engineering. Wiley (Indian Edition), 2014					

2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.															
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006															
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017															
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1: Know basics of crystallography and its importance for varied materials properties.													Understanding (K2)		
CO2: Gain knowledge on the electrical and magnetic properties of materials and their applications													Remembering (K1)		
CO3: Understand clearly of semiconductor physics and functioning of semiconductor devices													Understanding (K2)		
CO4: Understand the optical properties of materials and working principles of various optical devices													Understanding (K2)		
CO5: Appreciate the importance of functional nanoelectronic devices.													Applying (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1							3	2	1
CO2	3	2	1	1	2	1	1						3	2	1
CO3	3	2	2	2	2	1							3	2	2
CO4	3	2	2	1	2	2						1	3	2	2
CO5	3	2	2	1	2	1							3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BET203	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of Physics at +2 level • Fundamental knowledge of current, voltage, and electrical units • Basic mathematical skills involving algebra and trigonometry					
Course Objectives: • To introduce the basics of electric circuits and analysis • To impart knowledge in the basics of working principles and application of electrical machines • To introduce analog devices and their characteristics • To educate on the fundamental concepts of digital electronics • To introduce the functional elements and working of measuring instruments					
Unit I	ELECTRICAL MACHINES				6
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)					
Unit II	ELECTRICAL MACHINES				6
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor					
Unit III	ANALOG ELECTRONICS				6
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters					
Unit IV	DIGITAL ELECTRONICS				6

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)																
Unit V		MEASUREMENTS AND INSTRUMENTATION												6		
Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO-Block diagram- Data acquisition.																
Total periods:60																
Text Books:																
1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020																
2. S.K. Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.																
3. Sedha R.S., “A text bookbook of Applied Electronics”, S. Chand & Co., 2008																
4. James A. Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.																
5. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.																
References:																
1. Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019.																
2. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.																
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.																
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.																
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010																
Course Outcomes:													Blooms Taxonomy			
CO1:Compute the electric circuit parameters for simple problems.													Apply (K3)			
CO2:Explain the working principle and applications of electrical machines													Understand (K2)			
CO3: Analyze the characteristics of analog electronic devices													Analyze (K4)			
CO4:Explain the basic concepts of digital electronics													Understand (K2)			
CO5: Explain the operating principles of measuring instruments													Understand (K2)			
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	3	2	2								2	3			
CO2	2	2											2			
CO3	3	2		2									2	2		
CO4	2	2											1	1		
CO5	2			1									2			
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23GET201	ENGINEERING GRAPHICS	Category: ESC			
		L	T	P	C
		4	8	0	4
Prerequisites • Basic knowledge of geometry at higher secondary level • Ability to visualize simple 2D and 3D shapes • Basic skills in freehand sketching					
Course Objectives: • To sketch engineering curves. • To draw the projection of points, lines and plane surfaces • To construct orthographic projection of solids • To draw section of solids and development of surfaces					

- To construct isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

Unit I

PLANE CURVES

6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

Unit II

PROJECTION OF POINTS, LINES AND PLANE SURFACE

6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Unit III

PROJECTION OF SOLIDS AND FREEHAND SKETCHING

6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

Unit IV

PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

Unit V

ISOMETRIC AND PERSPECTIVE PROJECTIONS

6+12

Principles of isometric projection — isometric scale — isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

Total periods:60

Text Books:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Natarajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

References:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
5. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

Course Outcomes:

Blooms Taxonomy

C01: Construct the conical and special curves

Apply (K3)

CO2: Solve practical problems involving projection of points, lines and plane surfaces

Apply (K3)

CO3: Sketch the orthographic views of simple solids and freehand sketch

Analyze (K4)

CO4: Draw sectioned solids and development of surfaces

Apply (K3)

C05: Draw the isometric and perspective projections of simple solids.

Apply (K3)

CO - PO & PSO Mapping

[illegible]

அலகு V	அறிவியல்தமிழ்மற்றும்கணித்தமிழ்:												3		
அறிவியல்தமிழ்வளர்ச்சி – கணித்தமிழ்வளர்ச்சி – தமிழ்நூல்களையின்பதிப்புசெய்தல் – தமிழ்மென்பொருட்கள்உருவாக்கம் – தமிழ்இணையக்கல்விக்கழகம் – தமிழ்மின்னூலகம் – இணையத்தில்தமிழ்அகராதிகள் – சொற்குவைத்திட்டம்															
Total periods:15															
TEXT-CUM-REFERENCE BOOKS:															
1. தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).															
2. கணினித்தமிழ்முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).															
3. கீழடி-வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)															
4. பொருறை -ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)															
5.Social Life of Tamils (Dr. K.K. Pillay), A joint publication of TNTB & ESC and RMRL – (in print)															
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.															
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).															
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)															
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology& Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)															
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)															
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Textbook and Educational Services Corporation, Tamil Nadu)															
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.															
Course Outcomes:												Blooms Taxonomy			
CO1: Describe the weaving, ceramic technologies, and material culture of the Sangam Age.												Understand (K2)			
CO2: Explain the architectural, structural, and design technologies of ancient Tamil societies.												Understand (K2)			
CO3: Describe the manufacturing technologies such as metallurgy, shipbuilding, and bead-making with archaeological evidence.												Understand (K2)			
CO4: Describe the manufacturing technologies such as metallurgy, shipbuilding, and bead-making with archaeological evidence.												Understand / Apply (K2/K3)			
CO5: Discuss the evolution of Scientific Tamil and Tamil computing including digital resources.												Understand (K2)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO2	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	2	1	-	-	-	-
CO4	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO5	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23GET202	TAMILS AND TECHNOLOGY	Category: HSMC			
		L	T	P	C
		1	0	0	1
Prerequisites • Basic understanding of Tamil language • General knowledge of Tamil history and culture (preferred but not mandatory)					
Course Objectives: • To familiarize learners with the technological advancements of ancient Tamils in weaving, ceramics, architecture, and construction • To introduce the manufacturing technologies of the Sangam and post-Sangam periods, including metallurgy, shipbuilding, and bead-making. • To provide knowledge on traditional agricultural, irrigation, and marine technologies followed by ancient Tamil societies. • To create awareness about the evolution of Scientific Tamil and the development of Tamil computing and digital resources. • To help learners appreciate the scientific and technological heritage of the Tamil civilization through archaeological and literary evidence.					
Unit I	WEAVING AND CERAMIC TECHNOLOGY				3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.					
Unit II	DESIGN AND CONSTRUCTION TECHNOLOGY				3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.					
Unit III	MANUFACTURING TECHNOLOGY				3
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeologicalevidences - Gem stone types described in Silappathikaram.					
Unit IV	AGRICULTURE AND IRRIGATION TECHNOLOGY				3
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.					
Unit V	SCIENTIFIC TAMIL & TAMIL COMPUTING				3
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.					
Total periods:15					
TEXT-CUM-REFERENCE BOOKS:					
1. தமிழகவரலாறுமக்களும்பண்பாடும்கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).					
2. கணினித்தமிழ்முனைவர்இல. சுந்தரம். (விகடன்பிரசுரம்).					
3. கீழடி-வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம்(தொல்லியல்துறைவெளியீடு)					
4. பொருநை -ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு)					
5.Social Life of Tamils (Dr. K.K. Pillay), A joint publication of TNTB & ESC and RMRL – (in print)					
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.					
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).					
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)					

9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology& Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)															
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)															
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)															
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.															
Course Outcomes:													Blooms Taxonomy		
CO1: Describe the weaving, ceramic technologies, and material culture of the Sangam Age.													Understand (K2)		
CO2: Explain the architectural, structural, and design technologies of ancient Tamil societies.													Understand (K2)		
CO3: Describe the manufacturing technologies such as metallurgy, shipbuilding, and bead-making with archaeological evidence.													Understand (K2)		
CO4: Describe the manufacturing technologies such as metallurgy, shipbuilding, and bead-making with archaeological evidence.													Understand / Apply (K2/K3)		
CO5: Discuss the evolution of Scientific Tamil and Tamil computing including digital resources.													Understand (K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO2	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	2	1	-	-	-	-
CO4	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
CO5	-	-	-	-	2	1	-	-	-	2	1	-	-	-	-
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23GEP201	ENGINEERING PRACTICES LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites ● Basic knowledge of workshop tools and safety procedures. ● Elementary understanding of electrical, plumbing, and mechanical concepts.					
Course Objectives: ● Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in commonhouseholdwood work. ● Wiring various electrical joints in common household electrical wire work. ● Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work. ● Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB					
CIVIL ENGINEERING PRACTICES (CIVIL & ELECTRICAL)					
PART I:					
LIST OF EXPERIMENTS					
CIVIL ENGINEERING PRACTICES (15)					
PLUMBING WORK:					
a)	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers,elbows and other components which are commonly used in household.				
b)	Preparing plumbing line sketches.				
c)	Laying pipe connection to the suction side of a pump.				

d)	Laying pipe connection to the delivery side of a pump.
e)	Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.
WOOD WORK:	
a)	Sawing,
b)	Planing and
c)	Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.
Wood Work Study:	
a)	Studying joints in door panels and wooden furniture.
b)	Studying common industrial trusses using models.
PART II :	
ELECTRICAL ENGINEERING PRACTICES (15)	
a)	Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b)	Staircase wiring
c)	Fluorescent Lamp wiring with introduction to CFL and LED types.
d)	Energy meter wiring and related calculations/ calibration
e)	Study of Iron Box wiring and assembly
f)	Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g)	Study of emergency lamp wiring/Water heater
	15: a).: a).: a). b). c)
GROUP – B (MECHANICAL AND ELECTRONICS)	
PART III :	
	MECHANICAL ENGINEERING PRACTICES (15)
	WELDING WORK:
a)	Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
BASIC MACHINING WORK:	
a)	Turning.
b)	Drilling.
c)	Tapping.
ASSEMBLY WORK:	
a)	Assembling a centrifugal pump.
b)	Assembling a household mixer
c)	Assembling an air conditioner.
SHEET METAL WORK:	
a)	Making of a square tray
FOUNDRY WORK	
a)	Demonstrating basic foundry operations.
PART IV	
ELECTRONIC ENGINEERING PRACTICES (15)	
SOLDERING WORK	
a)	Soldering simple electronic circuits and checking continuity
ELECTRONIC ASSEMBLY AND TESTING WORK	
a)	Assembling and testing electronic components on a small PCB
ELECTRONIC EQUIPMENT STUDY (15)	
a)	Study an elements of smart phone
b)	Assembly and dismantle of LED TV
c)	Assembly and dismantle of computer/ laptop
Total periods: 60	
Text Books:	

1.Engineering Practices Laboratory Manual, Anna University, 2023 Edition.															
2.Kalpajian S., Manufacturing Engineering & Technology , 7th Edition, Pearson, 2014.															
3.R.K. Rajput, A Textbook of Engineering Workshop , Laxmi Publications, 2015.															
Reference Books:															
1.Hajra Choudhury S.K., Workshop Technology, Vol. I & II, Media Promoters & Publishers Pvt. Ltd., 2008.															
2.P.Kannaiah&K.Lakshminarayana, Workshop Practice, Scitech Publications, 2012.															
3.Bawa H.S., Workshop Technology, Tata McGraw Hill, 2003.															
4.Raghuwanshi B.S., Electrical and Electronics Engineering Practice Lab Manual, Wiley India, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Perform plumbing work, including pipe layout, connections, and fittings.													Apply (K3)		
CO2: Demonstrate woodworking skills including sawing, planning, and making joints.													Apply (K3)		
CO3: Carry out electrical wiring tasks for common household circuits.													Apply (K3)		
CO4: Perform basic welding, machining, sheet metal work, and mechanical assembly.													Apply (K3)		
CO5: Assemble, solder, and test simple electronic circuits.													Apply (K3)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO2	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO3	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO4	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO5	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation2															

23BEP202	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	Category: ESC			
		L	T	P	C
		0	0	4	2
Prerequisites • Basic knowledge of electrical circuits and components. • Elementary understanding of electronic devices (BJT, SCR, MOSFET) and logic gates. • Familiarity with measurement instruments (multimeter, oscilloscope).					
Course Objectives: • To train the students in conducting load tests on electrical machines • To gain practical experience in characterizing electronic devices • To train the students to use DSO for measurements.					
LIST OF EXPERIMENTS					
1	Verification of ohms and Kirchhoff’s Laws.				
2	Load test on DC Shunt Motor.				
3	Load test on Self Excited DC Generator				
4	Load test on Single phase Transformer				
5	Load Test on Induction Motor				
6	Characteristics of BJT, SCR and MOSFET				
7	Characteristics of BJT, SCR and MOSFET				
8	Half wave and Full Wave rectifiers				
9	Study of Logic Gates				
10	Implementation of Binary Adder and Subtractor				
11	Study of DSO				
Total periods: 60					
Text Books:					
1.Kothari D.P., I.J. Nagrath, Basic Electrical and Electronics Engineering Laboratory Manual, McGraw Hill, 2020.					

2.R.S. Sedha, Applied Electronics Laboratory Manual, S. Chand, 2008.

Reference Books:

1.Thomas L. Floyd, Electronic Devices Laboratory Manual, Pearson, 2017.

2. Albert Malvino, David Bates, Electronic Principles, McGraw Hill Education, 7th edition, 2017.

3.Mahmood Nahvi, Joseph Edminister, Electric Circuits – Schaum’s Outline Laboratory Experiments, McGraw Hill, 2002.

4.H.S. Kalsi, Electronic Instrumentation, Tata McGraw Hill, 2010.

Course Outcomes:	Blooms Taxonomy

Course Outcomes:	Blooms Taxonomy

CO1: Use experimental methods to verify the Ohm's and Kirchhoff's Laws.	Apply (K3)

CO1: Use experimental methods to verify the Ohm's and Kirchhoff's Laws.	Apply (K3)

CO2: Analyze experimentally the load characteristics of electrical machine.	Analyze (K4)

CO2: Analyze experimentally the load characteristics of electrical machine.	Analyze (K4)

CO3: Analyze the characteristics of basic electronic devices	Analyze (K4)

CO3: Analyze the characteristics of basic electronic devices	Analyze (K4)

CO4: Use DSO to measure the various parameters	Apply (K3)

CO4: Use DSO to measure the various parameters	Apply (K3)

CO5: Implement basic digital logic circuits using logic gates.	Apply (K3)

CO5: Implement basic digital logic circuits using logic gates.	Apply (K3)

CO – PO& PSO Mapping	

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO2	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO3	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO4	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-
CO5	2	-	3	-	-	2	-	-	1	-	-	-	2	-	-

1 - Low, 2 - Medium, 3 -High , '-' No correlation2

23GEP202	COMMUNICATION LABORATORY	Category: EEC			
		L	T	P	C
		0	0	4	2
Prerequisites • Basic proficiency in English (reading, writing, listening, and speaking). • Familiarity with sentence structures, vocabulary, and professional communication formats.					
Course Objectives: • To identify varied group discussion skills and apply them to take part in effective discussions in a professional context. • To analyze concepts and problems and make effective presentations explaining them clearly and precisely. • To be able to communicate effectively through formal and informal writing. • To be able to use appropriate language structures to write emails, reports and essays • To give instructions and recommendations that are clear and relevant to the context					
LIST OF EXPERIMENTS					
1	Speaking-Role Play Exercises Based on Workplace Contexts				
2	Talking about competition- discussing progress toward goals-talking about experiences-				
3	Talking about events in life- discussing past events-Writing: writing emails (formal& semi-formal).				
4	Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems				
5	Making arrangements-describing arrangements-discussing plans and decisions-				
6	Discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.				
7	Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages				
8	Making comparisons- discussing likes and dislikes- discussing feelings about experiences-				
9	Discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.				
10	Speaking: discussing the natural environment-describing systems-describing position and movement-				
11	Explaining rules-(example-discussing rental arrangements)- understanding technical instructions-				
12	Writing: Writing instructions-writing a short article.				

13	Speaking: describing things relatively-describing clothing														
14	Discussing safety issues (making recommendations) talking about electrical devices														
15	Describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.														
Total periods: 60															
Text Books:															
1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.															
2. English for Science & Technology Cambridge University Press 2021.															
3. Authored by Dr. VeenaSelvam, Dr. SujathaPriyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.															
References:															
1. Raman. Meenakshi, Sharma. Sangeeta (2019).ProfessionalEnglish.Oxford university press. New Delhi.															
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi															
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003															
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.															
5.Developing Communication Skills by Krishna Mohan, MeeraBannerji- Macmillan India Ltd. 1990, Delhi.															
Course Outcomes:													Blooms Taxonomy		
CO1: Speak effectively in group discussions held in a formal/semi formal contexts.													Apply(K3)		
CO2:Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions													Analyze (K4)		
CO3: Write emails, letters and effective job applications													Apply (K3)		
CO4: Write critical reports to convey data and information with clarity and precision													Analyze / Evaluate (K4/K5)		
CO5: Give appropriate instructions and recommendations for safe execution of tasks													Apply(K3)		
CO – PO& PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	2	-	-	-	2	-	-
CO2	2	2	-	2	-	-	-	-	2	-	-	-	2	1	-
CO3	2	2	-	1	-	-	-	-	—	-	-	-	2	1	-
CO4	2	2	-	1	-	-	-	-	—	-	-	-	2	1	-
CO5	2		-	1	-	-	-	-	2	-	-	-	2	1	-
1 - Low, 2 - Medium, 3 -High , ‘-‘ No correlation2															

MAT302	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	Category: BSC			
		L	T	P	C
		3	1	0	4
Prerequisites • Basic Mathematical Knowledge • Matrices and Calculus					
Course Objectives: • To introduce the basic concepts of PDE for solving standard partial differential equations. • To introduce Fourier series analysis this is central to many applications in engineering apart from its use in solving boundary value problems. • To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations. • To acquaint the student with Fourier transform techniques used in wide variety of situations. • To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.					
Unit I	PARTIAL DIFFERENTIAL EQUATIONS				9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First orders partial differential equations reducible to standard types- Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.															
Unit II		FOURIER SERIES												9+3	
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.															
Unit III		APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS												9+3	
Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).															
Unit IV		FOURIER TRANSFORMS												9+3	
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms– Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.															
Unit V		Z - TRANSFORMS AND DIFFERENCE EQUATIONS												9+3	
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.															
Total periods:60 PERIODS															
Text Books:															
1. Grewal B.S., “Higher Engineering Mathematics" 44 th Edition, Khanna Publishers, New Delhi, 2018.															
2.Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.															
References:															
1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.															
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.															
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.															
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.															
5. Wylie. R.C. and Barrett . L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Understand how to solve the given standard partial differential equations.													Understanding (k2)		
CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.													Applying (K3)		
CO3: Apply the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.													Applying(K3)		
CO4: Conclude the mathematical principles on transforms and partial differential equationswould provide them the ability to formulate and solve some of the physical problems of engineering.													Analyzing(K4)		
CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.													Understanding (K 2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	1	-	-	-	-	-	1	3	2	1
CO2	3	3	3	3	-	1	-	-	-	-	-	1	3	2	1
CO3	3	3	3	3	-	1	-	-	-	-	-	1	3	1	1
CO4	3	3	3	3	-	1	-	-	-	-	-	1	3	1	1

CO5	3	3	3	3	-	1	-	-	-	-	-	1	3	3	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MET301	ENGINEERING MECHANICS	Category: ESC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Physics (Mechanics, motion, forces, and equilibrium). • Mathematics (Vectors, trigonometry, and calculus basics). • Basic Engineering Knowledge in statics and dynamics. • Ability to understand the concepts of Force, Moment, and Equilibrium.					
Course Objectives: • To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures • To introduce the equilibrium of rigid bodies, vector methods and free body diagram • To study and understand the distributed forces, surface, loading on beam and intensity. • To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems. • To develop basic dynamics concepts – force, momentum, work and energy;					
Unit I	STATICS OF PARTICLES				9
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton’s First Law of Motion, Space and Free-Body Diagrams.					
Unit II	EQUILIBRIUM OF RIGID BODIES				9
Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon’s Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.					
Unit III	DISTRIBUTED FORCES				9
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass.					
Unit IV	FRICTION				9
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction					
Unit V	DYNAMICS OF PARTICLES				9
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton’s Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Principle of Impulse and Momentum, Impact of bodies.					
Total periods:45 PERIODS					
Text Books:					
1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.					
2.Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018.					
References:					
1. Boresi P and Schmidt J,: Statics and Dynamics, 1/e, Cengage learning, 2008.					
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.					
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.					
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition,					

Wiley student edition, 2013.															
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.															
Course Outcomes:														Blooms Taxonomy	
CO 1: Illustrate the vector and scalar representation of forces and moments														Apply(K3)	
CO2: Analyse the rigid body in equilibrium														Apply(K3)	
CO3: Evaluate the properties of distributed forces														Analyze(K4)	
CO4: Determine the friction and the effects by the laws of friction														Apply(K3)	
CO5: Calculate dynamic forces exerted in rigid body														Apply(K3)	
CO-PO Mapping															
CO / PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	1	3	-	-	-	-	-	-	-	2	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO4	2	2	3	1	3	-	-	-	-	-	-	-	2	2	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	3	2	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MET302	ENGINEERING THERMODYNAMICS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of Physics (particularly heat, temperature, and energy). • Basic concepts of Mechanics and Fluid Mechanics (related to pressure, volume, and work). • Mathematics (calculus, algebra, and basic thermodynamic equations). • Introduction to Heat Engines and Energy systems.					
Course Objectives: • Impart knowledge on the basics and application of zeroth and first law of thermodynamics. • Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices. • Impart knowledge on availability and applications of second law of thermodynamics Teach the various properties of steam through steam tables and Mollier chart. • Impart knowledge on the macroscopic properties of ideal and real gases.					
Unit I	BASICS, ZEROth AND FIRST LAW				9
Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.					
Unit II	SECOND LAW AND ENTROPY				9
Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance					
Unit III	AVAILABILITY AND APPLICATIONS OF II LAW				9
Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency					
Unit IV	PROPERTIES OF PURE SUBSTANCES				9
Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.					
Unit V	GAS MIXTURES AND THERMODYNAMIC RELATIONS				9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, JouleThomson experiment - Clausius-Clapeyron equation.															
Total periods:45 PERIODS															
Text Books:															
1. Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill (2017), New Delhi.															
2. Natarajan, E., “Engineering Thermodynamics: Fundamentals and Applications”, 2nd Edition (2014), Anuragam Publications, Chennai.															
References:															
1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.															
2, Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.															
3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.															
4. Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.															
5. Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007															
Course Outcomes:													Blooms Taxonomy		
CO 1: Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.													Apply (K3)		
CO2: Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.													Apply (K3)		
CO3: Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart													Apply (K3)		
CO4: Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.													Apply (K3)		
CO5: Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.													Apply (K3)		
CO-PO Mapping															
CO / PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	-	-	-	-	-	-	-	2	1	-
CO2	3	2	2	3	3	-	-	-	-	-	-	-	2	2	1
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	2	2
CO4	3	2	2	3	3	-	-	-	-	-	-	-	3	2	2
CO5	3	2	2	3	3	-	-	-	-	-	-	-	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CET01	FLUID MECHANICS AND MACHINERY	Category: ESC			
		L	T	P	C
		3	1	0	4
Prerequisites • Basic knowledge of engineering physics. • Understanding of basic mathematics (calculus & differential equations) • Fundamental idea of forces and motion.					
Course Objectives: • To introduce the students about properties of the fluids, behaviour of fluids under static conditions. • To impart basic knowledge of the dynamics of fluids and boundary layer concept. • To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends. • To exposure to the significance of boundary layer theory and its thicknesses. • To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.					

Unit I	FLUID PROPERTIES AND FLOW CHARACTERISTICS												9		
Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold’s transportation theorem - Continuity equation, energy equation and momentum equation - Applications.															
Unit II	FLOW THROUGH PIPES AND BOUNDARY LAYER												9		
Reynold’s Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.															
Unit III	DIMENSIONAL ANALYSIS AND MODEL STUDIES												9		
Fundamental dimensions - Dimensional homogeneity - Rayleigh’s method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.															
Unit IV	TURBINES												9		
Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.															
Unit V	PUMPS												9		
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it’s variations - Work saved by fitting air vessels - Rotary pumps.															
Total periods:60 PERIODS															
Text Books:															
1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)															
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.															
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.															
References:															
1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.															
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.															
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.															
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.															
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics													Understand (K2)		
CO2: Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.													Analyze (K4)		
CO3: Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies													Apply (K3)		
CO4: Explain the working principles of various turbines and design the various types of turbines.													Understand (K2)		
CO5: Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	1	-	2	3	2	-
CO2	3	3	2	2	1	-	-	-	-	1	-	2	3	2	-
CO3	3	3	3	3	1	-	-	-	-	1	-	3	3	3	-
CO4	3	2	3	2	1	-	-	-	-	1	-	2	3	3	-
CO5	3	2	3	2	1	-	-	-	-	1	-	2	3	3	-

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23MET303	ENGINEERING MATERIALS AND METALLURGY	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of Physics(particularly heat, temperature, and energy). • Basic concepts of Mechanics and Fluid Mechanics(related to pressure, volume, and work). • Mathematics (calculus, algebra, and basic thermodynamic equations). • Introduction to Heat Engines and Energy systems.					
Course Objectives: • To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation. • To learn selecting and applying various heat treatment processes and its microstructure formation. • To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field. • To illustrate the different polymer, ceramics and composites and their uses in engineering field. • To learn the various testing procedures and failure mechanism in engineering field.					
Unit I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS				9
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.					
Unit II	HEAT TREATMENT				9
Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.					
Unit III	FERROUS AND NON-FERROUS METALS				9
Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applicationoverview of materials standards					
Unit IV	NON-METALLIC MATERIALS				9
Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al ₂ O ₃ , SiC, Si ₃ N ₄ , PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materials- applications of Composites - Nano composites					
Unit V	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS				9
Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith’s theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.					
Total periods:45 PERIODS					
Text Books:					
1.Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9 th edition ,2018.					
2.Sydney H.Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1994					
References:					
1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.					
2.Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.					
3. G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt.Ltd, New Delhi, 2020.					

23MEP302	MANUFACTURING TECHNOLOGY LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Basic knowledge of manufacturing processes. • Familiarity with machine tools such as lathe, drilling, and milling machines. • Understanding of basic welding processes and safety procedures.					
Course Objectives: • To Selecting appropriate tools, equipment’s and machines to complete a given job. • To Performing various welding process using GMAW and fabricating gears using gear making machines. • To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.					
LIST OF EXPERIMENTS					
1	Fabricating simple structural shapes using Gas Metal Arc Welding machine.				
2	Preparing green sand moulds with cast patterns.				
3	Taper Turning and Eccentric Turning on circular parts using lathe machine.				
4	Knurling, external and internal thread cutting on circular parts using lathe machine.				
5	Shaping – Square and Hexagonal Heads on circular parts using shaper machine.				
6	Drilling and Reaming using vertical drilling machine.				
7	Milling contours on plates using vertical milling machine.				
8	Cutting spur and helical gear using milling machine.				
9	Generating gears using gear hobbing machine.				
10	Generating gears using gear shaping machine.				
11	Grinding components using cylindrical and centerless grinding machine.				
12	Grinding components using surface grinding machine.				
13	Cutting force calculation using dynamometer in milling machine				
14	Cutting force calculation using dynamometer in lathe machine				
LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS					
S.No.	NAME OF THE EQUIPMENT				Qty.
1.	Centre Lathes				7 Nos.
2.	Shaper				1 No.
3.	Horizontal Milling Machine				1 No.
4.	Vertical Milling Machine				1 No.
5.	Surface Grinding Machine				1 No.
6.	Cylindrical Grinding Machine				1 No.
7.	Radial Drilling Machine				1 No.
8.	Lathe Tool Dynamometer				1 No.
9.	Milling Tool Dynamometer				1 No.
10.	Gear Hobbing Machine				1 No.
11.	Gear Shaping Machine				1 No.
12.	Arc welding transformer with cables and holders				2 Nos.
13.	Oxygen and Acetylene gas cylinders, blow pipe and other welding outfit				1 No.
14.	Moulding table, Moulding equipments				2 Nos.
TOTAL: 60 PERIODS					
Text Books:					
1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy, Elements of Workshop Technology – Volume I & II, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2015.					
2. Rao P.N., Manufacturing Technology – Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi, 2018.					
3. Kalpakjian S. and Schmid S.R., Manufacturing Engineering and Technology, Pearson Education, 2014.					
References:					
1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Wiley India Pvt.					

Ltd., 2017.															
2. Campbell J.S., Principles of Manufacturing Materials and Processes, McGraw Hill Education, 2012.															
3. Ghosh A. and Mallik A.K., Manufacturing Science, East-West Press Pvt. Ltd., 2010.															
4. Schey J.A., Introduction to Manufacturing Processes, McGraw Hill Education, 2013.															
Course Outcomes:													Blooms Taxonomy		
CO1: Perform various welding processes and fabricate simple structures.													Apply (K3)		
CO2: Prepare sand moulds and identify mould defects.													Understand (K2)		
CO3: Perform machining operations (turning, shaping, drilling, milling, grinding) and measure machining parameters.													Apply (K3)		
CO4: Generate different types of gears using gear hobbing and shaping machines.													Apply (K3)		
CO5: Measure cutting forces in machining using dynamometers and analyze machining performance													Analyze (K3)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	1	-	-	-	1	1	-	1	2	1	-
CO2	2	1	1	-	1	-	-	-	1	1	-	1	2	1	-
CO3	3	2	3	1	2	-	-	-	1	1	-	2	3	2	1
CO4	3	2	3	1	2	-	-	-	1	1	-	2	3	2	1
CO5	3	2	3	2	2	-	-	-	1	1	-	2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23GEP301	PROFESSIONAL DEVELOPMENT	Category: EEC			
		L	T	P	C
		0	0	2	1
Prerequisites • Basic computer knowledge • Familiarity with operating systems (Windows) • Ability to handle basic file operations (open, save, copy, move)					
Course Objectives: • To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content. • To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered • To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.					
MS WORD: Create and format a document Working with tables Working with Bullets and Lists Working with styles, shapes, smart art, charts Inserting objects, charts and importing objects from other office tools Creating and Using document templates Inserting equations, symbols and special characters Working with Table of contents and References, citations Insert and review comments Create bookmarks, hyperlinks, endnotes footnote Viewing document in different modes Working with document protection and security Inspect document for accessibility					
MS EXCEL:					

Create worksheets, insert and format data Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data Sort and filter data Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae Create and Work with different types of charts Use pivot tables to summarize and analyse data Perform data analysis using own formulae and functions Combine data from multiple worksheets using own formulae and built-in functions to generate results Export data and sheets to other file formats Working with macros Protecting data and Securing the workbook															
MS POWERPOINT:															
Hours Select slide templates, layout and themes Formatting slide content and using bullets and numbering Insert and format images, smart art, tables, charts Using Slide master, notes and handout master Working with animation and transitions Organize and Group slides Import or create and use media objects: audio, video, animation Perform slideshow recording and Record narration and create presentable videos															
Text Books:															
1.Rutledge, Patrice-Anne, Microsoft Office 365: In Practice, Pearson Education, 2020.															
2.Weverka, Peter, Microsoft Office 365 All-in-One, Wiley Publications, 2021.															
3. Taxali R.K., PC Software for Windows 10 Office 2019 with Step-by-Step, Tata McGraw Hill Education, 2019.															
References:															
1. Joyce Cox, Joan Lambert, and Curtis Frye, Microsoft Office Step by Step (Word, Excel, PowerPoint), Microsoft Press, 2019.															
2. Jinjer Simon, Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables, Wiley India, 2015.															
3. Doug Lowe, PowerPoint 2019 for Dummies, Wiley Publications, 2019.															
4. Frederick Shih, Advanced Microsoft Word: Expert Techniques, McGraw Hill Education, 2018.															
5. Shelly Cashman Series, Microsoft Office 365 Word/Excel/PowerPoint Introductory, Cengage Learning, 2020.															
Total periods:30 PERIODS															
Course Outcomes:													Blooms Taxonomy		
CO1: Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements													Apply (K3)		
CO2: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding													Apply (K3)		
CO3: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.													Apply (K3)		
CO4: Integrate MS Word, Excel, and PowerPoint for combined technical tasks such as reports, dashboards, and presentations.													Analyze (K4)		
CO5: Apply digital productivity skills to academic and professional tasks with accuracy, clarity, and efficiency.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	3	-	-	-	2	3	1	2	2	-	-
CO2	2	2	3	3	3	-	-	-	2	2	1	2	3	-	-
CO3	1	1	2	2	3	-	-	-	3	3	2	2	2	-	-
CO4	2	2	3	3	3	-	-	-	2	2	1	2	3	-	-
CO5	1	1	2	2	3	-	-	-	3	3	2	2	2	-	-

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23MET401	THEORY OF MACHINES	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Engineering Mechanics (Statics & Dynamics). • Understanding of basic machine components and their functions. • Familiarity with vector mathematics and graphical methods. • Basic problem-solving skills in engineering applications					
Course Objectives: • To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions. • To study the basic concepts of toothed gearing and kinematics of gear trains • To Analyzing the effects of friction in machine elements • To Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms. • To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.					
Unit I	BASICS OF MECHANISMS				9
Classification of mechanisms –Basic kinematicconcepts anddefinitions –Degree of freedom, Mobility – Kutzbach criterion, Gruebler’s criterion – Grashof’s Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.					
Unit II	KINEMATICS OF LINKAGE MECHANISMS				9
Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.					
Unit III	FORCE ANALYSIS				9
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D’Alembert’s principle – superposition principle – dynamic Force Analysis in simple machine members					
Unit IV	BALANCING				9
Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines					
Unit V	FREE VIBRATION				9
Basic features of vibratory systems–Degrees of freedom – single degree of freedom – Free vibration –Equations of motion – Natural frequency – Types of Damping – Damped vibration – Torsional vibration of shaft–Critical speeds of shafts – Torsional vibration –Two and three rotor torsional systems.					
Total periods:45 PERIODS					
Text Books:					
1.Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017.					
2. Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3rd edition 2019.					
References:					
1.AmitabhaGhosh and Asok Kumar Mallik, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., 1988.					
2.Rao.J.S. and Dukkipati.R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2nd edition,2014					
3. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 5th edition 2019.					
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.					
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.					

Course Outcomes:													Blooms Taxonomy		
CO 1:Classify mechanisms and determine degrees of freedom for basic kinematic analysis.													Understand (K2)		
CO2:Analyze displacement, velocity, and acceleration of mechanisms using graphical and analytical methods.													Analyze (K4)		
CO3:Perform static and dynamic force analysis using free-body diagrams and D'Alembert's principle													Apply (K3)		
CO4:Evaluate and perform static and dynamic balancing of rotating and reciprocating components.													Apply (K3)		
CO5:Analyze single-degree vibration systems to determine natural frequency and damping behavior.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	1	-	1	3	1	-
CO2	3	3	2	1	-	-	-	-	-	1	-	1	3	2	1
CO3	3	2	2	1	-	-	-	-	-	1	-	1	2	2	1
CO4	3	3	2	2	-	-	-	-	-	1	-	2	3	2	1
CO5	3	3	2	2	1	-	-	-	-	1	-	2	3	3	1
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MET402	THERMAL ENGINEERING	Category: PCC			
		L	T	P	L
		4	0	0	4
Prerequisites • Engineering Physics – fundamentals of heat, temperature, and energy. • Basic Thermodynamics – laws of thermodynamics, pure substances, properties of gases and vapors. • Engineering Mathematics – calculus, differential equations, basic numerical methods. • Fluid Mechanics – continuity, Bernoulli equation, fluid flow concepts. • Basic Mechanical Engineering – introductory knowledge of engines and power-producing devices.					
Course Objectives: • To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion (IC) engines and Gas Turbines. • To analyzing the performance of steam nozzle, calculate critical pressure ratio • To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines • To analyzing the working of IC engines and various auxiliary systems present in IC engines To evaluating the various performance parameters of IC engines					
Unit I	THERMODYNAMIC CYCLES				6
Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.					
Unit II	STEAM NOZZLES AND INJECTOR				6
Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.					
Unit III	STEAM AND GAS TURBINES				6
Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.					
Unit IV	INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION				6

IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.															
Unit V		INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS												6	
Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms															
Total periods:60															
Text Books:															
1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.															
2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.															
References:															
1. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.															
2. Domkundwar, Kothandaraman, &Domkundwar, “A Course in Thermal Engineering”, 6th Edition, DhanpatRai& Sons, 2011.															
3. Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013.															
4. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.															
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011.															
Course Outcomes:													Blooms Taxonomy		
CO1: Apply thermodynamic concepts to different air standard cycles and solve problems.													Apply (K3)		
CO2: To solve problems in steam nozzle and calculate critical pressure ratio.													Apply (K 3)		
CO3: Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.													Understand / Apply (K2/K3)		
CO4: Explain the functioning and features of IC engine, components and auxiliaries.													Understand (K2)		
CO5: Calculate the various performance parameters of IC engines													Apply (K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	-	-	-	-	-	1	-	2	3	2	-
CO2	3	3	2	2	-	-	-	-	-	1	-	2	3	2	-
CO3	3	2	3	2	-	-	-	-	-	1	-	2	3	3	-
CO4	2	-	2	-	-	-	-	-	-	1	-	1	2	2	1
CO5	3	2	3	2	-	-	-	-	-	1	-	2	3	3	-
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MET403	HYDRAULICS AND PNEUMATIC	Category: PCC			
		L	T	P	L
		3	0	0	3
Prerequisites • Engineering Physics – basic fluid properties and pressure concepts • Fluid Mechanics – Bernoulli equation, laminar/turbulent flow, losses • Engineering Mathematics – basic calculus for flow/pressure calculations • Basic Mechanical Engineering – understanding of mechanical components • Engineering Drawing – reading and interpreting hydraulic/pneumatic symbols					

Course Objectives:		
- To provide the knowledge on the working principles of fluid power systems. - To study the fluids and components used in modern industrial fluid power system. - To develop the design, construction and operation of fluid power circuits. - To learn the working principles of pneumatic power system and its components. To provide the knowledge of trouble shooting methods in fluid power systems.		
Unit I	FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS	6
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory— Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems		
Unit II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	6
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems		
Unit III	HYDRAULIC CIRCUITS AND SYSTEMS	6
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.		
Unit IV	PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS	6
Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits		
Unit V	TROUBLE SHOOTING AND APPLICATIONS	6
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics Note: (Use of standard Design Data Book is permitted in the University examination)		
Total periods: 45		
Text Books:		
1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.		
2. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997		
References:		
1. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015		
2. Joshi.P., Pneumatic Control”, Wiley India, 2008.		
3. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, TataMcGraw Hill, 2001.		
4. Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.		
5. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition, 2019.		
Course Outcomes:		Blooms Taxonomy
CO1: Apply the working principles of fluid power systems and hydraulic pumps.		Apply (K3)
CO2: Apply the working principles of hydraulic actuators and control components.		Apply (K3)
CO3: Design and develop hydraulic circuits and systems.		Create / Design (K6)
CO4: Apply the working principles of pneumatic circuits and power system and its components		Apply (K3)
CO5: Identify various troubles shooting methods in fluid power systems.		Understand / Analyze (K2/K4)

CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	-	-	-	-	-	1	-	2	3	2	-
CO2	3	2	2	2	-	-	-	-	-	1	-	2	3	2	-
CO3	3	2	3	3	-	-	-	-	-	2	-	3	3	3	-
CO4	3	2	2	2	-	-	-	-	-	1	-	2	3	2	-
CO5	2	2	2	2	-	-	-	-	-	1	-	2	2	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MET404	MANUFACTURING TECHNOLOGY	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Physics – Material behavior, heat generation, and deformation. • Basic Mechanical Engineering – Machines, mechanisms, and workshop practices. • Engineering Graphics – Understanding of dimensions and geometrical features. • Manufacturing Processes (Introductory level) – Casting, forming, basic machining.					
Course Objectives: • To study the concepts and basic mechanics of metal cutting and the factors affecting machinability • To learn working of basic and advanced turning machines. • To teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes. • To study the basic concepts of CNC of machine tools and constructional features of CNC. • To learn the basics of CNC programming concepts to develop the part programme for Machine centre and turning centre					
Unit I	MECHANICS OF METAL CUTTING				9
Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.					
Unit II	TURNING MACHINES				9
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle					
Unit III	RECIPROCATING MACHINE TOOLS				9
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods					
Unit IV	CNC MACHINES				9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to-point/continuous - Turning and machining centres – Work holding methods in Turning and machining centres, Coolant systems, Safety features.

Unit V	PROGRAMMING OF CNC MACHINE TOOLS												9		
Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.															
Total periods:45 PERIODS															
Text Books:															
1.Kalpakistan. S, “Manufacturing Engineering and Technology”, Pearson Education India,7th Edition, 2018.															
2.Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.															
References:															
1.Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006															
2.Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 1984.															
3.Rao. P.N “Manufacturing Technology,” Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2009.															
4.A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.															
5. peter Smid, CNC Programming Handbook, Industrial Press Inc.;Third edition, 2007.															
Course Outcomes:													Blooms Taxonomy		
CO 1:Apply the mechanism of metal removal process and to identify the factors involved in improving machinability													Apply(K3)		
CO2: Describe the constructional and operational features of centre lathe and other special purpose lathes													Understand (K2)		
CO3: Describe the constructional and operational features of reciprocating machine tools.													Understand (K2)		
CO4: Apply the constructional features and working principles of CNC machine tools.													Apply (K3)		
CO5: Demonstrate the Program CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.													Apply (K3)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	3	2	-
CO2	3	-	2	-	1	-	-	-	-	-	-	-	3	2	-
CO3	3	-	2	-	1	-	-	-	-	-	-	-	3	2	-
CO4	3	2	3	1	3	-	-	-	-	-	-	1	3	3	2
CO5	3	2	3	2	3	-	-	-	1	2	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CET02	STRENGTH OF MATERIALS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Physics – concepts of force, deformation, elasticity. • Engineering Mechanics (Statics) – equilibrium, support reactions, free-body diagrams.					

• Basic Mathematics – differential equations, algebra, geometry. • Basic Civil/Mechanical Engineering concepts – structural members, loading types.		
Course Objectives: • To understand the concepts of stress, strain, principal stresses and principal planes. • To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses. • To determine stresses and deformation in circular shafts and helical spring due to torsion. • To compute slopes and deflections in determinate beams by various methods. • To study the stresses and deformations induced in thin and thick shells.		
Unit I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.		
Unit II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM	9
Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.		
Unit III	TORSION	9
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.		
Unit IV	DEFLECTION OF BEAMS	9
Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.		
Unit V	THIN CYLINDERS, SPHERES AND THICK CYLINDERS	9
Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lamé's theory.		
Total periods:45 PERIODS		
Text Books:		
1.Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand& company Ltd., New Delhi, 7th edition, 2018		
2.Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.		
References:		
1.Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.		
2.Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.		
3.Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019.		
4.Vazirani. V.N, Ratwani. M.M, Duggal .S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.		
Course Outcomes:		Blooms Taxonomy
CO1: Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.		Understand (K2)

environment and human health – human rights – value education, Professional ethics – HIV / AIDS – women and child welfare – Role of information technology in environment and human health.															
Total periods:36															
Text Books:															
1.Benny Joseph, 'Environmental Science and Engineering', 3 rd edition, Tata McGraw-Hill, New Delhi, 2017															
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2 nd edition, Pearson Education, 2004															
3. Anubha Kaushik and C.P. Kaushiks, 'Perspectives in Environmental Studies', 6 th edition, New Age International Publishers, 2018.															
4. A.K. De, 'Environmental Chemistry', New Age International Publishers, New Delhi, 2016.															
References:															
1. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publishing House, Mumbai, 2001.															
2. Rajagopalan, R., 'Environmental Studies-From Crisis to Cure', Oxford University Press, 3 rd edition, 2015.															
3. Erach Bharucha, 'Textbook of Environmental Studies for Undergraduate Courses', Orient Blackswan Private limited, 2013.															
Course Outcomes:														Blooms Taxonomy	
CO1: Familiar the functions of ecosystems, environment and biodiversity.														K1	
CO2: Know well about the effects of environmental pollutions														K1	
CO3: Inculcate the basic knowledge of renewable energy resources														K1	
CO4: Differentiate various social problems.														K2	
CO5: Describe the importance/impacts of population growth.														K2	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	2	-	-	-	1	1	-	-	-
CO2	3	1	1	-	-	1	2	-	2	-	1	1	-	-	-
CO3	3	1	-	-	1	1	2	-	2	-	1	1	-	-	-
CO4	3	1	-	-	1	1	2	-	2	-	1	1	-	-	-
CO5	3	1	-	-	1	1	2	-	-	-	1	1	-	-	-
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

NCC Credit Course Level 2*(NAVAL WING) NCC Credit Course Level - II						
		L	T	P	C	
		3	0	0	3	
PERSONALITY DEVELOPMENT						9
PD3	Group Discussion: Change your mindset, Time Management, Social Skills					6
PD5	Public Speaking					3
LEADERSHIP						7
L2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965					2
DISASTER MANAGEMENT						13
DM1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation					3
DM2	Initiative Training, Organising Skills, Do's &Don't's, Natural Disasters, Man Made Disasters					9
DM3	Fire Service & Fire Fighting					1
ENVIRONMENTAL AWARENESS & CONSERVATION						3

EA1	Environmental Awareness and Conservation	3
GENERAL AWARENESS		4
GA1	General Knowledge	4
NAVAL ORIENTATION		6
AF1	Armed Forces and Navy Capsule	3
EEZ1	EEZ Maritime Security and ICG	3
ADVENTURE		1
AD1	Introduction to Adventure Activities	1
BORDER & COASTAL AREAS		2
BCA1	History, Geography & Topography of Border/Coastal areas	2
TOTAL: 45 PERIODS		

NCC Credit Course Level 2*(AIR FORCE WING) NCC Credit Course Level - II					
		L	T	P	C
		3	0	0	3
PERSONALITY DEVELOPMENT					9
PD3	Group Discussion: Change your mindset, Time Management, Social Skills				6
PD5	Public Speaking				3
LEADERSHIP					7
L2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965				7
DISASTER MANAGEMENT					13
DM1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation				3
DM2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters				9
DM3	Fire Service & Fire Fighting				1
ENVIRONMENTAL AWARENESS & CONSERVATION					3
EA1	Environmental Awareness and Conservation				3
GENERAL AWARENESS					4
GA1	General Knowledge				4
GENERAL SERVICE KNOWLEDGE					6
GSK1	Armed Forces & IAF Capsule				2
GSK2	Modes of Entry in IAF, Civil Aviation				2
GSK3	Introduction to Adventure Activities				2
ADVENTURE					1
AD1	Introduction to Adventure Activities				1
BORDER & COASTAL AREAS					2
BCA1	History, Geography & Topography of Border/Coastal areas				2

23CEP404	STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Strength of Materials • Fluid Mechanics & Machinery • Basic engineering physics and mathematics • Ability to take measurements and perform calculations					
Course Objectives: • To study the mechanical properties of metals, wood and spring by testing in laboratory. • To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory					
Unit I	STRENGTH OF MATERIALS				30
LIST OF EXPERIMENTS 1. Tension test on mild steel rod 2. Torsion test on mild steel rod 3. Hardness test on metal (Rockwell and Brinell Hardness) 4. Compression test on helical spring 5. Deflection test on carriage spring					
Unit II	FLUID MECHANICS AND MACHINES LABORATORY				30
LIST OF EXPERIMENTS 1. Determination of coefficient of discharge of a venturimeter 2. Determination of friction factor for flow through pipes 3.Determination of coefficient of discharge of aorificemeter. 4. Characteristics of centrifugal pumps					

5. Characteristics of reciprocating pump 6. Study of Pelton wheel turbine															
Total periods:60 PERIODS															
Text Books:															
1. Sadhu Singh, Strength of Materials, Khanna Publishers, Latest Edition															
2. R.K. Rajput, Strength of Materials, S. Chand & Co., Latest Edition.															
3. Modi & Seth, Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, Latest Edition.															
4. R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, Latest Edition.															
References:															
1. Beer & Johnston, Mechanics of Materials, McGraw Hill, Latest Edition.															
2. Egor P. Popov, Engineering Mechanics of Solids, PHI Learning, Latest Edition.															
3. Dr. Jagdish Lal, Hydraulic Machines, Metropolitan Book Co., Latest Edition.															
4. K. Subramanya, Flow in Open Channels and Pipe Flow, Tata McGraw Hill.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Determine the tensile, torsion and hardness properties of metals by testing													Apply (K3)		
CO2: Determine the stiffness properties of helical and carriage spring													Apply (K3)		
CO3: Apply the conservation laws to determine the coefficient of discharge of a venturimeter and finding the friction factor of given pipe													Apply (K3)		
CO4: Apply the fluid static and momentum principles to determine the metacentric height and forces due to impact of jet													Apply (K3)		
CO5: Determine the performance characteristics of turbine, rotodynamic pump and positive displacement pump													Apply (K3)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3					2	2		2	3	2	
CO2	3	2		3					2	2		2	3	2	
CO3	3	2	1	3					2	2		2	3	3	
CO4	3	2	1	3					2	2		2	3	3	
CO5	3	2	2	3					2	2		2	3	3	
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MEP401	THERMAL ENGINEERING LABORATORY	Category: PCC

		L	T	P	C
		0	0	4	2
Prerequisites - Basic Thermodynamics - Engineering Mechanics / Engineering Physics (Thermal aspects)					
Course Objectives: - To study the valve and port timing diagram and performance characteristics of IC engines - To study the Performance of refrigeration cycle / components - To study the Performance and Energy Balance Test on a Steam Generator					
PART I: IC ENGINES LABORATORY					
LIST OF EXPERIMENTS					
1	Valve Timing and Port Timing diagrams.				
2	Actual p-v diagrams of IC engines.				
3	Performance Test on four – stroke Diesel Engine.				
4	Heat Balance Test on 4 – stroke Diesel Engine.				
5	Study of Morse Test on Multi-Cylinder Petrol Engine.				
6	Retardation Test on a Diesel Engine.				
7	Determination of p-θ diagram and heat release characteristics of an IC engine.				
8	Determination of Flash Point and Fire Point of various fuels / lubricants				
9	Performance test on a two stage Reciprocating Air compressor				
PART II STEAM LABORATORY					
LIST OF EXPERIMENTS					
1	Study of Steam Generators and Turbines.				
2	Performance and Energy Balance Test on a Steam Generator.				
3	Study of Energy Balance Test on Steam Turbine.				
LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS					
S No.	Name of the Equipment				Qty.
1	I.C Engine – 2 stroke and 4 stroke model				1 set
2	Apparatus for Flash and Fire point				1 No.
3	4-stroke Diesel Engine with mechanical loading				1 No.
4	4-stroke Diesel Engine with hydraulic loading				1 No.
5	4-stroke Diesel Engine with electrical loading				1 No.
6	Multi-Cylinder Petrol Engine				1 No.
7	Single Cylinder Petrol Engine				1 No.
8	Data Acquisition system with any one of the above engines				1 No.
9	Steam Boiler with turbine setup				1 No.
Total periods:60					
Text Books:					
1.R.K. Rajput, Strength of Materials, S. Chand Publishers.					
2.R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications.					
3.Modi & Seth, Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House.					
4.Sadhu Singh, Strength of Materials, Khanna Publishers.					
References:					

1.Beer & Johnston, Mechanics of Materials, McGraw Hill.															
2.Egor P. Popov, Engineering Mechanics of Solids, PHI Learning.															
3.S. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing.															
4.Jagadish Lal, Hydraulic Machines, Metropolitan Book Co.															
Course Outcomes:													Blooms Taxonomy		
CO1: Conduct tests to evaluate performance characteristics of IC engines													Apply / Analyze (K3/K4)		
CO2: Conduct tests to evaluate the performance of refrigeration cycle													Apply (K3)		
CO3: Conduct tests to evaluate Performance and Energy Balance on a Steam Generator													Analyze (K4)		
CO4: Interpret experimental data using appropriate data acquisition systems and measurement techniques													Analyze / Evaluate (K4/K5)		
CO5: Prepare technical reports and communicate experimental results effectively													Create / Evaluate (K6/K5)		
CO-PO Mapping															
Particular	P O1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	3	2	3	2	3				1	1		2	3	2	
CO2	3	2	2	2	2				1	1		2	2	2	
CO3	3	3	3	2	2				1	1		3	3	3	
CO4	2	3	2	3	3				2	2		2	2	2	
CO5			1						3	3	2				
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MET501	DESIGN OF MACHINE ELEMENTS	Category: PCC			
		L	T	P	C
		4	0	0	4
Prerequisites • Engineering Mechanics (Statics & Dynamics) • Strength of Materials • Theory of Machines • Basic Manufacturing Processes • Material Science					
Course Objectives: • To learn the various steps involved in the Design Process. • To Learn designing shafts and couplings for various applications. • To Learn the design of temporary and permanent Joints. • To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications. • To Learn designing and select sliding and rolling contact bearings, seals and gaskets.					
Unit I	FUNDAMENTAL CONCEPTS IN DESIGN				12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and „C” frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit – Design for finite and infinite life under variable loading - Exposure to standards.																
Unit II		DESIGN OF SHAFTS AND COUPLINGS												12		
Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.																
Unit III		DESIGN OF TEMPORARY AND PERMANENT JOINTS												12		
Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded jointsButt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.																
Unit IV		DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS												12		
Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solid and Rimmed flywheels- connecting rods and crank shafts																
Unit V		DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS												12		
Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.																
Total periods: 60 Periods																
Text Books:																
1.Bhandari V B, “Design of Machine Elements”, 4th Edition , Tata McGraw-Hill Book Co, 2016																
2.Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill , 2015.																
References:																
1.Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2004.																
2.Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2004.																
3.Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017.																
4.Sundararajamoorthy T. V. and Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.																
5.Design of Machine Elements SI Edition Eighth Edition By Pearson by M. F. Spotts, Terry E. Shoup, et al. 25 March 2019																
Course Outcomes:													Blooms Taxonomy			
CO1: Explain the design machine members subjected to static and variable loads.													Understand (K2)			
CO2: Apply the concepts design to shafts, key and couplings.													Apply (K3)			
CO3: Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.													Apply (K3)			
CO4: Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.													Apply (K3)			
CO5: Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.													Apply (K3)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	3	2	2	1					1		2	3	2		
CO2	3	2	3	2	2					1		2	3	3		
CO3	3	2	3	2	2				1	1		2	3	3		
CO4	3	2	3	2	2					1		2	3	3		
CO5	3	2	3	2	3					1		2	3	3		
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23MET502	HEAT AND MASS TRANSFER										Category: PCC			
											L	T	P	C
											3	1	0	4

Prerequisites		
- Engineering Mathematics (Differential equations, PDEs, calculus) - Thermodynamics - Fluid Mechanics - Basic Physics (heat, temperature, transport phenomena)		
Course Objectives:		
- To Learn the principal mechanism of heat transfer under steady state and transient conditions. - To learn the fundamental concept and principles in convective heat transfer. - To learn the theory of phase change heat transfer and design of heat exchangers. - To study the fundamental concept and principles in radiation heat transfer. - To develop the basic concept and diffusion, convective di mass transfer.		
Unit I	CONDUCTION	12
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler’s charts – Methods of enhanced thermal conduction		
Unit II	CONVECTION	12
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.		
Unit III	PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS	12
Nusselt’s theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.		
Unit IV	RADIATION	12
Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.		
Unit V	MASS TRANSFER	12
Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state and Transient Diffusion - Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.		
Total periods: 60 Periods		
Text Books:		
1.R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009.		
2.Yunus A. Cengel, “Heat Transfer A Practical Approach” – Tata McGraw Hill, 5thEdition – 2013		
References:		
1.Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 7th Edition, 2014.		
2.Holman, J.P., “Heat and Mass Transfer”, Tata McGraw Hill, 2010.		
3.Kothandaraman, C.P., “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2012		
4.Ozisik, M.N., “Heat Transfer”, McGraw Hill Book Co., 1994.		
5.S.P. Venkateshan, “Heat Transfer”, Ane Books, New Delhi, 2014		
Course Outcomes:		Blooms Taxonomy
CO1: Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.		Apply (K3)
CO2: Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.		Analyze (K4)
CO3: Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.		Evaluate (K5)
CO4: Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.		Apply (K3)
CO5: Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.		Understand & Apply (K2/K3)
CO-PO Mapping		

6	Two rotor vibration setup														
7	Spring mass vibration system														
8	Torsional Vibration of single rotor system setup														
9	Gear Models														
10	Kinematic Models to study various mechanisms														
11	Turn table apparatus														
12	Transverse vibration setup of a cantilever														
Total periods: 60 Periods															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate the use of basic metrology instruments for measurement and quality inspection.													Apply(K3)		
CO2: Determine the moment of inertia of mechanical systems and components experimentally.													Analyze(K4)		
CO3: Analyze vibration characteristics of mechanical systems through experimental methods.													Analyze(K4)		
CO4: Examine the working principles and performance of governors and gyroscopes through experiments.													Analyze(K4)		
CO5: Conduct experiments to determine critical speed and evaluate dynamic behavior of rotating shafts.													Analyze(K4)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2				1	1		1	2	1	
CO2	3	3	2	2	2				1	1		1	3	2	
CO3	3	3	2	2	2				1	1		1	3	2	
CO4	3	3	2	2	2				1	1		1	3	2	
CO5	3	3	2	2	2				1	1		1	3	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEP502	HEAT TRANSFER LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Engineering Thermodynamics • Heat and Mass Transfer (theory course) • Fluid Mechanics • Basic measurements & instrumentation					
Course Objectives: • To understand the practical implementation of various heat transfer mechanisms. • To familiarize with the calibration and usage of various measuring devices for temperature and heat flux. • To study the performance of heat transfer equipment like heat exchangers and heat pipes. • To apply the theoretical concepts of conduction, convection, and radiation in experimental setups.					
LIST OF EXPERIMENTS					
1	Determination of Thermal Conductivity of an Insulating Powder				
2	Determination of Thermal Conductivity of a Lagged Pipe				
3	Determination of Thermal Conductivity using Guarded Hot Plate Method				
4	Determination of Heat Transfer Rate in a Pin-Fin under Natural Convection				
5	Determination of Heat Transfer Rate in a Pin-Fin under Forced Convection				
6	Determination of Heat Transfer Coefficient in Free Convection				
7	Determination of Heat Transfer Coefficient in Forced Convection				
8	Determination of Emissivity of a Test Surface				
9	Verification of Stefan-Boltzmann Law				

10	Study of Heat Transfer in Parallel Flow Heat Exchanger														
11	Study of Heat Transfer in Counter Flow Heat Exchanger														
12	Determination of Performance of Air Conditioning System														
13	Determination of Coefficient of Performance (COP) of Refrigeration System														
14	Comparison of Theoretical and Experimental COP of a Refrigeration Cycle														
EQUIPMENT REQUIRED															
1	Thermal conductivity apparatus for insulating powder														
2	Pin-fin apparatus														
3	Free and forced convection setups.														
4	Emissivity measurement apparatus.														
5	Stefan-Boltzmann law verification setup.														
6	Parallel and counter flow heat exchangers.														
7	Lagged pipe apparatus														
8	Guarded plate apparatus														
9	AC test rig														
10	Refrigeration test rig.														
Total periods: 60 Periods															
Course Outcomes:													Blooms Taxonomy		
CO1: Determine thermal conductivity and heat transfer coefficients for various materials and conditions.													Apply (K3)		
CO2: Analyze the performance of heat exchangers under different flow configurations.													Analyze (K4)		
CO3: Measure and verify radiation properties like emissivity and Stefan-Boltzmann constant.													Analyze (K4)		
CO4: Calibrate temperature measuring devices and understand their practical applications.													Apply (K3)		
CO5: Apply heat transfer principles to evaluate boiling, condensation, and advanced heat transfer systems.													Apply (K3)		
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2				1	1		1	3	2	
CO2	3	3	2	2	2				1	1		1	3	3	
CO3	3	3	2	2	2				1	1		1	3	3	
CO4	3	2	2	2	2				1	1		1	2	2	
CO5	3	2	2	2	2				1	1		1	3	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MET601	METROLOGY AND MEASUREMENTS	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Engineering Physics • Fundamentals of Engineering Graphics • Basic Manufacturing Processes • Elementary knowledge of Mechanics & Tolerances					
Course Objectives: • To learn basic concepts of the metrology and importance of measurements. • To teach measurement of linear and angular dimensions assembly and transmission elements. • To study the tolerance analysis in manufacturing. • To develop the fundamentals of GD & T and surface metrology. • To provide the knowledge of the advanced measurements for quality control in manufacturing industries.					
Unit I	BASICS OF METROLOGY				9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.															
Unit II		MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS												9	
Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.															
Unit III		TOLERANCE ANALYSIS												9	
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stack up, tolerance charting.															
Unit IV		METROLOGY OF SURFACES												9	
Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.															
Unit V		ADVANCES IN METROLOGY												9	
Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers –Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi-sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners.															
Total periods: 45 Periods															
Text Books:															
1. Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.															
2. Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.															
References:															
1. AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.															
2. R.K.Jain, Engineering Metrology, Khanna Publishers, Delhi, 2017.															
3. National Physical LaboratoryGuide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk .															
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.															
5. Venkatesan, S. P., “Mechanical Measurements”, Second edition, John Wiley & Sons, 2015.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the concepts of measurements to apply in various metrological instruments.													Understand (K2)		
CO2: Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.													Apply (K3)		
CO3: Apply the tolerance symbols and tolerance analysis for industrial applications.													Apply (K3)		
CO4: Apply the principles and methods of form and surface metrology.													Apply (K3)		
CO5: Apply the advances in measurements for quality control in manufacturing Industries.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2					1			1	3	2	1
CO2	3	2	2	2					1			1	3	2	1
CO3	3	2	2	2					1			1	3	2	1
CO4	3	2	2	2					1			1	3	2	1
CO5	3	2	2	2					1			1	3	2	1

23MEP601	CAD/CAM LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Engineering Graphics– Understanding of 2D drafting, projection, and basic drawing conventions. • Basic Manufacturing Processes– Familiarity with machining operations like turning, milling, drilling, etc. • Fundamentals of Computer-Aided Design– Basic exposure to CAD interfaces, coordinate systems, and simple modelling. • Basic CNC Machine Operations– Awareness of CNC machine structure, axis systems, and basic G & M codes.					
Course Objectives: • To provide hands-on training in 2D drafting, 3D modelling, assembly creation, and CAD-based analysis. • To develop competency in modelling, analysis, and documentation of machine components and assemblies using CAD tools. • To impart practical skills in manual CNC part programming for turning and milling operations using G and M codes. • To enable generation and simulation of CL data for CNC machining applications using CAM tools. • To develop the ability to evaluate and validate CNC machining processes through simulation, toolpath verification, and basic analysis.					
3D GEOMETRIC MODELLING					
1	CAD Introduction				
Sketch:					
Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.					
Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.					
Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.					
Assembly: Constraints, Exploded Views, Interference check					
Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting					
2	Creation of 3D assembly model of following machine elements using 3D Modelling software				
1. Flange Coupling					
2. Plummer Block					
3. Screw Jack					
4. Lathe Tailstock					
5. Universal Joint					
6. Stuffing box					

7. Crosshead															
8. Safety Valves															
9. Connecting rod															
10. Piston															
11. Crankshaft															
3D GEOMETRIC MODELLING AND ANALYSIS															
3	Mass Properties and Centre of Gravity Analysis of a 3D Model using CAD software														
4	Parametric Modelling and Design Sensitivity Analysis using CAD software														
MANUAL PART PROGRAMMING															
1	CNC Machining Centre														
i) Linear Cutting.															
ii) Circular cutting.															
iii) Cutter Radius Compensation.															
iv) Canned Cycle Operations.															
2	CNC Turning Centre														
i) Straight, Taper and Radial Turning.															
ii) Thread Cutting															
iii) Rough and Finish Turning Cycle.															
iv) Drilling and Tapping Cycle.															
Total periods: 60 Periods															
Course Outcomes:														Blooms Taxonomy	
CO1: Apply 2D drafting and 3D modelling techniques using CAD software.														Apply (K3)	
CO2: Perform modelling, analysis, and documentation of machine components and assemblies using CAD tools.														Apply (K3)	
CO3: Develop and simulate CNC part programs for turning and milling operations using G and M codes.														Apply (K3)	
CO4: Apply CNC machining concepts to execute turning and milling operations effectively.														Apply (K3)	
CO5: Evaluate CNC machining performance through simulation and validation of toolpaths and machining parameters.														Evaluate (K5)	
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3				2			1	3	3	1
CO2	2	2	2	2	3				2			1	3	3	1
CO3	2	2	2	2	3				2			1	3	3	1
CO4	2	2	2	2	3				2			1	3	3	1
CO5	2	2	2	2	3				2			1	3	3	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEP602	METROLOGY LABORATORY	Category: PCC			
		L	T	P	C
		0	0	4	2
Prerequisites • Engineering Graphics – dimensions, angles, projections. • Basic Manufacturing Processes – machining, gears, threads, tolerances. • Engineering Physics – measurement principles, errors, units • Basic Mechanics – forces, torque, motion, displacement.					
Course Objectives: • Provide foundational knowledge of the core concepts, principles, and applications related to the subject. • Develop analytical and problem-solving skills by applying theoretical concepts to real-world scenarios. • Enhance practical competency through experiments, case studies, or hands-on activities relevant to the					

- Improve design and implementation skills, enabling students to propose effective solutions for engineering problems.
- Strengthen communication and teamwork abilities required for professional practice.

LIST OF EXPERIMENTS

1	Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge using slip gauges.
2	Calibration and use of depth micrometer and bore gauge.
3	Measurement of linear dimensions using comparators (mechanical/electrical/pneumatic).
4	Measurement of angles using bevel protractor and sine bar .
5	Measurement of screw thread parameters using screw thread micrometers.
6	Gear parameter measurement using Gear Testing Machine – runout, pitch variation, tooth thickness.
7	Non-contact optical measurement using toolmaker's microscope / profile projector.
8	Measurement of surface roughness using optical comparison method (screen comparators).
9	Machine tool metrology – straightness testing using autocollimator
10	Measurement of force, torque, and temperature.
11	Measurement of displacement and vibration using suitable sensors.
12	Calibration of slip gauges and setting up comparators for precision inspection.

EQUIPMENT REQUIRED

1	Micro meter
2	Vernier Calliper
3	Vernier Height Gauge
4	Vernier Depth Gauge
5	Slip Gauge Set
6	Bevel Protractor
7	Sine Bar
8	Profile Projector / Toolmaker's Microscope
9	Mechanical / Electrical / Pneumatic Comparator
10	Autocollimator
11	Temperature Measuring Setup
12	Force Measuring Setup
13	Torque Measuring Setup
14	Gear Testing Machine
15	Bore Gauge
16	Vibration Measurement Setup

Total periods: 60 periods

Course Outcomes:	Blooms Taxonomy
CO1: Apply principles of linear & angular measurement using standard instruments	Apply (K3)
CO2: Calibrate instruments such as Vernier, micrometer, slip gauges, comparators	Apply (K3)
CO3: Measure screw thread and gear parameters using specialized equipment	Apply (K3)
CO4: Apply optical/ non-contact measurement techniques	Apply (K3)
CO5: Perform machine tool metrology and measure force, torque, temperature, vibration	Apply (K3)

CO – PO & PSO Mapping

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2					1			1	3	2	1
CO2	3	2	2	2					1			1	3	2	1
CO3	3	2	2	2	1				1			1	3	2	1
CO4	3	2	2	2	1				1			1	3	2	1
CO5	3	2	2	2	2				1			1	3	2	1

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23MEP603	MINI PROJECT												Category: PCC			
													L	T	P	C
													0	0	4	2
Prerequisites - Fundamental knowledge of core engineering concepts. - Ability to perform literature review and identify a problem. - Basic skills in design, simulation, programming, or experimentation.																
Course Objectives: - To enable students to identify an engineering problem through technical literature and domain study. - To develop a suitable project methodology, work plan, and design/experimental approach. - To provide hands-on experience in design, modelling, simulation, or prototyping. - To analyze results, refine the design, and propose feasible engineering solutions. - To improve technical documentation, teamwork, and presentation skills for effective project execution..																
Guidelines for Review and Evaluation																
1	Students shall work in groups of 2 to 4 under the guidance of a project supervisor.															
2	The device/system/component(s) to be fabricated shall be selected in consultation with the supervisor and, if possible, with inputs from industry.															
3	Each group must submit a project report along with the fabricated working model.															
4	A Department Review Committee, constituted by the Head of the Department, will evaluate the progress through periodic reviews for internal assessment.															
5	At the end of the semester, the project will be evaluated through: Oral presentation, and Project report, jointly assessed by external and internal examiners appointed by the Head of the Department.															
Total periods: 60 periods																
Course Outcomes:														Blooms Taxonomy		
CO1:Identify and formulate an engineering problem based on literature review.														Remember/Understand (K1/K2)		
CO2:Develop an appropriate project plan, methodology, and design approach.														Apply(K3)		
CO3:Perform modelling, simulation, experimentation, or prototype development.														Apply/Analyze (K3/K4)		
CO4:Analyze project results and refine engineering solutions.														Analyze/Evaluate (K4/K5)		
CO4:Prepare technical documentation and present the project effectively.														Evaluate/Create (K5/K6)		
CO – PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1					1	2		1	3	2	1	
CO2	2	2	3	1	2				2	3	1	2	2	2	3	
CO3	3	3	3	2	3				2	2	1	2	3	3	3	
CO4	2	3	2	3	2				2	2		3	2	3	2	
CO5	1	1	2	1	2				3	3	2	2	1	1	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23MET701	MECHATRONICS AND IOT	Category: PCC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of electrical and electronic components • Fundamentals of sensors and transducers • Basic understanding of digital logic and controllers					

• Introductory knowledge of programming concepts • Fundamentals of mechanical systems and automation		
Course Objectives: • To understand fundamentals and role of sensors in mechatronic systems. • To design basic interfacing schemes for I/O devices in control applications. • To apply PLC concepts for industrial automation and control systems. • To design actuator-based mechatronic systems using structured design approach. • To understand IoT fundamentals for monitoring and controlling mechatronic systems.		
Unit I	INTRODUCTION AND SENSORS	9
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor – Temperature Sensors – Light Sensors.		
Unit II	PROGRAMMABLE PERIPHERAL INTERFACE	9
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
Unit III	PROGRAMMABLE LOGIC CONTROLLER	9
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.		
Unit IV	ACTUATORS AND MECHATRONICS SYSTEM DESIGN	9
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.		
Unit V	IoT FUNDAMENTALS FOR MECHATRONICS APPLICATIONS	9
Introduction to Internet of Things – Need and significance of IoT in Mechatronics – Basic IoT Architecture – Device layer – Gateway layer – Cloud and Application layer – Sensors and Actuators in IoT systems – Embedded controllers for IoT (Arduino and ESP32 – block level) – Communication Technologies – Wi-Fi – Bluetooth – MQTT – HTTP – Data acquisition and visualization – Cloud platforms overview – Security and safety basics in IoT – Applications of IoT in Mechanical Engineering – Smart manufacturing – Predictive maintenance – Condition monitoring – Energy management systems.		
Total periods: 45 Periods		
Text Books:		
1. Bolton W., “Mechatronics”, Pearson Education, 7th Edition, 2021.		
2. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.		
3. Bahga A. and Madiseti V., “Internet of Things: A Hands-On Approach”, Universities Press, 2nd Edition, 2019.		
References:		
1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 2nd Edition, 2019.		
2. Davis G. Alciatore and Michael B. Hiestand, “Introduction to Mechatronics and Measurement Systems”, McGraw Hill Education, 5th Edition, 2019.		
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2nd Edition, 2019.		
4. Nitaigour Premchand Mahalik, “Mechatronics: Principles, Concepts and Applications”, McGraw Hill Education, 2nd Edition, 2019.		
5. Smaili A. and Mrad F., “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2nd Edition, 2018.		
6. Buyya R. and Dastjerdi A.V., “Internet of Things: Principles and Paradigms”, Morgan Kaufmann, 1st Edition, 2016.		
Course Outcomes:	Blooms Taxonomy	
CO1: Select suitable sensors for given mechatronic applications.	Apply (K3)	
CO2: Design simple interfacing solutions for automation systems.	Analyze (K4)	
CO3: Apply PLC programming for industrial control problems.	Apply (K3)	
CO4: Design basic mechatronic systems integrating actuators and controllers.	Create (K6)	
CO5: Apply IoT concepts for data acquisition and remote monitoring applications.	Apply / Analyze (K3/K4)	

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.																
Unit V		PROCESS CONTROL AND DATA ANALYSIS												9		
Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control – Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection																
Total periods: 45 Periods																
Text Books:																
1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.																
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer																
References:																
1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi, 2013.																
2. Gideon Halevi and Ronald D. Weill, Principles of Process Planning, Chapman Hall, 1995.																
3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing, Pearson Education, Asia,3rdEdition,2004.																
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.																
5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.																
Course Outcomes:													Blooms Taxonomy			
CO1: Discuss the basics of computer aided engineering.													Understand(K2)			
CO2: Choose appropriate automotive tools and material handling systems.													Apply(K3)			
CO3: Discuss the overview of group technology, FMS and automation identification methods.													Understand(K2)			
CO4: Design using computer aided process planning for manufacturing of various components													Apply/Create(K3/K6)			
CO5: Acquire knowledge in computer process control techniques.													Apply(K3)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	2	1	2				1			1	2	1	3	
CO2	3	2	2	1	2				1			1	2	1	3	
CO3	3	2	2	1	2				1			1	2	1	3	
CO4	3	2	2	1	2				1			1	2	1	3	
CO5	3	2	2	1	2				1			1	2	1	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

development.

Unit I	DEMOCRATIC VALUES	6													
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement. Reading Text: Excerpts from John Stuart Mills’ On Liberty															
Unit II	SECULAR VALUES	6													
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani															
Unit III	SCIENTIFIC VALUES AND SCIENTIFIC ETHICS	6													
Scientific thinking and method – Inductive and Deductive reasoning – Hypothesis formulation and testing – Evidence-based reasoning – Skepticism, Empiricism, Rationalism and Scientific Temper – Transparency and fairness in scientific pursuits – Ethical responsibility of scientists – Responsible application of scientific inventions – Science and society.															
Unit IV	SOCIAL ETHICS	6													
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices. Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari															
Unit V	SUSTAINABLE DEVELOPMENT GOALS	6													
Concept of Sustainable Development – United Nations Sustainable Development Goals (SDGs) – Social, Economic and Environmental dimensions of sustainability – Role of individuals, society and professionals in achieving SDGs – Ethics, sustainability and intergenerational equity – Case examples related to education, health, energy, environment and social justice. Reading Text: United Nations, Transforming Our World: The 2030 Agenda for Sustainable Development															
Total periods: 30 Periods															
References:															
1. United Nations, Transforming Our World: The 2030 Agenda for Sustainable Development, United Nations Publications, 2015.															
2. Soumitro Banerjee, Research Methodology for Natural Sciences, IISc Press, 2022.															
3. Luke W. Galen, The Nonreligious: Understanding Secular People and Societies, Oxford University Press, 2016.															
4. John R. Shook (Ed.), The Oxford Handbook of Secularism, Oxford University Press, 2017.															
5. Gabriel A. Almond and Sidney Verba, The Civic Culture: Political Attitudes and Democracy in Five Nations, Princeton University Press, 2015 (Reprint Edition).															
Course Outcomes:												Blooms Taxonomy			
CO1: Identify the importance of democratic and secular values in harmonious social life.												Understand (K2)			
CO2: Demonstrate scientific temper and ethical responsibility in personal and professional life.												Apply (K3)			
CO3: Apply rational and ethical reasoning to analyze and address social issues.												Analyze (K4)			
CO4: Practice ethical behavior and social responsibility in societal and professional contexts.												Apply (K3)			
CO5: Recognize the role of Sustainable Development Goals in promoting ethical and sustainable development.												Understand / Apply (K2 / K3)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				3	3	2		2		2			
CO2	1	1	1			3	3	2		2		2			
CO3	1	2	1	2		3	2	2		2		2			
CO4	1	1				3	3	3		2		3			
CO5	2	2	1	2		3	2	2		2		3			

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23MGT701	INDUSTRIAL MANAGEMENT	Category: HSMC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic understanding of organizational structure and business environments.					
Course Objectives: - To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations. - To study the planning; organizing and staffing functions of management in professional organization. - To study the leading; controlling and decision making functions of management in professional organization. - To learn the organizational theory in professional organization.					
Unit I	INTRODUCTION TO MANAGEMENT				9
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.					
Unit II	PLANNING, ORGANIZING AND STAFFING				9
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.					
Unit III	DIRECTING AND CONTROLLING				9
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.					
Unit IV	ORGANIZATION THEORY				9
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygiene theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory – Change Management: Concept of Change; Lewin’s Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.					
Unit V	PRODUCTIVITY AND MODERN TOPICS				9
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).					
Total periods: 45 Periods					
Text Books:					
1. M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2009.					
2. Koontz. H. and Weihrich. H., “Essentials of Management: An International Perspective”, 8th Edition, Tata McGrawhill, New Delhi, 2010.					
References:					
1. Joseph J, Massie, “Essentials of Management”, 4th Edition, Pearson Education, 1987.					
2. Saxena, P. K., “Principles of Management: A Modern Approach”, Global India Publications, 2009.					
3. S.Chandran, “Organizational Behaviours”, Vikas Publishing House Pvt. Ltd., 1994.					
4. Richard L. Daft, “Organization Theory and Design”, South Western College Publishing, 11th Edition, 2012.					
5. S. Trevis Certo, “Modern Management Concepts and Skills”, Pearson Education, 2018.					
Course Outcomes:					Blooms Taxonomy
CO1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.					Understand (K2)

CO2: Discuss the planning; organizing and staffing functions of management in professional organization.													Understand (K2)		
CO3: Apply the leading; controlling and decision making functions of management in professional organization.													Apply (K3)		
CO4: Discuss the organizational theory in professional organization.													Understand (K2)		
CO5: Apply principles of productivity and modern concepts in management in professional organization.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	2	3	2	3	2	3	1	1	1
CO2	1	1	1	1	1	3	2	3	2	3	2	3	1	1	1
CO3	1	1	1	1	1	3	2	3	2	3	2	3	1	1	1
CO4	1	1	1	1	1	3	2	3	2	3	2	3	1	1	1
CO5	1	1	1	1	1	3	2	3	2	3	2	3	1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

LIST OF EQUIPMENTS REQUIRED															
S. No.	Name of the equipment												Quantity required		
1.	Basic Pneumatic Trainer Kit with manual and electrical controls / PLC control												1 (No.)		
2.	Basic Hydraulic Trainer Kit												1 (No.)		
3.	Hydraulics and Pneumatics Systems Simulation Software												10 (Nos.)		
4.	8051 Microcontroller Kit with stepper motor and drive circuit sets												2 (Nos.)		
5.	Image Processing System with hardware and software												1 (No.)		
Course Outcomes:												Blooms Taxonomy			
CO1: Program microprocessors and microcontrollers for basic control and interfacing tasks.												Apply (K3)			
CO2: Interface and control motors, sensors, and traffic signal systems experimentally.												Apply (K3)			
CO3: Design, implement, and test hydraulic, pneumatic, and electro-pneumatic circuits.												Analyze (K4)			
CO4: Model and simulate fluid power and electrical systems using appropriate software tools.												Analyze (K4)			
CO5: Develop basic industrial automation applications using PLC and image processing techniques.												Apply / Analyze (K3/K4)			
CO – PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1				1	1		1	2	1	1
CO2	2	2	2	2	2				1	1		2	2	2	2
CO3	2	2	3	2	2				1	1		2	2	2	3
CO4	2	2	2	3	2				1	1		3	2	2	2
CO5	2	2	2	3	3				1	1		3	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEP702	PROJECT WORK - 1	Category:EEC			
		L	T	P	C
		0	0	20	4
Prerequisites • Basic knowledge of Mechanical Engineering fundamentals • Understanding of engineering design tools • Ability to perform literature review • Basic report writing and presentation skills • Familiarity with ethical and professional responsibilities					
Course Objectives: • Enable students to identify a practical/mechanical engineering problem through literature survey. To provide hands-on experience in interfacing and controlling electromechanical systems such as stepper motors, DC motors, and traffic signals. • Train students to define objectives and prepare a clear problem statement. • Guide students in developing a methodology or conceptual design to address the problem. • Improve documentation skills by preparing a project proposal and interim report. • Enhance communication through reviews, discussions, and presentations.					
Total periods: 150 Periods					
Course Outcomes:					Blooms Taxonomy
CO1: Identify engineering problems using literature and field study.					Apply(K3)
CO2: Formulate problem statements and project objectives					Analyze(K4)
CO3: Develop methodology and conceptual design.					Evaluate(K5)
CO4: Prepare structured project proposals and partial reports					Apply(K3)
CO5: Present project idea effectively and work in teams.					Create(K6)
CO – PO & PSO Mapping					

- To study the relationship between gender and language. - To examine gender representation in media and digital platforms.																
Unit I		CONCEPTS												9		
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.																
Unit II		FEMINIST THEORY												9		
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.																
Unit III		WOMEN’S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL												9		
Rise of Feminism in Europe and America. Women’s Movement in India.																
Unit IV		GENDER AND LANGUAGE												9		
Linguistic Forms and Gender. Gender and narratives.																
Unit V		GENDER AND REPRESENTATION												9		
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.																
Total periods:45 PERIODS																
Course Outcomes:														Blooms Taxonomy		
CO1: Explain key concepts related to gender, patriarchy, identity, and power.														Understand (K2)		
CO2: Compare various feminist theories and their contributions.														Analyze (K4)		
CO3: Discuss women’s movements at global, national, and local levels.														Understand (K2)		
CO4: Analyze how gender influences language, communication, and narratives.														Analyze (K4)		
CO5: Evaluate gender representation in advertising, visual media, alternative media, and social media.														Evaluate (K5)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1				3	2	2	1	2		1	2	1		
CO2	2	2				3	2	2	1	2		1	2	1		
CO3	2	1				3	2	3	2	2		2	2	1		
CO4	2	2	1		1	3	2	3	2	2	1	2	2	1		
CO5	3	2	1		1	3	3	3	2	3	1	2	2	2		
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation-																

23MCT002	ELEMENTS OF LITERATURE	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of English grammar and vocabulary • Ability to read and interpret simple prose and poetry • Familiarity with basic literary terms such as poet, narrator, plot, and character					
Course Objectives: • To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience. • To make the students aware of the finer sensibilities of human existence through literature • To help students appreciate different genres of literature as means of expressing human experiences • To enhance analytical, critical thinking, discussion, and writing skills • To develop the ability to interpret literary texts without bias					
1. COURSE CONTENTS					
Introduction to Elements of Literature					
1. Relevance of literature					
a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias.					

d) Providing space to reconcile and get a cathartic effect.															
2. Elements of fiction															
a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.															
3. Elements of poetry															
a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.															
4. Elements of drama															
a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.															
1. READINGS:															
1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.															
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.															
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press, 1991.															
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.															
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.															
3.1 Textbook:															
3.2 *Reference Books: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.															
3. OTHER SESSION:															
4.1*Tutorials:															
4.2*Laboratory:															
4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature															
4. ASSESSMENT:															
5.1HA:															
5.2Quizzes-HA:															
5.3Periodical Examination: one															
5.4Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.															
5.5Final Exam:															
Total periods:45 PERIODS															
Course Outcomes:													Blooms Taxonomy		
CO 1: Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.													Understand (K2)		
CO2: Explain the major elements of fiction such as plot, character, theme, and narrative techniques.													Analyze(K4)		
CO3: Interpret poetic devices such as imagery, symbolism, metaphor, and other figurative forms.													Understand (K2)		
CO4: Analyze the features and dramatic techniques used in various forms of drama.													Analyze (K4)		
CO5: Evaluate the role of literature in shaping human emotions, social understanding, and cultural perspectives.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1						1	1	2		1	2		
CO2	2	2	1					1		2		1	2		
CO3	2	2	2	1				1		2		1	2		
CO4	2	3	2	2				1		3		1	3		

CO5	3	3	3	2	1			1		3		2	3	1	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

23MCT003	FILM APPRECIATION	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of visual media (films, advertisements, or online videos). • Ability to read and interpret narrative content. • General awareness of cultural, social, and historical contexts.					
Course Objectives: • To introduce students to the core components and processes in filmmaking. • To familiarize students with the evolution of film language and major developments in world cinema. • To enable students to understand and apply major film theories for interpretation. • To provide exposure to global film movements and national cinema traditions. • To help students critically evaluate Indian cinema, regional films, and documentaries.					
Theme - A	The Component of Films				9
A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making... structure of a film					
Theme - B	Evolution of Film Language				9
B-1: Film language, form, movement etc. B-2: Early cinema... silent film (Particularly French) B-3: The emergence of feature films: Birth of a Nation B-4: Talkies					
Theme - C	Film Theories and Criticism/Appreciation				9
C-1: Realist theory; Auteurists C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films? C-4: Film Criticism / Appreciation					
Theme - D	Development of Films				9
D-1: Representative Soviet films D-2: Representative Japanese films D-3: Representative Italian films D-4: Representative Hollywood film and the studio system					
Theme - E	Indian Films				9
E-1: The early era E-2: The important films made by the directors E-3: The regional films E-4: The documentaries in India					
READING: A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.					
Course Outcomes:					Blooms Taxonomy
CO1: Describe the basic components and processes involved in filmmaking.					Understand (K2)
CO2: Explain the evolution of film language and major developments in world cinema.					Understand (K2)

CO3: Analyze major film theories and apply them to interpret films.													Analyze (K4)		
CO4: Compare the characteristics of various national cinemas across different eras.													Analyze (K4)		
CO5: Evaluate Indian films, regional cinema, and documentaries through critical appreciation.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				1	2	1		2		1			
CO2	2	2		1		1	2	1		2		1			
CO3	1	3	1	2		1	2	2	1	2		1			
CO4	1	2	1	2		1	2	2	1	2		1			
CO5	1	3	1	2		2	3	2	1	3		1			
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

23MCT004	DISASTER MANAGEMENT	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of geography and environmental science. • Awareness of common natural and human-induced hazards. • Ability to understand social, economic, and cultural systems.					
Course Objectives: • To introduce the fundamental concepts of hazards, vulnerability, disaster risks, and resilience. • To familiarize students with disaster risk reduction strategies and global frameworks. • To understand disaster management phases, policies, and institutional mechanisms in India. • To learn tools, technology, and early warning systems used in disaster management. • To analyze real-world disaster case studies and develop practical response skills.					
Unit I	HAZRADS, VULNERABILITY AND DISASTER RISKS				9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals					
Unit II	DISASTER RISK REDUCTION (DRR)				9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.					
Unit III	DISASTER MANAGEMENT				9
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)					
Unit IV	TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT				9
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management					
Unit V	DISASTER MANAGEMENT: CASE STUDIES				9
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation					

DISASTER MANAGEMENT

Category: MC

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Prerequisites

- Basic understanding of geography and environmental science.
- Awareness of common natural and human-induced hazards.
- Ability to understand social, economic, and cultural systems.

Course Objectives:

- To introduce the fundamental concepts of hazards, vulnerability, disaster risks, and resilience.
- To familiarize students with disaster risk reduction strategies and global frameworks.
- To understand disaster management phases, policies, and institutional mechanisms in India.
- To learn tools, technology, and early warning systems used in disaster management.
- To analyze real-world disaster case studies and develop practical response skills.

Unit I

HAZRADS, VULNERABILITY AND DISASTER RISKS

9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

Unit II

DISASTER RISK REDUCTION (DRR)

9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

Unit III

DISASTER MANAGEMENT

9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

Unit IV

TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT

9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

Unit V

DISASTER MANAGEMENT: CASE STUDIES

9

Discussion on selected case studies to analyse the potential impacts and actions in the context of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation

and Management and field works related to disaster management.- Field work-Mock drill -															
Total periods:45 PERIODS															
Text Books:															
1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications															
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications															
3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423															
4 Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]															
References:															
1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications															
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications															
3 Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423															
Course Outcomes:													Blooms Taxonomy		
CO1:To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)													Understand (K2)		
CO2:To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction													Analyze (K4)		
CO3: To develop disaster response skills by adopting relevant tools and technology													Apply (K3)		
CO4:Enhance awareness of institutional processes for Disaster response in the country and													Understand (K2)		
CO5:Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1	1	1	2	2		2		2			
CO2	2	2	1	2	1	1	2	2		2		2			
CO3	2	3	2	2	2	1	2	2	1	2		2			
CO4	2	2	1	1	1	1	2	2		2		2			
CO5	1	3	2	2	1	2	3	3	1	3		2			
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

MANDATORY COURSES II

23MCT006	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic awareness of health and hygiene • Willingness to participate in physical and mindfulness activities • Openness to learning traditional wellness practices					
Course Objectives: • To enjoy life happily with fun filled new style activities that help to maintain health also • To adapt a few lifestyle changes that will prevent many health disorders • To be cool and handbill every emotion very smoothly in every walk of life • To learn to eat cost effective but healthy foods that are rich in essential nutrients • To develop immunity naturally that will improve resistance against many health disorders					
Unit I	HEALTH AND ITS IMPORTANCE				2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health. Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken		
Unit II	DIET	4+6
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong. Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water. Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM Common cooking mistakes Different cooking methods, merits and demerits of each method		
Unit III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life. Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Panchekarana Theory / (Five Element Theory) 96 fundamental Principles - UyirThathukkal (TriDosha Theory) - Udal Thathukkal Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.		
Unit IV	MENTAL WELLNESS	3+4
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.		

Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity															
Unit V		YOGA											2+12		
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.															
Total periods:60															
Text Books:															
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA															
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California															
References:															
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England															
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.															
Course Outcomes:													Blooms Taxonomy		
CO1:Learn the importance of different components of health													Understand (K2)		
CO2:Gain confidence to lead a healthy life													Apply (K3)		
CO3:Learn new techniques to prevent lifestyle health disorders													Apply (K3)		
CO4:Understand the importance of diet and workouts in maintaining health.													Analyze (K4)		
CO5:Calculate the various performance parameters of IC engines													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2	3	1							
CO2						2	3	3	2						
CO3			1			3	3	3							
CO4	1			1		2	2								
CO5						3	3	2							
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MCT007	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites • Basic understanding of social sciences at the school level • Interest in science, technology, and historical evolution • Ability to read and interpret historical sources					
Course Objectives: • Introduce the concepts and perspectives involved in understanding the history of science and technology. • Familiarize students with major historiographical works on Indian science and technology. • Explore the development of science and technology in ancient, medieval, and colonial India. • Analyze post-independence science and technology policies and advancements. • Understand the relationship between science, technology, and society in the Indian context.					
Unit I	CONCEPTS AND PERSPECTIVES				
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.					
Unit II	HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA				

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.															
Unit III	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA														
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200															
Unit IV	SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA														
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions															
Unit V	SCIENCE AND TECHNOLOGY IN COLONIAL INDIA														
Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms															
Unit VI	SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA														
Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology															
Total periods:45															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain key concepts, perspectives, and methods used in the history of science and technology													Understand (K2)		
CO2:Summarize major historiographical contributions to the study of science and technology in India													Understand (K2)		
CO3:Describe the evolution of science and technology in ancient, medieval, and colonial India													Understand (K2)		
CO4:Analyze the development of science and technology in post-independent India and its socio-economic implications													Analyze (K4)		
CO5:Evaluate the interaction between science, technology, and society using historical evidence													Evaluate (K5)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				1	1			1					
CO2	1									1					
CO3	2					1	1			1					
CO4	1	1		2		2	2	1		1					
CO5	1	2		2		3	2	2		1					
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MCT008	THOUGHT FOR A HUMANE SOCIETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites None.(Desirable: Universal Human Values 1, Universal Human Values 2)					
Course Objectives: This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.					
Unit I					9
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems					
Unit II					5

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy.															
Unit III		STEAM AND GAS TURBINES												2	
Fascism and totalitarianism. World war I and II. Cold war.															
Unit IV														5	
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.															
Unit V														3	
Welfare state. Relation with human desires. Empowered human beings, satisfaction.															
Unit VI														6	
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature.															
Unit VII														3	
Essential elements of Indian civilization.															
Unit VIII														4	
Technology as driver of society, Role of education in shaping of society. Future directions															
														2	
Conclusion															
Total periods:39															
References:															
1. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain fundamental concepts relating to humane society, human needs, and socio-political harmony													Understand(K2)		
CO2: Compare and contrast major political and economic systems such as capitalism, fascism, communism, welfare state, and Gandhian thought													Analyze(K4)		
CO3: Evaluate the historical impact of political ideologies on human welfare, conflicts, and global developments													Evaluate(K5)		
CO4: Assess the relevance of Indian civilization, decentralization, and community-centered living for present society													Analyze(K4)		
CO5: Formulate informed views on how technology, education, and governance contribute to building a humane and sustainable society													Create(K6)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1				2	2	2		2		2			
CO2	1	2				3	2	2		2		2			
CO3	1	2				3	2	3		2		3			
CO4		1				3	3	2		2		2			
CO5		2				3	3	3	1	3	2	3			
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MCT009	STATE, NATION BUILDING AND POLITICS IN INDIA	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites					
None.(Desirable: Prior exposure to civics, political science, or UHV courses)					

Course Objectives:															
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.															
Unit I															
Understanding the need and role of State and politics.															
Unit II															
Development of Nation-State, sovereignty, sovereignty in a globalized world.															
Unit III															
.Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India.															
Unit IV															
.1857 and the national awakening.															
Unit V															
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India															
Unit VI															
Goals, objective and philosophy. Why a federal system? National integration and nation-building.															
Unit VII															
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?															
Total periods:45															
References:															
1.Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.															
2.Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.															
3.Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the need, role, and functions of the State and politics in society													Understand (K2)		
CO2:Analyze the concept of nation-state, sovereignty, and their evolution in a globalized world													Analyze (K4)		
CO3:Describe the structure and functioning of the major organs of the State and forms of government													Understand (K2)		
CO4:Examine the evolution of the Indian national movement and constitutional development													Analyze (K4)		
CO5:Evaluate India's challenges in nation-building and propose informed perspectives for a better political future													Evaluate/Create (K5/K6)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					3	2	2		2		2			
CO2	1	2				3	2	2		2		3			
CO3	1	1				2	1	2		2		2			
CO4	1	2				3	2	2		2		3			
CO5		2				3	3	3	1	3		3			
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MCT010	INDUSTRIAL SAFETY	Category: MC			
		L	T	P	C
		3	0	0	0
Prerequisites					

None. (Desirable: Basic knowledge of physics, chemistry, and workplace operations.)															
Course Objectives: - To Understand the Introduction and basic Terminologies safety. - To enable the students to learn about the Important Statutory Regulations and standards. - To enable students to Conduct and participate the various Safety activities in the Industry. - To have knowledge about Workplace Exposures and Hazards. - To assess the various Hazards and consequences through various Risk Assessment Techniques.															
Unit I		SAFETY TERMINOLOGIES											9		
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators- Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry- Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS															
Unit II		STANDARDS AND REGULATIONS											9		
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006															
Unit III		SAFETY ACTIVITIES											9		
Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.															
Unit IV		INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION											9		
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release															
Unit V		HAZARD IDENTIFICATION TECHNIQUES											9		
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk AssessmentChecklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessmen															
Total periods:45															
Text Books:															
1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER															
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education															
References:															
1. Frank Lees (2012) ‘Lees’ Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.															
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.															
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.															
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England															
5. Society of Safety Engineers, USA															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concept of safety.													Understand (K2)		
CO2: Obtain knowledge of Statutory Regulations and standards.													Understand (K2)		
CO3: Know about the safety Activities of the Working Place.													Apply (K3)		
CO4: Analyze on the impact of Occupational Exposures and their Remedies													Analyze (K4)		
CO5: Obtain knowledge of Risk Assessment Techniques.													Apply (K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2	2		1		2	2	1	
CO2	2	2	1			3	2	3		1		2	2	1	
CO3	1	2	2	1		3	2	2	1	2		2	3	2	
CO4	2	3	2	2		3	3	3		2	1	3	3	3	

CO5	2	3	3	2		3	3	3		2	1	3	3	3	
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1

23MEE001	AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Engineering Materials • Basic Thermodynamics • Strength of Materials • Basic Machine Design • IC Engine Fundamentals					
Course Objectives: • To study the functional requirements of engine components and suitable materials • To learn to design of cylinder and piston components • To learn to design of connecting rod and crank shaft • To learn to design of flywheel and valve train • To study the Engine Testing cycles, Emission measurement technologies					
Unit I	FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS				6
Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components					
Unit II	DESIGN OF CYLINDER AND PISTON COMPONENTS				6
Design of cylinder, cylinder head, piston, piston rings and piston pin – more details in necessary					
Unit III	DESIGN OF CONNECTING ROD AND CRANK SHAFT				6
Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.					
Unit IV	DESIGN OF FLYWHEEL AND VALVE TRAIN				6
Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.					
Unit V	ENGINE TESTING				6
Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO2 - HC.-Particle counter					
LIST OF EXPERIMENTS					
1	Design and animate Piston Cylinder assembly and motion study using CAD software.				

2	Design and simulate Connecting rod and crank shaft														
3	Design flywheel and valve														
4	Design and simulate Two Cylinder Engine assembly using CAD software.														
5	Conduct the engine performance test using analysis software														
6	Conduct the emission test using analysis software														
Lecture :30					Practical :30					Total periods:60					
Text Books:															
1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001															
2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello 24 December 2019															
References:															
1. Hiroshima Yamagata, “The science and technology of materials in automotive engines”, Woodhead Publishing Limited, Cambridge, England															
2. Jain.R.K, “Machine Design”, Khanna Publishers, New Delhi, 2005.															
3. Manufacturing Automotive Components from Sustainable Natural Fiber Composites (Springer Briefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al. 9 August 2021															
CO1: Discuss the requirements of engine components and select suitable materials.													Blooms Taxonomy		
CO2: Apply the concept of design to cylinder and piston components and solve problems.													Untesrsatand (K2)		
CO3:Apply the concept of design to Connecting rod and crank shaft and solve problems.													Analyse (K4)		
CO4:Apply the concept of design to flywheel and valve train and solve problems.													Understand (K2)		
CO5:Discuss engine teste cycles, dynamometer and emission measurement technologies and instruments													Analyse (K4)		
													Understand (K2)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	T	3	2	1	1	2							3	2	3
CO2	3	3	2	2	2	2							3	2	3
CO3	3	2	2	1	2	3							3	3	2
CO4	3	2	1	3	3	3							3	3	2
CO5	3	2	1	1	3	2							3	2	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation-															

23MEE002	CONVENTIONAL AND FUTURISTIC VEHICLE TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Internal Combustion Engines (SI & CI engines) • Fundamentals of Thermodynamics and Heat Transfer • Basic understanding of Automotive Materials and Components • Introductory concepts of Vehicle Engineering and Powertrains • Fundamentals of Combustion and Emission Control • Basic knowledge of Electrical Circuits and Motors (recommended for hybrid/electric vehicle topics)					
Course Objectives: 1. To study the advanced engine technologies 2. To learn various advanced combustion technologies and its benefits 3. To learn the methods of using low carbon fuels and its significance 4. To learn and understand the hybrid and electric vehicle configurations 5. To study the application of fuel cell technology in automotives					
Unit I	ADVANCED ENGINE TECHNOLOGY				9
Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.					
Unit II	COMBUSTION TECHNOLOGY				9

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.															
Unit III		LOW CARBON FUEL TECHNOLOGY											9		
Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward.															
Unit IV		HYBRID AND ELECTRIC VEHICLE (BATTERY POWERED)											9		
Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward.															
Unit V		FUEL CELL TECHNOLOGY											9		
Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.															
Total periods:45 PERIODS															
Text Books:															
1.1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 200															
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6 , SPRINGER															
References:															
1.Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003															
2.James Larminie, John Lowry, Electric Vehicle Technology Explained,															
3.Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998															
4.Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 200															
5.James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the latest trends in engine technology													Understand (K2)		
CO2: Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment													Understand (K2)		
CO3: Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.													Analyze (K4)		
CO4: Discuss the working and energy flow in various hybrid and electric configurations.													Understand (K2)		
CO5: Analyzing the need for fuel cell technology in automotive applications.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1								3	2	3
CO2	3	3	2	1	1		2					2	3	2	3
CO3	3	3	2	1	2		3						3	2	3
CO4	3	2	3	2	3		3						3	2	3
CO5	3	2	2	1	3		3					1	2	2	3

23MEE003	RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Thermodynamics and Heat Transfer – Understanding energy systems and combustion principles. - Internal Combustion Engines (IC Engines) – Basics of engine operation, fuels, and emissions.					

- Fluid Mechanics – For fuel flow, air intake, and exhaust systems. - Renewable Energy Basics – Basic understanding of solar, hydrogen, and green energy systems. - Basic Chemistry – For understanding fuel composition, reactions, and emissions		
Course Objectives: - To study the low and zero carbon fuels suitability and methods of use in off-road vehicles. - To learn and understand the green energy production methodologies and its use in off-road vehicle categories. - To learn various fuel cell types and its suitability in off-highway vehicles applications - To illustrate the impact of in-cylinder technologies on engine out emissions control. - To study the existing after-treatment technologies used in off-highway vehicle applications.		
Unit I	LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES	9
Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles.		
Unit II	GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES	9
Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles		
Unit III	FUEL CELL POWERED OFF-HIGHWAY VEHICLES	9
Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.		
Unit IV	IN-CYLINDER TREATMENT TECHNOLOGIES	9
Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.		
Unit V	AFTER TREATMENT TECHNOLOGIES	9
Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO ₂ absorption techniques, Waste Heat Recovery and Organic Rankine Cycle.		
Total periods:45 PERIODS		
Text Books:		
1. John Twidell, and Tony Weir. Renewable Energy Sources – 3 rd Edition 2015,		
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines		
References:		
1.. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineerin		
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control		
3. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill 1 June 2011		
4.. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. 7 April 202		
5. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite 21 December 2017		
Course Outcomes:		Blooms Taxonomy
CO1: Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment		Analyse (K4)
CO2: Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications		Understand (K2)
CO3: Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications		Analyse (K4)
CO4: Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions		Understand (K2)
CO5: Develop the working of various existing after treatment systems in controlling the engine out emissions.		Analyse (K4)
CO-PO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2	1							3	2	2
CO2	3	2	1	1	1	3							3	2	3
CO3	3	1	3	1	2	1							3	2	3
CO4	3	3	2	1	2	1							3	2	2
CO5	3	3	2	1	2	1							3	2	3

23MEE004	VEHICLE HEALTH MONITORING, MAINTENANCE AND SAFETY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Internal Combustion Engines (IC Engines) – Understanding engine components, operation, and powertrain basics. - Basic Automotive Systems – Knowledge of brakes, clutch, steering, suspension, and tyres. - Electrical and Electronics in Vehicles – Basics of batteries, starting and charging systems, sensors, and vehicle electronics. - Vehicle Dynamics and Safety Fundamentals – Understanding motion, braking, and safety concepts. - Computer Applications in Automotive Diagnostics – Basic knowledge of OBD systems, scan tools, and computerized engine analyzers.					
COURSE OBJECTIVES - To enable the student to understand the principles, functions and practices adapted in maintenance activities of vehicles. - To study the powertrain maintenance, fault diagnosis, maintenance of Batteries - To develop vehicle system maintenance and service of clutch, brake. - To study the concepts of vehicle safety and regulations. - To study and understand the simulation of safety concepts					
Unit I	INTRODUCTION				9
Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools;					
Unit II	POWERTRAIN MAINTENANCE				9
Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.					
Unit III	VEHICLE SYSTEM MAINTENANCE				9

[illegible]

23MEE005	CAE AND CFD APPROACH IN FUTURE MOBILITY	Category: PEC			
		L	T	P	C
		2	0	2	3

Prerequisites

- Engineering Mechanics and Strength of Materials – For understanding structural analysis and stress-strain concepts.
- Fluid Mechanics and Heat Transfer – Basics of fluid flow and thermal systems for CFD applications.
- Basic Computer Applications – Familiarity with software tools, CAD, and simulation platforms.
- Mathematics for Engineers – Differential equations, linear algebra, and numerical methods.
- Fundamentals of Thermodynamics – For understanding energy, flow, and heat transfer simulation

Course Objectives:		
• To study the use of computer in mobility software or mobility. • To study the concepts computer aided design and rapid prototyping • To introduce the basic concepts of the finite elements methods. • To introduce basics and fundamental of the computational fluid dynamics • To introduce Turbulence Modelling and various simulation techniques.		
Unit I	INTRODUCTION TO CAE /CFD	6
Introduction to use of computer in Mobility Product Life Cycle, Software for mobility. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modelling and simulation. CFD as a design and research applications of CFD in mobility engineering		
Unit II	CAD AND RAPID PROTOTYPING	6
Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG). Mechanism design and assembly. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modelling for RP, Surface modelling, STL file generation, Defects in STL files and repairing algorithms, Interface formats		
Unit III	INTRODUCTION TO FEA	6
Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems and case studies in stress analysis of mechanical components using 2D and 3D elements		
Unit IV	INTRODUCTION TO CFD	6
CFD vs. experimentation; continuity, navier-stokes and energy equations; modelling and discretization techniques; basic steps in CFD computation Various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method. Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks		
Unit V	PROBLEM SOLVING USING CFD	6
Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows;, Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Simulation of Ahmed and Windsor bodies; Vorticity based grid-free simulation technique; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation		
LIST OF EXPERIMENTS		
1	Coupled analysis of structural / thermal	
2	buckling analysis	
3	CFD simulation of flow analysis over a Cylinder Surface 3D	
4	CFD simulation of Intermixing of Fluids in a Bent-Pipe 3D	
5	CFD simulation of flow and heat transfer analysis of Double Pipe Counter Flow Heat Exchanger	
6	Design & processing of Engine components by RPT	
Lecture : 30 Practical : 30 Total periods:60		
Text Books:		
1. Computational Fluid Dynamics: A Practical Approach by Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu		
2. Applied Computational Fluid Dynamics by S. C. Gupta		
References:		
1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007		
2. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008 3. Tirupathi R.Chandrupatla and Ashok D.Belegundu, “Introduction to Finite Elements in Engineering”,		
3.International Edition, Pearson Education Limited, 2014.		
4. Dhanaraj. R and Prabhakaran Nair. K, “Finite Element Analysis”, Oxford Publications, 2015.		

5. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014															
Course Outcomes:												Blooms Taxonomy			
CO1: Discuss the basic concept of the CAE /CFD												Understand (K2)			
CO2: Develop the computer aided design and rapid prototyping.												Apply (K3)			
CO3: Discuss the basic concept of Finite Element methods.												Apply (K3)			
CO4: Discuss the concepts of computational fluid dynamics												Understand (K2)			
CO5: Solving the problem and simulation using computational fluid dynamics.												Apply (K3)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1							2	2	2
CO2	3	3	2	2	2	1							2	2	3
CO3	3	3	3	2	2	2							3	3	2
CO4	3	3	2	2	2	2							2	3	2
CO5	3	3	2	3	3	2							2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE006	HYBRID AND ELECTRIC VEHICLE TECHNOLOGY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Physics: Mechanics, motion, forces, energy, pressure, and basic thermodynamics. • Mathematics: Calculus, differential equations, linear algebra, and numerical methods. • Basic Engineering Concepts: Material properties, stress-strain, energy flow, and fluid behaviour. • Computer Skills: Basic computing, software tools, CAD, and simulation familiarity. • Analytical & Logical Thinking: Problem-solving, modelling, and interpreting equations and simulations					
Course Objectives: • To introduce the concept of hybrid and electric drive trains. • To elaborate on the types and utilisation of hybrid and electric drive trains. • To expose on different types of AC and DC drives for electric vehicles. • To learn and utilise different types of energy storage systems • To introduce concept of energy management strategies and drive sizing					
Unit I	INTRODUCTION				9
Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies					
Unit II	HYBRID ELECTRIC DRIVE TRAINS				9
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis					
Unit III	CONTROL OF AC & DC DRIVES				9
Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency					

Unit IV	ENERGY STORAGE												9		
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices															
Unit V	DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES												9		
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues															
Total periods:45															
Text Books:															
1. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, 2021															
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003															
References:															
1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel															
2.Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.															
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998															
4. Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec 6 June 2012															
5. Energy Management in Hybrid Electric Vehicles using Co-Simulation by Christian Paar 11 February															
Course Outcomes:													Blooms Taxonomy		
CO1:Discuss Characterise and configure hybrid drivetrains requirement for a vehicle													Remembering (K1)		
CO2;Design and apply appropriate hybrid and electric drive trains in a vehicle 3. Design and install suitable AC and DC drives for electric vehicles.													Understand (K2)		
CO3:Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle													Remembering (K1)		
CO4:Apply energy management strategies to ensure better economy and efficiency													Understand (K2)		
CO5:Discuss Characterise and configure hybrid drivetrains requirement for a vehicle													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	1	1	1	1	1	3	2	2
CO2	3	2	1	3	3	2	1	2	1	1	1	1	3	2	3
CO3	3	2	1	2	3	2	1	2	1	1	1	1	3	2	2
CO4	3	2	2	3	3	3	1	1	1	1	1	1	3	3	2
CO5	3	2	2	2	3	2	1	1	1	1	1	1	3	3	3

23MEE007	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Thermodynamics – Understanding of energy, work, heat transfer, and thermodynamic cycles. • Heat Transfer – Basics of conduction, convection, radiation, and phase change phenomena. • Electrical Machines & Circuits – Basic knowledge of batteries, electrical circuits, and power electronics. • Fluid Mechanics – Understanding fluid flow and heat exchangers for cooling system design. • Materials Science – Knowledge of battery materials, thermal properties, and phase change materials (optional but helpful).					
009					
Course Objectives: • To study the working principle of Li-ion Batteries and Battery Packs. • To learn the thermal management system in Battery modules. • To develop the different case studies in Battery Thermal Management System. • To learn the working principle of Fuel Cells cooling methods. • To learn the inside components of Thermal Management Systems in various famous Electric and • Fuel Cell Electric Vehicles.					

Unit I	ADVANCED BATTERIES												9		
Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Supercapacitors Vs batteries. Diamond battery concepts.															
Unit II	THERMAL MANAGEMENT IN BATTERIES												9		
Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management															
Unit III	BATTERY THERMAL MANAGEMENT CASE STUDIES												9		
EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modelling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multiphysics- simulation concepts.															
Unit IV	THERMAL MANAGEMENT IN FUEL CELLS												9		
Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.															
Unit V	FUEL CELL THERMAL MANAGEMENT CASE STUDIES												9		
Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Internal circulation system, Hydrogen refuelling- Case studies.															
Total periods:45															
Text Books:															
1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems””, Wiley, 2017.															
2. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles””, Wiley, 2015.															
References:															
1. Nag.P.K, “Engineering Thermodynamics”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.															
2. “Vehicle thermal Management Systems Conference Proceedings”, 1st Edition; 2013, Coventry Techno centre, UK															
3. Younes Shabany,” Heat Transfer: Thermal Management of Electronics Hardcover” 2010, CRC Press.															
4. T. Yomi Obidi, “Thermal Management in Automotive applications”, 2015, SAE International.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the different Li-ion Batteries and Fuel Cell performances.													Understand (K2)		
CO2: Design a Battery Pack with appropriate PCM.													Analyse (K4)		
CO3: Apply Cooling Models using Simulation													Understand (K2)		
CO4: fuel Estimate economy.													Understand (K2)		
CO5: Utilize different Thermal Management System approaches during real world usage.													Analyse (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1							3	3	3
CO2	3	2	1	3	2	1							3	2	3
CO3	3	2	1	3	2	1							3	3	2
CO4	3	2	2	3	2	1							3	2	3
CO5	3	3	2	3	2	1							3	3	2

VERTICAL 2

23MEE008	VALUE ENGINEERING										Category: PEC			
											L	T	P	C

		3	0	0	3
Prerequisites					
- Engineering Economics / Costing – Understanding cost structures, worth, and basic financial principles. - Project Management Fundamentals – Knowledge of project planning, execution, and control. - Basic Manufacturing & Product Design – Familiarity with product life cycle and production processes. - Decision Making & Analytical Skills – Ability to apply problem-solving techniques, cost-benefit analysis, and critical thinking. - Basic Statistics / Operations Research (optional but helpful) – For techniques like ABC analysis and probabilistic approaches.					
Course Objectives:					
- To study the value engineering process and able to identify its functions within the process. - To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes. - To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle - To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing. - To demonstrate to implement value engineering solutions and propose to perfect them.					
Unit I	VALUE ENGINEERING BASICS				9
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions – concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.					
Unit II	VALUE ENGINEERING JOB PLAN AND PROCESS				9
Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioural and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering					
Unit III	VALUE ENGINEERING TECHNIQUES				9
Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)					
Unit IV	WORKSHEETS AND GUIDELINES				9
Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.					
Unit V	VERSATILITY OF VALUE ENGINEERING				9
Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for 45value engineering specialties					
Total periods:45					
Text Books:					
1. Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009 3Ed”, 2009.					
2. Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”,					
References:					
1. Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.					
2. Richard Park., “Value Engineering A Plan for Invention”, CRC Press, 1998.					
3. Arthur E. Mudge., “Value Engineering :A systematic approach", McGraw Hill, 1989.					
4. Alphonse Dell'Isola., “Value Engineering: Practical Applications...for Design, Construction,					
5.Maintenance and Operations”, R.S. Means Company, 1997.					
Course Outcomes:					Blooms Taxonomy
CO1: Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.					Understand (K2)

[illegible]

Unit III	VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION	9
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) -Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery Materials –Benefits - Applications		
Unit IV	POWDER BED FUSION AND MATERIAL EXTRUSION	9
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.		
Unit V	OTHER ADDITIVE MANUFACTURING PROCESSES	9
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation		
LIST OF EXPERIMENTS		
1	Modelling and converting CAD models into STL file.	
2	Manipulation and error fixing of STL file.	
3	Design and fabrication of parts by varying part orientation and support structures.	
4	Fabrication of parts with material extrusion AM process.	
5	Fabrication of parts with vat polymerization AM process.	
6	Design and fabrication of topology optimized parts.	
7	Extrusion based AM machine	
8	Resin based AM machine	
9	Mechanical design software	
10	Open-source AM software for STL editing, manipulation and slicing	
Lecture : 30 Practical : 30 Total periods:60		
Text Books:		
1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0		
2. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1		
References:		
1. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.		
2. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.		
3.Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590		
Course Outcomes:		Blooms Taxonomy
CO1: Recognize the development of AM technology and how AM technology propagated into businesses and developing opportunities		Understand (K2)
CO2: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.		Analyse (K4)
CO3: Acquire knowledge on process of transforming a concept into the final product in AM technology.		Understand (K2)
CO4: Elaborate the vat polymerization and direct energy deposition processes and its applications.		Understand (K2)
CO5: Acquire knowledge on process and applications of powder bed fusion and material extrusion.		Analyse (K4)
CO-PO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	1							3	2	2
CO2	3	2	3	1	2	1							3	3	3
CO3	3	2	3	2	2	1							3	2	2
CO4	3	3	3	2	1	2							3	3	3
CO5	3	3	1	2	1	2							3	2	2

23MEE010	CAD/CAM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Graphics / Technical Drawing – Knowledge of orthographic projections, sections, and dimensioning. • Engineering Mechanics / Design Fundamentals – Understanding of basic design principles, tolerances, and fits. • Basic Computer Skills – Familiarity with computers and basic software operations. • Mathematics – Understanding of geometry, vectors, and transformations for 2D/3D modeling. • Manufacturing Processes (optional but helpful) – Basic understanding of machining, tools, and processes for CAM applications					
Course Objectives: • To Introduce and understand the Basic of Design. • To study the two dimensional drafting and bill of material creation. • To learn three dimensional modelling and its advantages. • To study the basic and purpose of assembling modeling. • To study the basics of computer aided machining and part programming.					
Unit I	BASICS OF DESIGNS				9
Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading					
Unit II	2D DRAFTING				9
Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting					
Unit III	3D MODELING				9
Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.					
Unit IV	ASSEMBLY MODELING				9

23MEE011	DESIGN FOR X	Category: PEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Engineering Design Fundamentals – understanding of design process and product development.
- Manufacturing Processes – basics of casting, forming, machining, and welding operations.
- Material Science – knowledge of material behavior and selection for manufacturability.
- Engineering Drawing – familiarity with geometric tolerancing, dimensioning, and assembly drawings.
- Computer-Aided Design (CAD) – basic modeling and design visualization skills.

Course Objectives:

- To introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn the design consideration principles of forming in the design of extruded, stamped, and forged products
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles in additive manufacturing

Unit I	INTRODUCTION												9		
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.															
Unit II	FACTORS INFLUENCING FORM DESIGN												9		
Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.															
Unit III	COMPONENT DESIGN - MACHINING CONSIDERATION 9												9		
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility – Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.															
Unit IV	COMPONENT DESIGN – CASTING CONSIDERATION												9		
Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA.															
Unit V	DESIGN FOR ADDITIVE MANUFACTURING												9		
Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.															
Total periods:45 PERIODS															
Text Books:															
1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.															
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.															
References:															
1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.															
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.															
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design:Understanding the Principles of How Things Are Made, Elsevier, 2014.															
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason															
5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994															
Course Outcomes:													Blooms Taxonomy		
CO1; Elaborate the design principles for manufacturability													Understand (K2)		
CO2: discuss the factors influencing in form design													Understand (K2)		
CO3: Apply the component design features of various machine.													Apply (K3)		
CO4: Discuss the design consideration principles of welding in the design of welded products.													Analyze(K4)		
CO5: Discuss the design consideration principles of additive manufacturing.													Evaluate (K5)		
CO-PO Mapping:															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2							1			3		
CO2	3	3	2							1			3	2	
CO3	2	3	3	2	2								3	3	
CO4	2	3	3	2	2								3	2	

CO5	2	3	3	2	3		2					3	3	
1 - Low, 2 -Medium, 3 - High , ‘-‘ No correlation														

23MEE012	ERGONOMICS IN DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Design Fundamentals – understanding of product and system design. • Human Anatomy and Physiology (Basic) – for studying human–machine interaction. • Manufacturing Processes – knowledge of production systems and workstation design. • Engineering Drawing – interpretation of design layouts and equipment positioning. • Basic Computer Skills – for using ergonomic and plant layout simulation software					
Course Objectives: • To introduce to industrial design based on ergonomics. • To consider ergonomics concept in manufacturing • To apply ergonomics in design of controls and display. • To apply environmental factors in ergonomics design. • To develop aesthetics applicable to manufacturing and product					
Unit I	INTRODUCTION				9
An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat,Sound.					
Unit II	ERGONOMICS AND PRODUCTION				9
Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt’s perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.					
Unit III	DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS				9
Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools					
Unit IV	ENVIRONMENTAL FACTORS				9
Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style					
Unit V	AESTHETIC CONCEPTS				9
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software’s, total layout design.					
Total periods:45 PERIODS					
Text Books:					
1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares , Francisco Rebelo					
2. Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.					
References:					
1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002					
2. Brain Shakel,“Applied Ergonomics Hand Book”, Butterworth Scientific London 1988.					
3. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.					
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006					

5. Mayall W.H. "Industrial design for Engineers", London Hiffie books Ltd., 1988.															
Course Outcomes:														Blooms Taxonomy	
CO1: Appreciate ergonomics need in the industrial design.														Understand (K2)	
CO2: Apply ergonomics in creation of manufacturing system														Apply (K3)	
CO3: Discuss on design of controls and display.														Analyze (K4)	
CO4: Consider environmental factors in ergonomics design.														Evaluate (K5)	
CO5: Report on importance of aesthetics to manufacturing system and product														Create (K6)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				2	3			2			3		
CO2	3	3	3	2	2		2						3	3	
CO3	2	3	3	2	2								3	3	
CO4	2	2	2	2	2	3	3						3	2	
CO5	2	2	3	2	2	2	3	3	2	3			3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE013	NEW PRODUCT DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Design and Drawing – knowledge of design documentation and revisions. • Manufacturing Processes – casting, machining, forming, and welding. • Material Science – mechanical and physical properties, testing, and selection. • Computer-Aided Design (CAD) – modelling, tool design, and basic CAM programming. • Project Management Basics – concepts like Gantt chart, critical path, and feasibility study. Blooms Taxonomy					
Course Objectives: • To introduce the fundamental concepts of the new product development • To develop material specifications, analysis and process. • To Learn the Feasibility Studies & reporting of new product development. • To study the New product qualification and Market Survey on similar products of new product development • To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model					
Unit I	FUNDAMENTALS OF NPD				9
Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.					
Unit II	MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS				9
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.					
Unit III	ESSENTIALS OF NPD				9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programming. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.															
Unit IV		CRITERIONS OF NPD												9	
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.															
Unit V		REPORTING & FORWARD-THINKING OF NPD												9	
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)															
Total periods:45 PERIODS															
Text Books:															
1. Product Development – Sten Jonsson															
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger															
References:															
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark															
2. Change by Design															
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker															
4. Winning at New Products – Robert Brands 3rd Edition															
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar															
Course Outcomes:													Blooms Taxonomy		
CO1:Discuss fundamental concepts and customer specific requirements of the New Product development													Understand (K2)		
CO2:Discuss the Material specification standards, analysis and fabrication, manufacturing process.													Understand (K2)		
CO3:Develop Feasibility Studies & reporting of New Product development													Apply (K3)		
CO4:Analyzing the New product qualification and Market Survey on similar products of new product development													Analyze (K4)		
CO5:Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2							2			3	2	
CO2	3	3	2	2	2								3	3	
CO3	2	3	3	2	3								3	3	
CO4	2	2	3	3	3		2						3	3	
CO5	2	3	3	3	3		2						3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE014	PRODUCT LIFE CYCLE MANAGEMENT	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Engineering Design and Product Development - Manufacturing Processes and Systems					

- | |
|--|
| <ul style="list-style-type: none"> • Computer-Aided Design (CAD) and Data Management Concepts • Basics of Project Management and Industrial Applications • Knowledge of Enterprise Resource Planning (ERP) and Database Systems |
|--|

Course Objectives:0

- To study about the history, concepts and terminology in PLM
- To learn the functions and features of PLM/PDM
- To develop different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To use PLM/PDM with legacy data bases, Coax & ERP systems

Unit I	HISTORY, CONCEPTS AND TERMINOLOGY OF PLM	9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

Unit II	PLM/PDM FUNCTIONS AND FEATURES	9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

Unit III	DETAILS OF MODULES IN A PDM/PLM SOFTWARE	9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

Unit IV	ROLE OF PLM IN INDUSTRIES	9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation

Unit V	BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE	9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

Total periods:45 PERIODS

Text Books:

- | |
|---|
| 1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10 : 3662516330 |
| 2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10: 0899303196 |

References:

- | |
|--|
| 1. Antti Saaksvuori and Anse lmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition) |
| 2. Ivica Crnkovic, Ulf Ask Lund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003. |
| 3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007 |
| 4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, |
| 5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006. |

Course Outcomes:	Blooms Taxonomy

CO 1: Summarize the history, concepts and terminology of PLM	Understand (K2)

CO2: Develop the functions and features of PLM/PDM	Apply (K3)

CO3:Discuss different modules offered in commercial PLM/PDM tools.	Analyze (K4)

CO4: Interpret the implement PLM/PDM approaches for industrial applications	Evaluate (K5)

CO5: Integrate PLM/PDM with legacy data bases, CAx& ERP systems	Create (K6)

CO-PO Mapping	

[illegible]

CO3	2	3	3	2	3								3	3	
CO4	2	2	3	3	3		2						3	3	
CO5	2	3	3	3	3		2						3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL 3

23MEE015	SENSORS AND INSTRUMENTATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Electrical and Electronics Engineering - Basic Physics related to motion, temperature, pressure and light - Basics of Control Systems and Signal Processing - Computer-based Data Acquisition and Measurement Techniques - Engineering Mathematics involving data analysis and instrumentation					
Course Objectives: - To understand the concepts of measurement technology. - To learn the various sensors used to measure various physical parameters. - To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development - To learn about the optical, pressure and temperature sensor - To understand the signal conditioning and DAQ systems					
Unit I	INTRODUCTION				9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.					
Unit II	MOTION, PROXIMITY AND RANGING SENSORS				9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).					
Unit III	FORCE, MAGNETIC AND HEADING SENSORS				9
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.					
Unit IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS				9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.															
Unit V		SIGNAL CONDITIONING AND DAQ SYSTEMS												9	
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel Data acquisition – Data logging – applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.															
Total periods:45 PERIODS															
Text Books:															
1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009. 2															
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.															
References:															
1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons Canada, 2001.															
2. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001															
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.															
4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.															
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2 edition, CRC Press, 2015.															
Course Outcomes:													Blooms Taxonomy		
CO1: Recognize with various calibration techniques and signal types for sensors.													Understand (K2)		
CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.													Understand (K2)		
CO3: Apply the various sensors and transducers in various applications.													Apply (K3)		
CO4: Select the appropriate sensor for different applications													Analyze (K4)		
CO5: Acquire the signals from different sensors using Data acquisition systems.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2							2			3	2	
CO2	3	3	2	2	2								3	3	
CO3	2	3	3	2	3								3	3	
CO4	2	2	3	3	3		2						3	3	
CO5	2	3	3	3	3		2						3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE016	ELECTRICAL DRIVES AND ACTUATORS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Electrical Circuits and Measurements • Fundamentals of Power Electronics • DC and AC Machines • Basics of Control Systems • Concepts of Semiconductor Devices					
Course Objectives: • To familiarize a relay and power semiconductor devices • To get a knowledge on drive characteristics • To obtain the knowledgeon DC motors and drives. • To obtain the knowledgeon AC motors and drives. • To obtain the knowledge on Stepper and Servo motor.					
Unit I	RELAY AND POWER SEMI-CONDUCTOR DEVICES				9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits.															
Unit II	DRIVE CHARACTERISTICS												9		
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.															
Unit III	DC MOTORS AND DRIVES												9		
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications.															
Unit IV	AC MOTORS AND DRIVES												9		
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.															
Unit V	STEPPER AND SERVO MOTOR												9		
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer. - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.															
Total periods:45 PERIODS															
Text Books:															
1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.															
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.															
References:															
1. Gopal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House,New Delhi, 2001.															
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand&Co. Ltd., New Delhi, 2012.															
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007															
Course Outcomes:													Blooms Taxonomy		
CO 1: Recognize the principles and working of relays, drives and motors.													Understand (K2)		
CO2:Explain the working and characteristics of various drives and motors..													Understand (K2)		
CO3:Apply the solid state switching circuits to operate various types of Motors and Drivers.													Apply (K3)		
CO4:Interpret the performance of Motors and Drives													Analyze (K4)		
CO5:Suggest the Motors and Drivers for given applications.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2							2			3	2	
CO2	3	3	2	2	2								3	3	
CO3	2	3	3	2	3								3	3	
CO4	2	2	3	3	3		2						3	3	
CO5	2	3	3	3	3		2						3	3	

`23MEE017	EMBEDDED SYSTEMS AND PROGRAMMING	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Digital Electronics and Logic Circuits • Basic Electrical and Electronic Components • Fundamentals of Programming (C Language) • Microprocessor and Computer Organization Concepts • Control Systems and Sensors					

Course Objectives:0		
• To familiarize the architecture and fundamental units of microcontroller. • To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols. • To design the interface circuit and programming of I/O devices, sensors and actuators. • To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems. • To acquaint the knowledge of real time embedded operating system for advanced system developments.		
Unit I	INTRODUCTION TO MICROCONTROLLER	9
Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.		
Unit II	PROGRAMMING AND COMMUNICATION	9
Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I 2C, SPI and CAN of 8051 Microcontroller - Bluetooth and WI-FI interfacing of 8051 Microcontroller.		
Unit III	PERIPHERAL INTERFACING	9
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light		
Unit IV	ARM PROCESSOR	9
Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set –Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.		
Unit V	SINGLE BOARD COMPUTERS AND PROGRAMMING	9
System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages – Python for Embedded Systems- GPIO Programming – Interfacing		
LIST OF EXPERIMENTS		
1	Assembly Language Programming and Simulation of 8051.	
2	Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.	
3	Input switches and keyboard interfacing of 8051.	
4	Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051. .	
5	Timer, Counter and Interrupt Program Application for 8051.	
6	Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.	
7	UART Serial and Parallel Port Programming of 8051.	
8	I2C, SPI and CAN Programming of 8051.	
9	Interfacing and Programming of Bluetooth and Wi-Fi with 8051	
10	Programming of ARM Processor for Sensor Interface.	
11	Stepper Motor and Servo Motor Control Using ARM Processor.	
12	Serial Communication of ARM Processor with Computation Platform.	
13	Wireless Communication of ARM Processor with Computation Platform.	
14	GPIO Programming of Real Time Embedded Operating Systems.	
15	IOT application using SBC.	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.Frank Vahid and Tony Givagis, “Embedded System Design”, 2011, Wiley.		
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.		
References:		
1. Muhammad Ali Mazidi and Janice GillispieMazdi, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, 2006.		

2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition, 2015															
3. James W. Stewart, “The 8051 Microcontroller Hardware, Software and Interfacing”, Regents Prentice Hall, 2003.															
4. John B. Peatman, “Design with Microcontrollers”, McGraw Hill International, USA, 2005.															
Course Outcomes:													Blooms Taxonomy		
CO1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.													Remember (K1)		
CO2: Recognize the role of each functional units in microcontroller, processors and system-on-chip based on the features and specifications.													Understand (K2)		
CO3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing													Apply (K3)		
CO4: Design the circuit and write the programming microcontroller, processors and system on chip													Analyze (K4)		
CO5: Develop the applications using Embedded system.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2								3	2	
CO2	3	3	2		2								3	3	
CO3	2	3	3	3	3								3	3	
CO4	2	3	3	3	3								3	3	
CO5	2	3	3	3	3								3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE018	ROBOTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Mechanics and Kinematic • Fundamentals of Control Systems • Understanding of Sensors and Actuators • Basic Programming Skills (C / MATLAB) • Knowledge of Engineering Graphics and 3D Modelling					
Course Objectives: • To learn about basics of robots and their classifications • To understand the robot kinematics in various planar mechanisms • To learn about the concepts in robot dynamics • To understand the concepts in trajectory planning and programming • To know about the various applications of robots.					
Unit I	BASICS OF ROBOTICS				9
Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.					
Unit II	ROBOT KINMEATICS				9
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms					
Unit III	ROBOT DYNAMICS				9
Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation					
Unit IV	TRAJECTORY, PATH PLANNING AND PROGRAMMING				9
Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS					
Unit V	ROBOT AND ROBOT APPLICATIONS				9

Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.															
Total periods:45 PERIODS															
Text Books:															
1. John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.															
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.															
References:															
1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2 Edition,2012.															
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer,2ndEdition, 2010															
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800															
4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.															
Course Outcomes:													Blooms Taxonomy		
CO1: State the basic concepts and terminologies of robots													Remember (K1)		
CO2: Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots													Understand (K2)		
CO3: Derive the Forward and Inverse Kinematics, Dynamics for Various Robots													Apply (K3)		
CO4: Apply the various programming techniques in industrial applications													Analyze (K4)		
CO5:Analyze the use of various types of robots in different applications													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1								3	2	
CO2	3	3	2		2								3	3	
CO3	3	3	3	2	3								3	3	
CO4	2	3	3	3	3								3	3	
CO5	2	3	3	3	3								3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE019	SMART MOBILITY AND INTELLIGENT VEHICLES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Automobile Engineering • Fundamentals of Electronics and Sensors • Understanding of Communication and Networking Systems • Basic Control Systems and Programming Skills • Familiarity with Vehicle Dynamics and Mechatronics					
Course Objectives: • To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles. • To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system. • To learn Basic Control System Theory applied to Autonomous Automobiles. • To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task • To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.					
Unit I	INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES				9

• Basic exposure to virtual or augmented reality applications																
Course Objectives: - To learn various immersive technologies of VR, AR and MR. - To learn software related to immersive technologies. - To learn the concepts of developing AR applications. - To learn the concepts of developing VR and unreal engine. - To study the haptic perception and extended reality.																
Unit I		INTRODUCTION TO IMMERSIVE TECHNOLOGIES												9		
Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices Applications																
Unit II		SOFTWARE TOOLS												9		
Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4																
Unit III		BUILDING AR APPLICATION WITH UNITY												9		
AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application																
Unit IV		BUILDING VR APPLICATION WITH UNREAL ENGINE												9		
VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application																
Unit V		HAPTIC PERCEPTION AND EXTENDED REALITY												9		
Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration																
Total periods:45 PERIODS																
Text Books:																
1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137																
2. XR Haptics, Implementation & Design Guidelines, by Eric Vezzoli , Chris Ullrich , Gijs den Butter , Rafal Pijewski, March 13, 2022																
References:																
1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)																
2. Augmented Reality - Theory, Design and Development, by Chetankumar G Shetty.																
3. Strategic Communication and AI, by Simon Moore , Roland Hübscher, Routledge; 1st edition (10 September 2021), ISBN-10 : 0367627795																
4. Immersive Analytics, by Kim Marriott , Falk Schreiber, Springer; 1st ed. 2018 edition (15 October 2018).																
5. Immersive Analytics A Clear and Concise Reference, by Gerardus Blokdyk, 5STARCooks (5 September 2018).																
Course Outcomes:														Blooms Taxonomy		
CO1: Apply detailed knowledge about immersive technology														Apply (K3)		
CO2: Gaining the knowledge of different types of Tools and Devices														Understand (K2)		
CO3: Acquiring the knowledge about Unity and Unreal Engine														Apply (K3)		
CO4: Explain the developing application in immersive technologies														Analyze (K4)		
CO5: Discuss about haptics in immersive technologies														Evaluate (K5)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	3	2	3								3	3		
CO2	3	3	2	2	3								3	3		
CO3	3	3	3	3	3								3	3		
CO4	2	3	3	3	3								3	3		
CO5	2	3	3	3	3								3	3		
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23MEE021	DRONE TECHNOLOGIES										Category: PEC			
											L	T	P	C

													3	0	0	3
Prerequisites																
• Basic knowledge of Engineering Mechanics and Aerodynamics • Fundamentals of Electrical and Electronic Circuits • Basic understanding of Microcontrollers and Programming (Arduino/Embedded C)																
Course Objectives:																
• To understand the basics of drone concepts • To learn and understand the fundaments of design, fabrication and programming of drone • To impart the knowledge of an flying and operation of drone • To know about the various applications of drone • To understand the safety risks and guidelines of fly safely																
Unit I	INTRODUCTION TO DRONE TECHNOLOGY												9			
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability																
Unit II	DRONE DESIGN, FABRICATION AND PROGRAMMING												9			
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.																
Unit III	DRONE FLYING AND OPERATION												9			
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment-Drone controls Flight operations –management tool –Sensors-Onboard storage capacity Removable storage devices- Linked mobile devices and applications																
Unit IV	DRONE COMMERCIAL APPLICATIONS												9			
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing																
Unit V	FUTURE DRONES AND SAFETY												9			
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license-Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms																
Total periods:45 PERIODS																
Text Books:																
1.Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.																
2.Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc,2016																
References:																
1.John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016																
2.Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.																
Course Outcomes:													Blooms Taxonomy			
CO1: Know about a various type of drone technology, drone fabrication and programming.													Remembering, Understanding (K1/K2)			
CO2: Execute the suitable operating procedures for functioning a drone													Applying (K3)			
CO3: Select appropriate sensors and actuators for Drones													Analysing (K4)			
CO4: Develop a drone mechanism for specific applications													Creating (K6)			
CO5: Create the programs for various drones													Creating (K6)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1		2							1	3	2		
CO2	2	2	3	2	2			1	1		1	2	3	2	1	
CO3	2	3	3	2	3		1					2	3	3	2	

CO4	1	2	3	3	3		1			2	2	3	3	3	3
CO5	1	2	3	3	3		1			2	3	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL 4

23MEE022	DIGITAL MANUFACTURING AND IOT	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Basic knowledge of Manufacturing Processes • Fundamentals of Computer-Aided Design (CAD) and Automation Systems • Basic understanding of Electronics, Sensors, and Microcontrollers (Arduino/Raspberry Pi) • Awareness of Internet and Networking Concepts					
Course Objectives: • To study the various aspects of digital manufacturing. • To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management. • To formulate of smart manufacturing systems in the digital work environment. • To interpret IoT to support the digital manufacturing. • To elaborate the significance of digital twin.					
Unit I	INTRODUCTION				9
Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.					
Unit II	DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT				9
Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM					
Unit III	SMART FACTORY				9
Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity					
Unit IV	INDUSTRY 4.0				9
Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems – Machine to Machine communication – Case Studies.					

- Understanding of Quality Control and Management - Familiarity with Industrial Engineering and Production Systems		
Course Objectives: - To introduce the basics of 6 SIGMA - To learning about the lean manufacturing tools. - To study about the deeper understanding methodologies of Lean manufacturing. - To study the lean concepts and its elements. - To learn implementation and challenges of lean manufacturing.		
Unit I	BASICS OF 6 SIGMA	9
Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.		
Unit II	INTRODUCTION TO LEAN MANUFACTURING TOOLS	9
Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.		
Unit III	DEEPER UNDERSTADING METHODOLOGIES	9
What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.		
Unit IV	LEAN ELEMENTS	9
Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects		
Unit V	IMPLEMENTATION AND CHALLENGES	9
Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.		
Total periods:45 PERIODS		
Text Books:		
1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill		
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia		
3. The Toyota Way: 14 Management Principles		
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai		
References:		
1.Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/		
2.International Society of Six Sigma Professionals: https://issp.org/about-us/		
3.NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).		
4.Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.		
5.Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones		
Course Outcomes:		Blooms Taxonomy
CO1: Discuss the basics of 6 SIGMA		Remembering, Understanding (K1/K2)
CO2: Elaborate the lean manufacturing tools.		Understanding, Applying (K2/K3)
CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing.		Applying, Analyzing(K3/K4)
CO4: Discuss lean concepts and its elements.		Understanding, Analyzing(K2/K3)

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control																
Unit V		APPLICATIONS OF ROBOTS												9		
Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare																
LIST OF EXPERIMENTS																
1	3D modeling and motion simulation of rotational joint assembly															
2	3D modeling and motion simulation of prismatic joint assembly															
3	3D modeling and motion simulation of Cartesian robot															
4	3D modeling and motion simulation of articulated robot															
5	3D modeling and motion simulation of spherical robot															
6	3D modeling and motion simulation of cylindrical robot															
Lecture: 30 PERIODS					Practical: 30 PERIODS					Total periods: 60 PERIODS						
Text Books:																
1.Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch, Frank C. Park, Cambridge University Press; 1st edition (25 May 2017), ISBN-10: 110715																
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751																
References:																
1. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019) ISBN-10: 1682856763																
2. Advanced Technologies in Modern Robotic Applications, by ChenguangYang, Hongbin Ma, Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN10: 981109263X																
3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10: 0816057451																
4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; StandardEdition (30 August 2018), ISBN-10: 1788835441																
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10: 1639873732																
Course Outcomes:														Blooms Taxonomy		
CO1: Discuss the definition, history of robotics and robot anatomy.														Remembering, Understanding (K1/K2)		
CO2:Develop the simulation of robot kinematics														Applying, Analyzing(K3/K4)		
CO3:Describe the grasping and manipulation of robots.														Understanding, Applying (K2/K3)		
CO4:Explain about mobile robot and manipulation.														Understanding, Analyzing (K2/K3)		
CO5:Discuss the applications of industrial, service, domestic robots.														Understanding, Evaluating (K2/K5)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1		1							1	3	2		
CO2	2	3	3	2	3							2	3	3	3	
CO3	2	2	3	2	3							2	3	3	2	
CO4	2	3	3	3	3		1			2	2	3	3	3	3	
CO5	2	2	2	2	3		1		1	2	3	3	3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23MEE025	GREEN MANUFACTURING DESIGN AND PRACTICES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Engineering Chemistry and Environmental Science - Fundamentals of Manufacturing Processes - Industrial Safety and Pollution Control Concepts					
Course Objectives: - To introduce the concept of environmental design and industrial ecology. - To impart knowledge about air pollution and its effects on the environment. - To enlighten the students with knowledge about noise and its effects on the environment. - To enlighten the students with knowledge about water pollution and its effects on the environment. - To introduce the concept of green co-rating and its need					
Unit I	DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT				9
Environmental effects of design -selection of natural friendly material - Eco design – Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology– Pollution prevention – Reduction of toxic emission – design for recycle.					
Unit II	AIR POLLUTION SAMPLING AND MEASUREMENT				9
Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equationthe Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone.					
Unit III	NOISE POLLUTION AND CONTROL				9
Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human,Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.					
Unit IV	WATER DEMAND AND WATER QUALITY				9
Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.					
Unit V	GREEN CO-RATING				9
Ecological Footprint - Need for Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies of Green CoRating					
Total periods:45 PERIODS					
Text Books:					
1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010					
2. Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006					
References:					
1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010					
2. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.					
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.					
4. Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006					
5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.					
6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.					
Course Outcomes:					Blooms Taxonomy

CO1: Explain the environmental design and selection of eco-friendly materials.													Understand (K2)		
CO2: Analyse manufacturing processes towards minimization or prevention of air pollution.													Analyse (K4)		
CO3: Analyse manufacturing processes towards minimization or prevention of noise pollution.													Analyse (K4)		
CO4: Analyse manufacturing processes towards minimization or prevention of water pollution.													Analyse (K4)		
CO5: Evaluate green co-rating and its benefits.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2			2	3					1	3	2	
CO2	2	3	3	2		2	3					2	3	3	
CO3	2	3	3	2		2	3					2	3	3	
CO4	2	3	3	2		2	3					2	3	3	
CO5	2	3	2	3	1	3	3	2	2	2	2	3	3	3	2
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23MEE026	ENVIRONMENT SUSTAINABILITY AND IMPACT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Environmental Science and Engineering • Fundamentals of Sustainable Development • Basics of Industrial and Environmental Policy					
Course Objectives: • To make the students to understand the concepts of Environmental Sustainability & Impact Assessment • To familiarize the students in environmental decision-making procedures. • Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities • To provide information on the environmental consequences for decision making • To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.					
Unit I	ENVIRONMENTAL IMPACT ASSESMENT				9
Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.					
Unit II	ENVIRONMENTAL DECISION MAKING				9
Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.					
Unit III	ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION				9
Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.					
Unit IV	LIFE CYCLE ASSESSMENT				9
Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting					
Unit V	SUSTAINABLE URBAN ECONOMIC DEVELOPMENT				9

Spatial economics – Knowledge economy and urban regions.															
Total periods:45 PERIODS															
Text Books:															
1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker, Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194															
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10: 0367244470															
References:															
1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development –Edward Elgar Publishing, 2007															
2. Robert B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005															
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008															
4. Canter, R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1996.															
5. Shukla, S.K. And Srivastava, P.R., “Concepts In Environmental Impact Analysis”, Commonwealth Publishers, New Delhi, 1992.															
6. John G. Rau and David C Hooten “Environmental Impact Analysis Handbook”, McGraw Hill Book Company, 1990.															
Course Outcomes:														Blooms Taxonomy	
CO1:Explain the concepts of Environment Sustainability and trained to make decision related to Environment.														Understand (K2)	
CO2:Make decision that has an effect on our environment														Apply (K3)	
CO3: Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.														Evaluate (K5)	
CO4:Explain the Life cycle assessment of Environmental sustainability.														Analyse (K5)	
CO5:Explain sustainable urban economic development.														Understand (K2)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1			3	3	2				1	3	2	
CO2	2	3	2	3	1	3	3	2				2	3	3	
CO3	2	3	3	3	2	3	3	2	2	2	2	3	3	3	
CO4	2	3	3	2	1	3	3	2				3	3	3	2
CO5	2	2	2	2	2	3	3	3	2	2	2	3	3	3	3
1 - Low, 2 - Medium, 3 - High, ‘-‘ No correlation															

23MEE027	ENERGY SAVING MACHINERY AND COMPONENTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Electrical Machines and Power Systems - Basic Thermodynamics and Energy Conversion - Fundamentals of Mechanical Engineering and Fluid Machinery					
Course Objectives: - To introduce the various energy saving machineries and components to the students for the purpose of conserving energy. - To study the basics and principles of transforms, Pumps and motors. - To impart the knowledge about the methods of energy conservation. - To introduce the energy efficiency devices and concepts of ENCON. - To impart the knowledge about CO2 mitigation.					
Unit I	BASICS OF ELECTRICAL ENERGY USAGE				9

Fuel to Power : Cascade Efficiency – Electricity Billing: Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption – Time of Day Tariff – Power Factor Basics – Penalty Concept for PF – PF Correction – Demand Side Management (a brief) - energy monitoring, measurement and analysis.																
Unit II		TRANSFORMERS AND MOTORS												9		
Transformer – Basics and Types – AVR and OLTC Concepts – Selection of Transformers – Performance Prediction - Energy Efficient Transformers - Motors : Specification and Selection – Efficiency / Load Curve – Load Estimation – Assessment of Motor Efficiency under operating conditions – Factors affecting performance – ill effects of Rewinding and Over sizing - Energy Efficient Motors – ENCON Scope. Transmission Line Parameters – Transmission Line Losses- Kelvin’s Law Performance Calculation and Analysis																
Unit III		FANS, PUMPS AND COMPRESSORS												9		
Basics – Selection – Performance Evaluation – Cause for inefficient operation – scope for energy conservation – methods adopted for effecting ENCON – Economics of ENCON adoption.																
Unit IV		STUDY OF ILLUMINATION AND ENERGY EFFICIENT DEVICES												9		
Specification of luminaries - Types - Efficacy - Selection and Application - ENCON Avenues and Economic Proposition - New Generation Luminaries (LED - Induction Lighting) - Soft Starters- Auto Star - Delta - Star Starters- APFC - Variable Speed and Frequency Drives - Time Sensors - Occupancy Sensors.																
Unit V		CO2 MITIGATION AND CASE STUDIES												9		
Evaluation for 3 / 4 Typical Sectors – PAT Scheme (an introduction) – CO2 Mitigation – Energy Conservation - Cost Factor. Case Studies on Industrial Energy Audit.																
Total periods: 45 PERIODS																
Text Books:																
1. Energy-Efficient Shutdown of Circuit Components and Computing Systems, by Ehsan Pakbaznia, Proquest, Umi Dissertation Publishing (1 September 2011), ISBN-10: 1243819898																
2. Handbook on Energy Efficiency, TERI, New Delhi, 2001																
References:																
1. Hamies, Energy Auditing and Conservation; Methods Measurements, management and Case Study, Hemisphere, Washington, 1980																
2. Trivedi, PR and Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997																
3. Handbook on Energy Efficiency, TERI, New Delhi, 2001																
4. Peters, Kraushaar and Ristenen, Sustainable Energy, beta – test – draft, Energy and Problems of a Technical Society, 1993																
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors																
6. Nagrath IJ and Kothari DP, Power system engineering, TMH, 2007																
Course Outcomes:													Blooms Taxonomy			
CO1: Explain the various energy saving machinery and components.													Understand (K2)			
CO2: Evaluate the various methods of conservation of energy.													Evaluate (K5)			
CO3: Evaluate the performance and energy conservation of fans, pumps and compressors.													Evaluate (K5)			
CO4: Discuss the various energy efficiency devices.													Understand (K2)			
CO5: Explain the co2 mitigation and cost factor.													Understand (K2)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1		2	3	2				1	3	2		
CO2	2	3	3	3	2	3	3	2				2	3	3		
CO3	2	3	3	3	3	3	3	2	2			2	3	3	2	
CO4	2	2	2	2	2	3	3	2				2	3	3	2	
CO5	2	2	2	2	2	3	3	3	2	2	2	3	3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23MEE028	GREEN SUPPLY CHAIN MANAGEMENT					Category: PEC			
						L	T	P	C
						3	0	0	3

Prerequisites		
• Basic knowledge of manufacturing processes • Awareness of industrial environmental impacts • Fundamentals of materials science and supply chain concepts		
Course Objectives:		
• To familiar the various standards and legislation of modern electronic manufacturing. • To know the conventional electronic processing and lead-free electronic manufacturing techniques. • To recognize the steps involved in assembly process and understand the need of recycle the electronics • To implement reliability and product life cycle estimation tools in green electronic manufacturing. • To demonstrate the green electronic manufacturing procedure in applications.		
Unit I	INTRODUCTION TO GREEN ELECTRONICS	9
Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).		
Unit II	GREEN ELECTRONICS MATERIALS AND PRODUCTS	9
Basics of IC manufacturing and its process – Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer-based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products		
Unit III	GREEN ELECTRONICS ASSEMBLY AND RECYCLING	9
Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.		
Unit IV	PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN	9
Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and international standards - Eco-design in electronics industry.		
Unit V	CASE STUDIES	9
Reliability of green electronics systems, Reuse and recycle of End-of-Life (EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling.		
Total periods: 45 PERIODS		
Text Books:		
1. Green Supply Chain Management, by Charisios Achillas, Dionysis D. Bochtis, Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 : 1138644617		
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.		
References:		
1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006.		
2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011.		
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.		
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.		
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.		
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.		
Course Outcomes:		Blooms Taxonomy
CO1: Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.		Remembering, Understanding (K1/K2)
CO2: Explain the conventional electronic processing and lead free electronic manufacturing techniques.		Understanding, Applying (K2/K3)
CO3: Realize the assembly process and the need of recycle of electronics		Understanding,

													Analyzing (K2/K4)		
CO4: Use reliability and product life cycle estimation tools for electronic manufacturing.													Applying, Analyzing (K3/K4)		
CO5: Validate the green electronic manufacturing procedures in applications.													Evaluating, Creating (K5/K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	3	1				2	2		
CO2	2	2	1	1	2		3					2	2		
CO3	1	2	2	1	2		3	1				2	2		
CO4	2	2	3	3	2		2					2	3	2	
CO5	0	2	3	3	3		3	2				3	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL 5

23MEE029	DESIGN OF PRESSURE VESSELS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Knowledge of Strength of Materials and Theory of Machines • Basic understanding of Thermodynamics and Fluid Mechanics • Fundamentals of Design of Machine Elements					
Course Objectives: • To introduce the Mathematical knowledge to design pressure vessels and piping • To learn the ability to carry of stress analysis in pressure vessels and piping • To study the design of vessels and theory of reinforcement. • To study buckling and fracture analysis in vessels. • To learn piping layout and flow diagram.					
Unit I	INTRODUCTION				9
Methods for determining stresses – Terminology and Ligament Efficiency – Applications					
Unit II	STRESSES IN PRESSURE VESSELS				9
Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.					
Unit III	DESIGN OF VESSELS				9
Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.					
Unit IV	BUCKLING AND FRACTURE ANALYSIS IN VESSELS				9
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.					

Unit V	PIPING												9		
Introduction – Flow diagram – piping layout and piping stress Analysis.															
Total periods:												45 PERIODS			
Text Books:															
1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.															
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. 1 January 2001															
References:															
1. Henry H. Bedner, “Pressure Vessels, Design Hand Book”, CBS publishers and Distributors,1987.															
2. Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.															
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.															
4. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.															
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. 1 January 2001															
Course Outcomes:												Blooms Taxonomy			
CO1: Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications												Remembering, Understanding (K1/K2)			
CO2: Analyse stress in pressure vessels												Analyzing, Applying (K4/K3)			
CO3: Design and analysis of pressure vessels.												Applying, Evaluating, Creating (K3/K5/K6)			
CO4: Analysis of buckling and fracture analysis in vessels.												Analyzing, Evaluating (K4/K5)			
CO5: Design and analysis piping layout and piping.												Applying, Creating (K3/K6)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1							1	2		
CO2	3	3	2	2	2							2	3	2	-
CO3	3	3	3	2	3							2	3	3	2
CO4	2	3	2	3	2							3	3	2	1
CO5	3	3	3	3	3							3	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE030	FAILURE ANALYSIS AND NDT TECHNIQUES	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Engineering Materials and Metallurgy • Manufacturing Processes • Strength of Materials • Basic Physics of Waves and Radiation					
Course Objectives: • To introduce need and scope of failure analysis and fundamental sources of failures. • To learn about non-destructive testing and basic principles of visual inspection. • To study about magnetic testing and principles, techniques. • To learn the principle of radiography testing and its inspection techniques and methods. • To study the acoustistic testing principle and technique and instrumentation.					
Unit I	INTRODUCTION				9

Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA.																
Unit II		VISUAL INSPECTION												9		
Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards.																
Unit III		MAGNETIC TESTING												9		
Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations.																
Unit IV		RADIOGRAPHY TESTING												9		
Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations																
Unit V		ACOUTISTIC TESTING												9		
Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards.(digital signal process).																
LIST OF EXPERIMENTS																
1	Conducting experiment using liquid penetrant testing															
2	Conducting experiment using magnetic particle testing															
3	Conducting experiment using ultrasonic testing															
4	Conducting experiment using electromagnetic testing															
5	Conducting experiment using acoutistic emission testing															
Lecture: 30 PERIODS					Practical: 30 PERIODS					Total periods: 60 PERIODS						
Text Books:																
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.																
2. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010																
References:																
1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.																
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol.1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing																
3. Charles, J. Hellier, Handbook of Non destructive evaluation, McGraw Hill, New York 2001.																
4. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005																
5. J.Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).																
Course Outcomes:														Blooms Taxonomy		
CO1: Discuss the need and scope of failure analysis and fundamental sources of failures.														Understand (K2)		
CO2: Describe about non-destructive testing and basic principles of visual inspection.														Understand (K2)		
CO3: Explain about magnetic testing and principles, techniques.														Understand (K2)		
CO4: Explain the principle of radiography testing and its inspection techniques and methods.														Understand (K2)		
CO5: Describe the acoutistic testing principle and technique and instrumentation.														Understand (K2)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

1.Bolz, H. A and Hagemann, G. E (ed.), ,,,Materials Handling Handbook''', Ronald Press															
2.8005:1976, Classification of Unit Loads, Bureau of Indian Standards.															
3.Apple, J.A., ,,,Material Handling System Design''', John Wiley & Sons															
4.Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors															
5.Immer J. R., Material Handling, Tata McGraw Hill Publication.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the basic concepts of material handling equipment.													Understand (K2)		
CO2: Explain the basic working principles of various industrial Vehicles.													Understand (K2)		
CO3: Develop the basic working principles of various conveyors.													Apply (K3)		
CO4: Elaborate the basic working principles of various Auxiliary Equipment and Hoisting Equipment.													Apply (K3)		
CO5: Explain the basic working principles of various Bulk Handling Equipment and Systems.													Understand (K2)		
CO-PO Mapping															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1					1		1	3	2	1
CO2	3	2	2	1	1				1	1		1	3	3	1
CO3	3	2	3	2	2				1	1		1	3	3	2
CO4	3	2	3	2	2				1	1		1	3	3	2
CO5	3	2	2	2	2				1	1		1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE032	ROTATING MACHINERY DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Mechanics • Strength of Materials • Fluid Mechanics and Thermodynamics • Basic Machine Design					
• Course Objectives: • To familiarize the course member with various operations of gas turbines and other driven rotating machines. • To familiarize students with the common problems associated with the mechanical design and the lifting of the major rotating components of the gas turbine engine. • To study the failure criteria of rotating machinery. • To learn the design of discs, blades for rotating machinery. • To study about blade vibrations Damage Mechanisms.					
Unit I	INTRODUCTION				9
Overview of the different operational regimes for gas turbine applications: base load, peak load, standby and backup operations, alongside their individual operational requirements. Fundamentals of Creep and Fatigue damage mechanisms. Material, design and operational parameters that affect creep and fatigue. Experimental and test procedures to characterise creep and fatigue damage.					
Unit II	DESIGNING FORCES				9
Loads/forces/stresses in gas turbine engines: loads - rotational inertia, flight, precession of shafts, pressure gradient, torsion, seizure, blade release, engine mountings and bearings-Discussion of major loadings rotating components and pressure casing components					
Unit III	FAILURE CRITERIA				9
Monotonic failure criteria: proof, ultimate strength. Theories of failure - bi-axial loads. Other failure mechanisms - gas turbine engines including creep and fatigue. Fatigue properties - SN and RM diagrams. Stress concentration, mean stress, Cumulative fatigue, Goodman diagram and safety factor for gas turbine components. Larson-Miller time-temperature parameter.					
Unit IV	BLADE DESIGN				9
Design of discs, blades. Illustration of magnitude stresses in conventional axial flow blades- simple desk top method -effects of leaning the blade. Design of flanges and bolted structures. Leakages through a flanged joint and failure from fatigue.					
Unit V	BLADE VIBRATIONS AND DAMAGE MECHANISMS				9
Natural frequencies turbomachine blades. Blade twist, centrifugal stiffening, Sources of blade excitation, Stationary flow disturbance, rotating stall and flutter. Campbell diagram and troublesome resonances. Allowances for temperature, pre-twist and centrifugal stiffening. Methods for dealing with resonances.					
Total periods:45 PERIODS					
Text Books:					
1.A S Rangawala, Turbomachinery Dynamics-Design and operations, McGraw-Hill, 2005,ISBN-13: 978-0071453691.					
2.Design, Modeling and Reliability in Rotating Machinery, Robert X. Perez (Editor) ISBN: 978-1119-63169-9					
3.Principals of Turbo machines D. G. Shepherd The Macmillan Company 1964					
References:					
1..P.P Walsh and P. Peletcher, Gas Turbine Performance“ Blackwell Science, 1998,ISBN0632047843.					

2.. Turbines, Compressors & Fans S. M. Yahya Tata McGraw Hill Co. Ltd 2nd edition, 2002															
3.Principals of Turbo machines D. G. Shepherd The Macmillan Company 1964															
4.Fluid Mechanics & Thermodynamics of Turbo machines S. L. Dixon Elsevier 2005															
5.Shaft Alignment Handbook (Mechanical Engineering) by John Piotrowski 2 November 2006															
Course Outcomes:													Blooms Taxonomy		
CO1: Differentiate the operational regimes and requirements related to different gas turbine applications.													Understand (K2)		
CO2: Describe and distinguish the design requirements and loads encountered by gas turbine components during normal operation;													Understand (K2)		
CO3: Analyse, evaluate and assess the loads, stresses, failure criteria and factors of safety used in gas turbine engines													Analyze / Evaluate (K4/K5)		
CO4: Evaluate impact of vibrations on design and operation of gas turbine;													Evaluate (K5)		
CO5: Assess the creep and fatigue damage of gas turbine components based on design and operational parameters													Evaluate (K5)		
CO-PO Mapping															
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1					1		1	3	2	1
CO2	3	3	2	1	1				1	1		1	3	3	2
CO3	3	3	3	3	2				1	1		2	3	3	3
CO4	3	3	3	3	2				1	1		2	3	3	3
CO5	3	3	3	3	2				1	1		2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE033	THERMAL AND FIRED EQUIPMENT DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites ● Engineering Thermodynamics – laws of thermodynamics, energy balance, properties of steam. ● Heat Transfer – conduction, convection, and radiation mechanisms. ● Fluid Mechanics – flow through pipes, pumps, and compressors. ● Power Plant Engineering basics – working principles of power cycles and auxiliary systems.					
● Course Objectives: ● To introduce the concepts of thermal and fired equipment. ● To study the basis, design and construction of boilers. ● To study of typical fuel firing systems in the boiler. ● To study of materials requirements for pressure parts. ● To study of various boiler auxiliaries system.					
Unit I	INTRODUCTION				9
Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers,Morden trends in boiler design , Basic knowledge of different types of Thermal Fired Equipment ,sub critical and super critical boilers - Coal ,Oil ,Gas , Pulverised fuel cyclone, FBC, CFBC ,MSW , and Stoker firing, Boiler efficiency , auxiliary power consumption , Performance data , Performance Correction Curves					
Unit II	BASIS OF BOILERS AND DESIGN				9
Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts					
Unit III	FIRING SYSTEM- FUEL AND MILLING				9
Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat / Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.					
Unit IV	PRESSURE PARTS AND DESIGN AND MATERIALS				9
Economiser, Drums , Water Walls ,Headers ,Links , Super Hater , Super Heaters , Reheaters, Tubes , Spiral Tubes , Surface area , Free Gas Area , Metal temperature ,LMTD , Acid Due Point Temperature , Carbon steel , Low alloy steel , Titanium alloy steel					
Unit V	BOILER AUXILIARIES				9
Air preheaters (APH) – bi sector APH , Tri sector APH, Cold PA System, Hot PA System, Tubular APH,Steam coil Air preheater , FANS – Axial, Radial, Performance curves, MILLS- Tube , Vertical mills , Air quality Control systems ,DustCollection System - Mechanical Precipitator, Electrostatic Precipitator, FGD ,SCR , SNCR					
Total periods:45 PERIODS					
Text Books:					
1.A Course in Power Plant Engineering; Dhanapat Rai and Sons - Domkundwar					
2.Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar					
References:					
1.Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964					
2.Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical) by V. Ganapathy					

3.Steam Generators: Description and Design by Donatello Annaratone															
4.. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by J Paul Guyer															
5.Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation) by Mamoru Ozawa and Hitoshi Asano 28 January 2021															
Course Outcomes:													Blooms Taxonomy		
CO1: . Explain the concepts of thermal and fired equipment.													Understanding (K2)		
CO2: Discuss the basis, design and construction of boilers.													Applying (K3)		
CO3: .Describe of typical fuel firing systems in the boiler.													Understanding (K2)		
CO4: Discuss the materials requirements for pressure parts.													Analyzing (K4)		
CO5: Discuss of various boiler auxiliaries system.													Applying (K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	2					2	3	2	1
CO2	3	3	3	2	2				1			2	3	2	1
CO3	2	2	2	1	2	1	2					1	2	3	2
CO4	3	3	3	2	3		2					2	3	3	2
CO5	2	2	2	1	2	1	3		1	2		3	2	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE034	INDUSTRIAL LAYOUT DESIGN AND SAFETY	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Engineering Drawing / CAD – for visualizing plant and equipment layouts. • Manufacturing Processes – understanding of production systems and process flow. • Industrial Engineering Basics – work study, process planning, and productivity concepts. • Fundamentals of Safety Engineering – basic occupational safety and risk awareness.					
Course Objectives: The main learning objective of this course is to prepare the students for: • To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis. • To learn the facilities layout design algorithms and selecting appropriate software. • To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling. • To learn the safety planning and management principles in industries. • To learn the various safety management approaches in industries.					
Unit I	INTRODUCTION				9
Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs					
Unit II	FACILITIES LAYOUT DESIGN & ALGORITHMS				9

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation).		
Unit III	FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS	9
Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation		
Unit IV	SAFETY PLANNING & MANAGEMENT	9
Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.		
Unit V	APPROACHES IN SAFETY MANAGEMENT	9
Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.		
Total periods:30 PERIODS		
Text Books:		
1.. Sunderesh S. Heragu, “Facilities Design”, 3 rd Edition, CRC Press Taylor & Francis Group,2008.		
2.L. M. Deshmukh, “Industrial Safety Management: Hazard Identification and Risk Control”, Tata McGraw-Hill Publishing Co. Ltd., 2005		
References:		
1.Eric Teicholz, “Facility Design and Management Handbook”, Tata McGraw-Hill Publishing Co. Ltd., 2001.		
2.James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, “Facilities Planning”, 4th Edition, John Wiley & Sons, 2010.		
3.Matthew P. Stevens and Fred E. Meyers, “Manufacturing Facilities Design and Material Handling”, 5th Edition, Purdue University Press, 2013.		
4.. Charles D.Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.		
5.J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.		
6.Industrial Hazard and Safety Handbook: (Revised impressionby Ralph W King and John Magid 24 September 2013		
Course Outcomes:		Blooms Taxonomy
CO1: Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis		Understanding (K2)
CO2: Discuss the facilities layout design algorithms and selecting appropriate software.		Applying (K3)
CO3: Describe the facilities layout problem modeling tools and algorithms for production, warehouse, and material handling.		Analyzing (K4)
CO4: Explain the safety planning and management principles in industries.		Understanding (K2)
CO5: Illustrate the various safety management approaches in industries		Applying (K3)
CO-PO Mapping		

Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	2			1		2	3	2	1
CO2	3	3	3	2	3				1			2	3	3	1
CO3	3	3	3	2	3	1	2					2	3	3	2
CO4	2	2	1	1	2	3	3	2				2	2	2	3
CO5	2	2	2	1	2	3	3	2	1	2		3	2	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE035	DESIGN CODES AND STANDARDS		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Mechanical Engineering Fundamentals – Material science, mechanics of materials. • Basic Design Principles – Strength of materials, pressure vessels, and heat exchanger basics. • Process Equipment Knowledge – Familiarity with process industry equipment and operations. • Engineering Documentation – Awareness of technical reports, drawings, and standards documentation.						
Course Objectives: • To study the Codes and Standards and Need for them in the Industry • To know the different sources and the bodies that publish Codes and Standards • To familiarize the Government Regulations and its applicability • To familiarize with different codes used in Different Industry • To familiarize the Codes and Standards used in Process Industry						
Unit I	INTRODUCTION					9
Introduction to Codes and Standards. What is code? What is Standard? Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices.						
Unit II	CODES					9
Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes						
Unit III	STANDARDS					9
Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.						
Unit IV	REGULATIONS					9
Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers						
Unit V	DESIGN CODES					9
Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.						
Total periods:45 PERIODS						
Text Books:						
1.Mechanical Engg. Handbook. ASME. ASTM.API						

2.Perrys Chemical Engg Handbook															
References:															
1.ASME															
2.. API															
3.ISO, IBR, OISD															
4.AWS															
5.ISHRAE															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the need for codes and Standards in Industry													Understanding (K2)		
CO2:Discuss the different codes and standards used in different industry.													Understanding (K2)		
CO3:Discuss the sources of different codes and standards and the societies that publish them and how these are evolved													Analyzing (K4)		
CO4:Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International													Understanding (K2)		
CO5:Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry													Applying (K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1				1		2	3	2	1
CO2	3	2	2	1	2	1				1		2	3	3	1
CO3	3	3	3	2	3	1	2			1		2	3	3	2
CO4	2	2	1	1	2	3	2	2				2	2	2	3
CO5	3	3	3	2	3	2	2			2		2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE036	BIOENERGY CONVERSION TECHNOLOGIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of Thermodynamics and Heat Transfer. - Fundamentals of Energy Engineering. - Basic understanding of biomass and conventional fuels. - Awareness of combustion and biofuel applications.					
Course Objectives: - To elucidate on biomass, types, availability, and characteristics - To study the bio-methanation process. - To impart knowledge on combustion of biofuels - To describe on the significance of equivalence ratio on thermochemical conversion of biomass - To provide insight to the possibilities of producing liquid fuels from biomass					
Unit I	INTRODUCTION				9
Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies					
Unit II	BIOMETHANATION				9
Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants					
Unit III	COMBUSTION				9
Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion					
Unit IV	GASIFICATION, PYROLYSIS AND CARBONISATION				9
Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation					
Unit V	LIQUIFIED BIOFUELS				9
Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications					
Total periods:45 PERIODS					
Text Books:					
1.Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550					
2.Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).					
3.Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981					
References:					
1.. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.					
2.Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S					
3.Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986					
4.Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997					
Course Outcomes:					Blooms Taxonomy
CO1: Estimate the surplus biomass availability of any given area.					Apply
CO2: Design a biogas plant for a variety of biofuels.					Applying (K3)
CO3: . Determine and compare the cost of steam generation from biofuels with that of coal					Analyze (K4)

and petroleum fuels.															
CO4: Analyse the influence of process governing parameters in thermochemical conversion of biomass													Analyze (K4)		
CO5: Synthesize liquid biofuels for power generation from biomass													Create (K6)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1							3	2	2
CO2	3	3	2	1	2	1							3	3	2
CO3	3	3	3	2	2	2							3	3	3
CO4	3	3	3	2	3	2							3	3	3
CO5	3	3	3	3	3	3							3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE037	CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites ● Basic knowledge of environmental science, thermodynamics, and industrial processes. ● Understanding of greenhouse gases and energy systems.					
● Course Objectives: ● To introduce climate change and carbon footprint ● To study the principle of product life cycle and Green House Gas emissions accounting ● To study the Methodology for Carbon Footprint Calculation ● To learn emission mitigation and carbon sink ● To study the case study of carbon footprint					
Unit I	CLIMATE CHANGE AND CARBON FOOTPRINT				9
Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations					
Unit II	PRODUCT LIFE CYCLE AND GHG EMISSIONS				9
Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality- Allocation and Assessing Uncertainty					
Unit III	METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT				9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes															
Unit IV		EMISSION MITIGATION AND CARBON SINK												9	
Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polcies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing															
Unit V		CASE STUDIES												9	
Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation – Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management															
Total periods:45 PERIODS															
Text Books:															
1.. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23August 2016), ISBN-10 : 9811011737															
2.Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742															
References:															
1.. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press															
2.Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers															
3.World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard															
4.ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.															
5.IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the climate change and carbon footprint													Understand (K2)		
CO2:Discuss the principle of product life cycle and Green House Gas emissions accounting													Understand (K2)		
CO3:Explain the Methodology for Carbon Footprint Calculation													Understand (K2)		
CO4:Discuss emission mitigation and carbon sink													Understand (K2)		
CO5:Discuss emission mitigation and carbon sink													Understand (K2)		
CO-PO Mapping													Understand (K2)		
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2		2									3		
CO2	3	2		2									3		
CO3	3	2		2									3		

CO4	3	2		2									3		
CO5	3	2		2									3		

1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation

23MEE038	ENERGY CONSERVATION IN INDUSTRIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites ● Basic knowledge of Thermodynamics and Heat Transfer ● Fundamentals of Electrical Engineering ● Familiarity with Industrial Systems and Utilities					
Course Objectives: ● To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign ● To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs ● To learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries ● 4To Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency ● To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project					
Unit I	INTRODUCTION				9
Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing					
Unit II	ELECTRICAL SUPPLY SYSTEMS				9
Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics					
Unit III	ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES				9
Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.					
Unit IV	ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES				9
Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems					
Unit V	ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS				9
Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme					
Total periods:45 PERIODS					
Text Books:					
1.Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4					

Volumes). Available at http://www.em-ea.org/gbook1.asp . This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India															
2.. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers &Dist, 2007.															
References:															
1.Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the needfor energy auditing for becoming environmentally benign													Understand (K2)		
CO2: Analyse factors behind energy billing and apply the concept of demand side management for lowering energy costs													Analyse (K4)		
CO3: Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries													Apply (K3)		
CO4: Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency													Analyse (K4)		
CO5: Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project													Apply (K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2		2									3		
_CO2	3	3		2									3		
CO3	3	2		2									3		
CO4	3	2		2									3		
CO5	3	2		2									3		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE039	ENERGY EFFICIENT BUILDINGS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites ● Fundamentals of Thermodynamics and Heat Transfer ● Basics of HVAC Systems ● Understanding of Building Materials and Construction					
● Course Objectives: ● To learn the climate and buildings, building efficiency rating and standards ● Developing energy efficiency in building envelopes through alternate methods ● To study the thermal comfort, passive heating and cooling techniques ● To apply various energy saving concepts in buildings. ● To incorporate Renewable energy systems in buildings					
Unit I	INTRODUCTION				9

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards															
Unit II		LANDSCAPE AND BUILDING ENVELOPES												9	
Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools															
Unit III		THERMAL COMFORT, PASSIVE HEATING AND COOLING												9	
Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for build environment – Heat Pumps, Evaporative Cooling and Radiant Cooling															
Unit IV		ENERGY CONSERVATION IN BUILDING UTILITIES												9	
Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors, Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers,Refrigeration and Air Conditioning Systems,Water and Waste Management systems															
Unit V		RENEWABLE ENERGY IN BUILDINGS												9	
Introduction of Renewable sources in buildings,, Stand-alone PV systems, BIPV, Solar water heating,Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings															
Total periods:45 PERIODS															
Text Books:															
1.. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018),ISBN-10 : 3319814869															
2.Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818.															
References:															
1.ASHRAE Handbook – Fundamentals / Equipment*s/ Applications – ASHRAE 2021,2020, 2019 Editions															
2.Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998															
3.Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994															
4.JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.															
5.Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.															
Course Outcomes:													Blooms Taxonomy		
CO1:Familiar with climate responsive building design and basic concepts													Understand (K2)		
CO2:Explain the basic terminologies related to buildings													Understand (K2)		
CO3:Discuss the energy efficient air conditioning techniques													Understand (K2)		
CO4:Evaluate the performance of buildings													Analyse (K4)		
CO5:Gets acquainted with Renewable energy systems in buildings													Understand (K2)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2		2									3		
CO2	3	2		2									3		
CO3	3	2		2									3		

CO4	3	3		3									3		
CO5	3	2		2									3		
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE040	ENERGY STORAGE DEVICES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites ● Basic Thermodynamics and Heat Transfer ● Fundamentals of Electrical Machines and Circuits ● Basics of Renewable Energy Systems					
Course Objectives: ● To study the various types of energy storage devices and technologies and them comparison. ● To learn the techniques of various energy storage devices and their performances. ● To learn the basics of batteries and hybrid systems for EVs and other mobile applications. ● To learn about the renewable energy storage systems and management systems. ● To have an insight into other energy storage devices, hydrogen, and fuel cells.					
Unit I	INTRODUCTION TO ENERGY STORAGE				9
Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.					
Unit II	ENERGY STORAGE SYSTEMS				9
Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types Charging and Discharging – Battery testing and performance.					
Unit III	MOBILE AND HYBRID ENERGY STORAGE SYSTEMS				9
Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.					
Unit IV	RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT				9
Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management					
Unit V	OTHER ENERGY DEVICES				9
Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC,MCFC and Biofuel Cells – Biogas Storage.					
Total periods:45 PERIODS					
Text Books:					
1.Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2 nd Edition, Springer, 2015.					
2.. Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001					
References:					
1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt,” Energy Storage in Power					

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Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.																
Unit IV		BIO-ENERGY												9		
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.																
Unit V		OCEAN AND GEOTHERMAL ENERGY												9		
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.																
Text Books:																
1. Fundamentals and Applications of Renewable Energy Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636																
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707																
References:																
1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.																
2.Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.																
3.Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.																
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.																
5.Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.																
Course Outcomes:														Blooms Taxonomy		
CO 1: Discuss the Indian and global energy scenario.														Understand (K2)		
CO2: Describe the various solar energy technologies and its applications.														Understand (K2)		
CO3: Explain the various wind energy technologies.														Apply (K3)		
CO4: Explore the various bio-energy technologies.														Apply (K3)		
CO5: Discuss the ocean and geothermal technologies.														Understand (K2)		
CO-PO Mapping																
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3	
CO1	3	2					2	2		1		2	3	2		
CO2	3	2	1	1	2		2	1		1		2	3	2		
CO3	3	2	2	2	2		3	1		-		2	3	3	2	
CO4	3	3	2	2	3		3	2		1		3	3	3	3	
CO5	2	2	1	1	2		3	3		1		2	2	3	2	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation																

23MEE042	EQUIPMENT FOR POLLUTION CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Environmental Science • Fundamentals of Fluid Mechanics and Mechanical Design • Awareness of Industrial Processes and Waste Generation					
Course Objectives: • To study the pollution control regulation and standards, water and wastewater. • To study the equipment for various water pollution. • To study the equipment for air pollution control. • To study the equipment for solid waste processing • To study the pollution monitoring equipment					
Unit I	POLLUTION CONTROL REGULATIONS AND STANDARDS				9
Pollutants in water and wastewater – sources and impacts- Characteristics and impacts of solid and hazardous wastes - Indian Constitution and Environmental Protection Legislations – Environmental Standards under different Environmental legislations - Water Act (1974), Air Act (1981), Environmental Protection Act (1986) and major Notifications, Municipal solid Wastes (Management and Handling) Rules -Bio Medical Wastes (Management and Handling) Rules - Hazardous Wastes (Management and Handling Rules),Environment Impact Assessment Notifications - Unit operations and unit processes in Pollution Control- - Selection criteria for Pollution Control Equipment.					
Unit II	EQUIPMENT FOR WATER POLLUTION CONTROL				9
Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings.- Filed visit to a wastewater treatment plant					
Unit III	EQUIPMENT FOR AIR POLLUTION CONTROL				9
Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Biofilters - Filed visit to an industry with air pollution control systems					
Unit IV	EQUIPMENT FOR SOLID WASTE PROCESSING				9
Operational principles and Design criteria of Dewatering equipment – centrifuge, Vacuum Filter, Filter Press- Size Reduction equipment – shredders, grinders – Trommel and Disc Screens – Air Classifiers - bailing and briquetting – incinerators –Pyrolysis – field visit to a solid waste processing facility					
Unit V	POLLUTION MONITORING EQUIPMENT				9
Equipment’s for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment					
Total periods: 45 PERIODS					
Text Books:					
1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.					
2. Rao. C.S (2006)., “Environmental Pollution and Control Engineering”, 2nd Edition, Revised, Wiley Eastern Limited, India.					
References:					
1. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001					
2. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2014.					
3. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016.					
4. CPCB (2021), "Pollution Control Acts, Rules and Notifications issued thereunder, PCL Series- Central Pollution					

Control Board, Delhi															
5. CPHEEO, “Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the different types of pollution, their sources and effects.													Understand (K2)		
CO2: Discuss the pollution control regulations and standards													Understand (K2)		
CO3: Design equipment for pollution control													Apply (K3)		
CO4: Discuss different methods of pollution control from various sources in air, water and soil													Apply (K3)		
CO5: Discuss the Conduct performance assessment of pollution control equipment.													Analyze (K4)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2				3	3	2		1		2	3	2	
CO2	2	3				3	3	2		1		2	3	3	
CO3	3	3	3	2	2	2	2	1		1		3	3	3	2
CO4	3	2	2	3	2	3	3	2		1		3	3	3	3
CO5	3	3	2	3	2	3	3	3		2		3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL 7

23MEE043	COMPUTATIONAL SOLID MECHANICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Knowledge of Engineering Mechanics and Strength of Materials - Fundamentals of Mathematics and Numerical Methods - Basics of Finite Element Analysis and Material Science					
Course Objectives: - To study the definition and basics on theory of elasticity - To learn finite element method and procedure for static linear elasticity - To study the Non Linear and History depend problems - To study time dependent and dynamic problems of Small and large strain visco-plasticity - To study Structural Elements & Interfaces and contact using penalty method.					
Unit I	BASIC ON THEORY OF ELASTICITY				9
Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain – displacement relations, Stress – strain relations, Lamé’s constant –cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr’s circle, Saint Venant’s principle.					
Unit II	FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY				9
Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.					

Unit III	NON LINEAR AND HISTORY DEPEND PROBLEMS												9		
Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity -Large strain visco-plasticity.															
Unit IV	TIME DEPENDENT AND DYNAMIC PROBLEMS												9		
First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.															
	STRUCTURAL ELEMENTS & INTERFACES AND CONTACT												9		
Continuum Beams – Shells – Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)															
Total periods: 45 PERIODS															
Text Books:															
1.L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008.(0070139881 ·9780070139886).															
2.J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527X ·9789390385270).															
3.R.D.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001 (978-0471-35605-9).															
4.S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010.(9780070701229-0070701229)															
5. G. Ramamurty, Applied Finite Element Analysis, I.K. International Publishing House Pvt.Limited,2013. (9789380578453- 9380578458)															
References:															
1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element															
2. Solution (Computational Fluid and Solid Mechanics)by Miguel Luiz Buclelem and KlausJurgen Bathe 25 February 2013The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics) by Dominique Chapelle and Klaus-Jurgen Bathe 27 January 2013															
3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics)by M. Kojic and Klaus-Jurgen Bathe 22 October 2010															
4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics)by D. Drikakis and W. Rider 22 October 2010															
5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics) by Ben Q. Li 22 October 2010															
Course Outcomes:													Blooms Taxonomy		
CO 1: Discuss the definition and basics on theory of elasticity													Understand (K2)		
CO2: Derive the finite element method for static linear elasticity, solve problems													Apply (K3)		
CO3: Discuss the Non Linear and History depend problems, Solve problems													Analyze (K4)		
CO4: Discuss time dependent and dynamic problems, solve problems.													Analyze (K4)		
CO5: Discuss Structural Elements & Interfaces and contact, solve problems.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2			1					1		2	3	2	
CO2	3	3	3	2	2					1		3	3	3	2
CO3	3	3	3	3	2					1		3	3	3	3
CO4	3	3	3	3	2					2		3	3	3	3
CO5	3	3	3	3	3					2		3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE044	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites - Basics of Fluid Mechanics - Heat and Mass Transfer - Numerical Methods						
Course Objectives: - To study the fluid flow simulation techniques and its mathematical behaviour - To learn the Discretise 1D and 2D systems using finite difference and finite volume techniques - To Formulate diffusion –convection problems using finite volume method - To study the flow field for different types of grids - To learn the need for turbulence models and its types						
Unit I		INTRODUCTION				9
Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors						
Unit II		FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION				9
Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nicolson, and pure implicit methods, stability of schemes.						
Unit III		FINITE VOLUME METHOD FOR CONVECTION DIFFUSION				9
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.						
Unit IV		FLOW FIELD ANALYSIS				9
Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.						
Unit V		TURBULENCE MODELLING				9
Turbulence model requirement and types, mixing length model, Two equation (k- ϵ) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.						
Total periods: 45 PERIODS						
Text Books:						
1. Versteeg, H.K., and Malalasekera, W.,”An Introduction to Computational Fluid Dynamics”: The finite volume Method, Pearson Education, 2014 .						
2.Ghoshdastidar, P.S., “Computational Fluid Dynamics and Heat Transfer”, Cengage Learning, 2017.						
References:						
1. John. F. Wendt, “Computational Fluid Dynamics – An Introduction”, Springer, 2013.						
2. K. Muralidhar &T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.						
3. Suhas V, Patankar, “Numerical Heat transfer and Fluid flow”, Taylor & Francis, 2009.						
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.						
5. Yogesh Jaluria & Kenneth E. Torrance, “Computational Heat Transfer”, CRC press, 2002.						
Course Outcomes:						Blooms Taxonomy
CO1: Discuss the definition and basics on theory of elasticity						Understand (K2)

CO2: Derive the finite element method for static linear elasticity, solve problems.													Apply (K3)		
CO3: Discuss the Non Linear and History depend problems, Solve problems.													Analyze (K4)		
CO4: Discuss time dependent and dynamic problems, solve problems.													Apply (K3)		
CO5: Discuss Structural Elements & Interfaces and contact, solve problems.													Understand (K2)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2		1									3	2	
CO2	3	3	2	3	2								3	3	
CO3	3	3	2	3	2								3	3	
CO4	3	3	3	3	3								3	3	
CO5	3	2		2	3		1						3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE045	THEORY ON COMPUTATION AND VISUALIZATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Computer Programming - Basic Discrete Mathematics and Logic - Understanding of Data Structures					
Course Objectives: - To study the concepts and techniques of discrete mathematics for theoretical computer science. - To learn different formal languages and their relationship. - To classify and construct grammars for different languages and vice-versa. - To study Visualization, Graphical and Quantitative Information. - To learn Visualization design and data Ink.					
Unit I	REVIEW OF MATHEMATICAL THEORY				9
Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction.					
Unit II	REGULAR LANGUAGES AND FINITE AUTOMATA				9
Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output – Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union-intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, ??- Non Deterministic Finite Automata, Conversion of NFA- ? to NFA, Kleene’s Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.					
Unit III	CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA				9
Definitions and Examples, Unions Concatenations AndKleene’s of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity , Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF. Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.					
Unit IV	VALUE OF VISUALIZATION				9
Information Visualization, In Readings in Information Visualization, Graphical Excellence, Graphical Integrity, Sources of Graphical Integrity InThe Visual Display of Quantitative Information					
Unit V	VISUALIZATION DESIGN				9
The Power of Representation, Data-Ink and Graphical Redesign, Data-Ink Maximization and Graphical Design, Data Density and Small Multiples					
Total periods: 45 PERIODS					
Text Books:					

1. Introduction to the Theory of Computation by Michael Sipser															
2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman															
References:															
1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill															
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria& Sons															
3. Introduction to computer theory By Deniel I. Cohen , Joh Wiley & Sons, Inc															
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discussing the concepts and techniques of discrete mathematics for theoretical computer science.													Understand (K2)		
CO2: Explain the different formal languages and their relationship.													Understand (K2)		
CO3: Discussing to classify and construct grammars for different languages and vice-versa													Apply (K3)		
CO4: Explaining the Visualization, Graphical and Quantitative Information..													Understand (K2)		
CO5: Applng the Visualization design and data Ink.													Apply (K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2		1									3	2	
CO2	3	3	2	2									3	3	
CO3	3	3	2	3	2								3	3	
CO4	2	2		2	3		1						3	3	
CO5	2	2		2	3		2						3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE046	COMPUTATIONAL BIO-MECHANICS	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Engineering Mechanics - Basics of Human Anatomy and Physiology - Knowledge of Finite Element Method or Numerical Techniques					
Course Objectives: - To Introduction of principles and concepts of bio-mechanics. - Focuses on the studies of tissues and structure of musculoskeletal system. - To study the mechanics of joints and human motion. - To explain the computational approaches in biomechanics. - To learn the quantification of forces and motion.					
Unit I	INTRODUCTION TO BIOMECHANICS				9
Perspective of biomechanics, Terminologies, Kinematic and kinetic concepts for analyzing human motion, Kinetic concepts for analyzing human motion, Linear kinetics of human movement, Equilibrium, Angular kinetics of human Movement, Mechanical properties of soft tissues, bones, and muscles					
Unit II	BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM				9
Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and C Spinal Nerve Roots, Skeletal Muscle					

Unit III	BIOMECHANICS OF JOINTS AND HUMAN MOTION													9		
Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow Wrist, and Hand, Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment.																
Unit IV	COMPUTATIONAL APPROACHES IN BIOMECHANICS													9		
Finite Element Analysis in Biomechanics, Computational modelling of Vancouver Periprosthetic Fracture in Femur, Scaffolds, artificial hip and knee joints, Aortic Valve.																
Unit V	GAIT ANALYSIS													9		
Exoskeleton design, Ergonomics, Sports mechanics, Performance Analysis, Biomechanical analysis, 3D printing.																
Total periods: 45 PERIODS																
Text Books:																
1. Susan J Hall, —Basic Biomechanics, 6th Edition, The McGraw-Hill Companies Inc., 2011																
2. Jay D Humphrey and Sherry L Delange, —An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, 1st edition, Springer-Verlag, 2010																
References:																
1. Margareta Nordin and Victor H Frankel, —Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams and Wilkins, 2001.																
2. Ozkaya, Nihat, Nordin, and Margareta, —Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, 2nd Edition, Springer, 2009.																
3. Pritam Pain, Sreerup Banerjee, Goutam Kumar Bose , Advances in Computational Approaches in Biomechanics, 2022																
4. Kinetics and Dynamics: From Nano- to Bio-Scale: 12 (Challenges and Advances in Computational Chemistry and Physics)by Piotr Paneth and Agnieszka Dybala-Defratyka 12 August 2010																
5. Computational Approaches to Biochemical Reactivity: 19 (Understanding Chemical Reactivity) by Gábor Náray-Szabó and Arie Warshel 31 March 2002																
Course Outcomes:													Blooms Taxonomy			
CO1: Discuss the principles of mechanics.													Understand (K2)			
CO2: Elaborate the tissues and structures of the musculoskeletal system													Understand (K2)			
CO3: Discuss of joint mechanics and human motion.													Apply (K3)			
CO4: Create Examples of computational mathematical modelling applied in biomechanics.													Create (K6)			
CO5: Describe the analysis of human motion.													Analyze(K4)			
CO-PO Mapping																
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	
CO1	3	2		1			1						3	2		
CO2	3	2	2	2			1						3	3		
CO3	3	3	2	3	2		1						3	3		
CO4	3	3	3	3	3		2						3	3		
CO5	2	2	2	3	3		2						3	3		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23MEE047	ADVANCED STATISTICS AND DATA ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Engineering Mathematics and Probability & Statistics • Familiarity with Programming/Computational Tools (e.g., MATLAB, Python, or R) • Understanding of Data Handling and Visualization Concepts					
Course Objectives: • To introduce the basic concepts of linear regression and multiple regression • To introduce exploratory data analysis • To study logistic regression models for classification • To develop the forecasting techniques for the predictions • To introduce the time series analysis for the prediction of future behavior					
Unit I	REGRESSION				9
Introduction – Linear regression - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters – Modeling techniques. - Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-co linearity outliers, Ridge regression.					
Unit II	EXPLORATORY DATA ANALYSIS				9
Rise of statistics, Data Wrangling, Data Quality. Visual encoding – Mapping Data to Visual Variables, Encoding Effectiveness, Scales & Axes, Aspect Ratio, Regression Lines, Multidimensional Data, Parallel Coordinates, Dimensionality Reduction.					
Unit III	LOGISTIC AND MULTINOMIAL REGRESSION				9
Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, Hosmer Lemshow Test, Classification Table, Gini Co-efficient.					
Unit IV	FORECASTING AND CAUSAL MODELS				9
Moving average, Exponential Smoothing, Casual Models					
Unit V	TIME SERIES ANALYSIS				9
Auto regression (AR), Moving Average(MA) Models, ARMA, ARIMA models , Multivariate Models					
Total periods: 45 Periods					
Text Books:					
1. Douglas C Montgomery and George C Runges, “Applied Statistics and Probability for Engineers”, John Wiley & Sons, 2014.					
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulachi, “Introduction to Time Series Analysis and Forecasting” ,Wiley,2015					
References:					
1. David Forsyth, „Probability and Statistics for Computer Science“, Springer; 2018					
2. Michael J. Evans, Jeffrey S. Rosenthal, „Probability and Statistics - The Science of Uncertainty“. W H Freeman & Co, 2010					
3. Max Kuhn, Kjell Johnson, “Applied Predictive Modeling”, Springer, 2014.					
4. Ronald E. Walpole, Raymond H. Meyers, Sharon L. Meyers, “Probability and Statistics for Engineers and Scientists”, Pearson Education, 2014.					
5. Daniel T. Larose, Chantal D. Larose “Data Mining and Predictive Analytics”, Wiley,2015					
6. Thomas W.Miller, “Modeling Techniques in Predictive Analytics with Python and R: A guide to Data Science”, Pearson Education, 2014.					
Course Outcomes:					Blooms Taxonomy
CO1: Develop how to do regression fit for the given data.					Apply (K3)
CO2: Visualize the data through explanatory data analysis					Analyze(K4)

CO3: Classify the given data through logistic regression													Apply (K3)		
CO4: Analyzing forecasting techniques and causal inferences.													Analyze(K4)		
CO5: Utilize the effective time series analysis to predict/forecast the future behavior of data.													Evaluate / Create (K5/K6)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	2							2	3	2	
CO2	2	3	2	3	3							2	3	2	
CO3	2	3	2	3	2							2	3	3	
CO4	3	3	3	3	2							3	3	3	
CO5	2	3	3	3	3							3	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE048	CAD AND CAE	Category: PEC			
		L	T	P	C
		2	0	2	3
Prerequisites • Basic knowledge of Engineering Graphics and Engineering Mechanics • Understanding of Strength of Materials and Engineering Mathematics • Familiarity with any CAD software (AutoCAD, SolidWorks, CATIA, etc.)					
Course Objectives: • Applying the fundamental concepts of computer graphics and its tools in a generic framework. • Creating and manipulating geometric models using curves, surfaces, and solids. • Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering design. • Developing mathematical models for Boundary Value Problems and their numerical solution. • Formulating solution techniques to solve non-linear problems					
Unit I	FUNDAMENTALS OF COMPUTER GRAPHICS				9
Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics					
Unit II	GEOMETRIC MODELING				9
Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).					
Unit III	VISUAL REALISM and CAD STANDARDS				9
Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock’s Algorithm, Priority Algorithms– shading – coloring – computer animation. Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.					
Unit IV	FINITE ELEMENT ANALYSIS				9
Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element Equations – Linear and Higher order Shape functions – Bar, Beam Elements –Applications to Heat Transfer problems.					
Unit V	NON-LINEAR ANALYSIS				9

Introduction to Non-linear problems - some solution techniques- computational procedure- material non-linearity- Plasticity and visco-plasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing –Mesh quality- Error estimate- Introduction to Analysis Software.															
Total periods: 30 PERIODS															
LIST OF EXPERIMENTS															
1	Design and animate Piston Cylinder assembly and motion study using CAD software.														
2	Design and simulate Connecting rod and crank shaft using CAD software.														
3	Design and simulate Two Cylinder Engine assembly using CAD software.														
4	Coupled Simulation of structural /thermal analysis														
5	Harmonic, Transient and spectrum analysis of simple systems.														
6	buckling analysis														
Total periods: 30 PERIODS															
Text Books:															
1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007															
2.Seshu.P, “Textbook of Finite Element Analysis”, PHI Learning Pvt. Ltd., NewDelhi, 2012.															
References:															
1. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.															
2. Donald Hearn and M. Pauline Baker “Computer Graphics””. Prentice Hall, Inc, 1992.															
3. Foley, Wan Dam, Feiner and Hughes – “Computer graphics principles & practice”, Pearson Education - 2003															
4. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.															
5.Reddy,J.N. “Introduction to the Finite Element Method”, 4th Edition, Tata McGrawHill,2018.															
Course Outcomes:														Blooms Taxonomy	
CO1: Discuss the fundamental concepts of computer graphics and its tools in a generic framework.														Understand (K2)	
CO2: Create and manipulate geometric models using curves, surfaces and solids.														Apply (K3)	
CO3: Discuss concept of 3D modeling , visual realism and standard CAD practices in engineering design.														Analyze(K4)	
CO4: Develop the mathematical models for one dimensional finite element problems and their numerical solutions.														Apply (K3)	
CO5: Formulate solution techniques to solve non-linear problems.														Evaluate / Create (K5/K6)	
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2							2	3	2	-
CO2	2	3	3	3	3							2	3	3	2
CO3	2	2	3	3	3							3	3	3	3
CO4	3	3	3	3	3							3	3	3	2
CO5	3	3	3	3	3							3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE049	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic understanding ofLinear Algebra, Probability, and Statistics - Knowledge ofProgramming (Python / MATLAB) - Familiarity withArtificial Intelligence and Robotics fundamentals					
Course Objectives: - To introduce basic machine learning techniques such as regression, classification - To learn about introduction of clustering, types and segmentation methods - To learn about fuzzy logic, fuzzification and defuzzification - To learn about basics of neural networks and neuro fuzzy networks. - To learn about Recurrent neural networks and Reinforcement learning.					
Unit I	INTRODUCTION TO MACHINE LEARNING				9
Philosophy of learning in computers, Overview of different forms of learning, Classifications vs.Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.					
Unit II	CLUSTERING AND SEGMENTATION METHODS				9
Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.					
Unit III	FUZZY LOGIC				9
Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application.					
Unit IV	NEURAL NETWORKS				9
Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics.					
Unit V	RNN AND REINFORCEMENT LEARNING				9
Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics.					
Total periods: 45 PERIODS					
Text Books:					
1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addison Wesley, England, 2011					
References:					
1. Bruno Siciliano, Oussama Khatib, “Handbook of Robotics”, 2016 2nd Edition, Springer					
2. Simon Haykin, “Neural Networks and Learning Machines: A Comprehensive Foundation”, Third Edition, Pearson, delhi 2016.					
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, 4th Edition, Chichester, 2011, Sussex Wiley.					

Course Outcomes:													Blooms Taxonomy		
CO1: Understand basic machine learning techniques such as regression, classification													Understand (K2)		
CO2: Understand about clustering and segmentation													Apply (K3)		
CO3: Model a fuzzy logic system with fuzzification and defuzzification													Apply / Analyze(K3/K4)		
CO4: Understand the concepts of neural networks and neuro fuzzy networks.													Understand / Analyze(K2/K4)		
CO5: Gain knowledge on Reinforcement learning.													Apply / Evaluate (K3/K5)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2							2	3	2	-
CO2	2	3	3	3	3							2	3	3	2
CO3	2	3	3	3	3							3	3	3	3
CO4	3	3	3	3	3							3	3	3	3
CO5	3	3	3	3	3							3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL 8

23MEE050	AUTOMOBILE ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Thermodynamics and Internal Combustion Engines • Understanding of Mechanical Design and Manufacturing Processes					
Course Objectives: • To study the construction and working principle of various parts of an automobile. • To study the practice for assembling and dismantling of engine parts and transmission system • To study various transmission systems of automobile. • To study about steering, brakes and suspension systems • To study alternative energy sources					
Unit I	VEHICLE STRUCTURE AND ENGINES				9
Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).					
Unit II	ENGINE AUXILIARY SYSTEMS				9
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).					
Unit III	TRANSMISSION SYSTEMS				9
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.					
Unit IV	STEERING, BRAKES AND SUSPENSION SYSTEMS				9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS),electronic brake force distribution (EBD) and Traction Control.															
Unit V		ALTERNATIVE ENERGY SOURCES											9		
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles-Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.															
Total periods: 45 PERIODS															
Text Books:															
1. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.															
2. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.															
References:															
1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2012.															
2. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.															
3. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.															
4. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart - Will Cox Company Inc, USA ,1978.															
5. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Recognize the various parts of the automobile and their functions and materials.													Remember / Understand (K1/K2)		
CO2: Discuss the engine auxiliary systems and engine emission control.													Understand (K2)		
CO3: Distinguish the working of different types of transmission systems.													Analyze(K4)		
CO4: Explain the Steering, Brakes and Suspension Systems.													Understand / Analyze (K2/K4)		
CO5: Predict possible alternate sources of energy for IC Engines.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1		1					1	3	2	1
CO2	3	3	2	2	2		2					1	3	3	2
CO3	3	3	3	2	3		2					1	3	3	2
CO4	3	2	2	2	3		2					1	3	2	2
CO5	3	3	3	3	3		3	2				2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE051	MEASUREMENTS AND CONTROLS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Physics (fundamentals of mechanics, electricity, and thermodynamics) • Basic Electrical and Electronics Engineering • Fundamentals of Instrumentation and Sensors • Engineering Mathematics (Statistics and Laplace transforms)					

Course Objectives:															
- To Identify measurement parameters and analyze errors of measurements. - To Select and apply suitable transducer for a particular measurement. - To identify measurement parameters and select the appropriate sensor for it. - To Explain the working of various types of control systems of apply for specific applications. - To apply the principle of automatic control systems to control various parameter(s).															
Unit I		MEASUREMENTS AND ERROR ANALYSIS											9		
General concepts – Units and standards – Measuring instruments –sensitivity, readability, range, accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors – Statistical analysis of experimental data – Regression analysis – Curve fitting - calibration and Uncertainty.															
Unit II		INSTRUMENTS											9		
Transducer, modifying (intermediate) and Terminal stages – Mechanical and electrical transducers, preamplifiers – charge amplifiers – filters – attenuators – D" Arsonval – CRO – Oscillographs – recorders – microprocessorbased data logging, processing and output															
Unit III		PARAMETERS FOR MEASUREMENT											9		
Dimension, displacement, velocity, acceleration, Impact – Force, torque, power- Pressure, Temperature, Heat Flux, Heat Transfer Coefficients, Humidity – Flow – Velocity - Time, frequency and phase angle – noise and sound level.															
Unit IV		CONTROL SYSTEMS											9		
Basic elements – feedback principle, implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – Electrical, magnetic, electronic control systems.															
Unit V		APPLICATION OF CONTROL SYSTEMS											9		
Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls – designing of measurement and control systems for different applications.															
Total periods:45 PERIODS															
Text Books:															
1. Venkateshan S P, Mechanical Measurements, 2ndEdition, John Wiley & Sons, Ltd, 2015.															
2.William Bolton, Instrumentation and Control Systems, 2ndEdition, Newnes, 2015.															
References:															
1.Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013.															
2.Ernest Doebelin and DhaneshManik, Measurement Systems, McGraw Hill InternationalEdition, 2017.															
3.Holman J P, “Experimental Methods for Engineers”, McGraw Hill Int. Edition, 7th Ed., 2017.															
4.Nagrath I J, “Control Systems Engineering”, New Age International Publishers, 2018.															
5.NakraB.C and Chaudhry K.K, Instrumentation, Measurement, and Analysis, Tata McGraw Hill, 4th Edition, 2016.															
Course Outcomes:													Blooms Taxonomy		
CO1: Identify measurement parameters and analyze errors of measurements.													Understand (K2)		
CO2: Select and apply suitable transducer for a particular measurement.													Applying (K3)		
CO3: Identify measurement parameters and select the appropriate sensor for it.													Applying (K3)		
CO4: Explain the working of various types of control systems of apply for specificapplications.													Analyzing (K4)		
CO5: Apply the principle of automatic control systems to control various parameter(s).													Analyzing (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1							2	3		
CO2	3	2	2	3	2							2	3	2	
CO3	2	3	2	3	2							2	3	3	
CO4	3	2	3	3	2				1			3	3	2	

CO5	3	2	3	3	3				1			3	3	2	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE052	DESIGN CONCEPTS IN ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Graphics and Design • Engineering Mechanics • Manufacturing Technology • Basics of Materials Science					
Course Objectives: • To study the various design requirements and get acquainted with the processes involved in product development. • To study the design processes to develop a successful product. • To learn scientific approaches to provide design solutions. • Designing solution through relate the human needs and provide a solution. • To study the principles of material selection, costing and manufacturing in design.					
Unit I	DESIGN TERMINOLOGY				9
Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.					
Unit II	INTRODUCTION TO DESIGN PROCESSES				9
Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirementsQuality Function Deployment (QFD)- product design specifications-generation of alternative solutionsAnalysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluati					
Unit III	CREATIVITY IN DESIGN				9
Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocksCreativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts					
Unit IV	HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT				9
Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects					
Unit V	MATERIAL AND PROCESSES IN DESIGN				9
Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).					
Total periods:45 PERIODS					
Text Books:					
1.Dieter. G. N., Linda C. Schmidt, “Engineering Design”, McGraw Hill, 2013..					
2.Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.					
References:					
1.Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998					
2. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, “Integrated Product and Process Design and Development”, CRC Press, 2009.					
3. James Garratt, “Design and Technology”, Cambridge University Press, 1996.					
4. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, “Mechanical Engineering Design”, McGraw Hill Professional, 2003					

5. Sumesh Krishnan and MukulSukla. Concepts in Engineering Design, Notion Press, 2016.															
Course Outcomes:														Blooms Taxonomy	
CO1: Analyze the various design requirements and get acquainted with the processes involved in product development.														Analyzing (K4)	
CO2: Apply the design processes to develop a successful product.														Applying (K3)	
CO3: Apply scientific approaches to provide design solutions.														Applying (K3)	
CO4: Design solution through relate the human needs and provide a solution.														Creating (K6)	
CO5: Apply the principles of material selection, costing and manufacturing in design.														Applying (K3)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2							2	3	2	
CO2	3	2	3	3	3							2	3	3	
CO3	2	3	3	3	3							2	3	3	
CO4	2	2	3	2	3	3	3	3	2	3	2	2	3	3	
CO5	3	2	3	3	3	2	2		1	2		2	3	2	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE053	COMPOSITE MATERIALS AND MECHANICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Strength of Materials • Mechanics of Solids • Engineering Materials and Metallurgy • Basic Manufacturing Processes					
Course Objectives: • To study the fundamentals of composite material strength and its mechanical behavior • To study the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber. • To study Thermo-mechanical behavior and study of residual stresses in Laminates during processing. • To Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips. • To study the fundamentals of composite material strength and its mechanical					
Unit I	INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS &MANUFACTURING				9
Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramicand Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke’s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina – Transformation Matrix, Transformed Stiffness. Manufacturing:Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes					
Unit II	FLAT PLATE LAMINATE CONSTITUTE EQUATIONS				9
Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.					
Unit III	LAMINA STRENGTH ANALYSIS				9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure															
Unit IV		THERMAL ANALYSIS												9	
Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations –Unidirectional, Offaxis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.															
Unit V		ANALYSIS OF LAMINATED FLAT PLATES												9	
Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies															
Total periods:45 PERIODS															
Text Books:															
1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.															
2. Hyer, M.W., “Stress Analysis of Fiber – Reinforced Composite Materials”, McGraw Hill, 1998															
References:															
1. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 1990.															
2. Halpin, J.C., “Primer on Composite Materials, Analysis”, Technomic Publishing Co., 1984.															
3. Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press-2006, First Indian Edition - 2007															
4. Mallick, P.K., Fiber,” Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 1993.															
5. Mallick, P.K. and Newman, S., (edition), “Composite Materials Technology: Processes and Properties”, Hansen Publisher, Munish, 1990.															
Course Outcomes:													Blooms Taxonomy		
CO1:Summarize the various types of Fibers, Equations and manufacturing methods for.													Understanding (K2)		
CO2:Derive Flat plate Laminate equations.													Applying (K3)		
CO3:Analyze Lamina strength.													Analyzing (K4)		
CO4:Analyze the thermal behavior of Composite laminates													Analyzing (K4)		
CO5:Analyze Laminate flat plates.													Analyzing (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1							2	3	2	
CO2	3	3	3	3	2							2	3	3	
CO3	3	3	2	3	2							2	3	3	
CO4	3	3	2	3	2							2	3	3	
CO5	3	3	3	3	2							3	3	3	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE054	ELECTRICAL DRIVES AND CONTROL	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Electrical and Electronics Engineering • Engineering Physics (Electromagnetism fundamentals) • Power Electronics (basic converter circuits) • Engineering Mathematics (Laplace transforms and differential equations)					
Course Objectives: • To learn the basic concepts of different types of electrical machines and their performance. • To study the different methods of starting D.C motors and induction motors • To study the conventional and solid-state drives • To study the conventional and solid-state speed control of D.C. drives • To study the conventional and solid-state speed control of A.C. drives					
Unit I	INTRODUCTION				9
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives– heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors					
Unit II	DRIVE MOTOR CHARACTERISTICS				9
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors– Braking of Electrical motors – DC motors: Shunt, series, and compound - single phase and three phase induction motors.					
Unit III	STARTING METHODS				9
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phases quirrel cage and slip ring induction motors					
Unit IV	CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF D.C. DRIVES				9
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.					
Unit V	CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF A.C. DRIVES				9
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.					
Total periods:45 PERIODS					
Text Books:					
1. Nagrath I.J.&Kothari.D.P, “Electrical Machines”, Tata McGraw-Hill, 2006					
2. VedamSubrahmaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010					
References:					
1. Partab. H., “Art and Science and Utilisation of Electrical Energy”, Dhanpat Rai and Sons, 2017.					
2. Pillai.S.K “A First Course on Electric Drives”, Wiley Eastern Limited, 2012					
3. Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2006.					
4. Fundamentals Of Electric Drives AndControlby B.R. Gupta and V. Singhal 1 January 2013					
5. Advanced Electrical Drives - Analysis ModelingControlby Rik De Doncker, Andre Veltman, et al. 1 January 2014					
Course Outcomes:					Blooms Taxonomy
CO1: Discuss the basic concepts of different types of electrical machines and their performance...					Understanding (K2)
CO2: Explain the different methods of starting D.C motors and induction motors.					Understanding (K2)
CO3: Discuss the conventional and solid-state drives.					Understanding (K2)
CO4: Describe the conventional and solid-state speed control of D.C. drives					Applying (K3)
CO5: Explain the conventional and solid-state speed control of A.C. drives.					Applying (K3)

CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1							2	3	2	
CO2	3	3	2	2	1							2	3	2	
CO3	3	3	2	2	2							2	3	2	
CO4	3	3	3	3	3							2	3	3	
CO5	3	3	3	3	3							3	3	3	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE055	POWER PLANT ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Thermodynamics • Applied Thermodynamics / Thermal Engineering • Fluid Mechanics and Heat Transfer • Basic Electrical Engineering					
Course Objectives: • To study the coal based thermal power plants. • To study the diesel, gas turbine and combined cycle power plants. • To learn the basic of nuclear engineering and power plants. • To learn the power from renewable energy • To study energy, economic and environmental issues of power plants					
Unit I	COAL BASED THERMAL POWER PLANTS				9
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.					
Unit II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS				9
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.					
Unit III	NUCLEAR POWER PLANTS				9
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.					
Unit IV	POWER FROM RENEWABLE ENERGY				9
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal,Biogas and Fuel Cell power systems.					
Unit V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS				9
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.					
Total periods:45 PERIODS					
Text Books:					
1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.					
2. A Textbook of Power Plant Engineeringby R.K. Rajput 1 January 2016					
References:					
1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.					

2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.															
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.															
4. Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar 1 November 2019.															
5. Power Plant Engineering As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. 1 January 2019.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the layout, construction and working of the components inside a thermal power plant.													Understanding (K2)		
CO2: Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.													Understanding (K2)		
CO3: Explain the layout, construction and working of the components inside nuclear power plants.													Understanding (K2)		
CO4: Explain the layout, construction and working of the components inside Renewable energy power plants													Understanding (K2)		
CO5: Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.													Understanding (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1		1			1		1	3	2	
CO2	3	2	2	1	1		1			1		1	3	2	
CO3	3	2	2	1	1	1	2	1		1		1	3	2	
CO4	3	2	2	2	2	1	3	1		1		1	3	3	2
CO5	2	3	3	3	2	3	3	2		2	2	3	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE056	REFRIGERATION AND AIR CONDITIONING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Thermodynamics • Fluid Mechanics and Heat Transfer • Basic Mechanical Systems and Energy Conversion Concepts					
Course Objectives: • To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components. • To provide knowledge on design aspects of Refrigeration & Air conditioning systems. • To study the Vapour absorption and air refrigeration systems. • To learn the psychrometric properties and processes. • To study the air conditioning systems and load estimation.					
Unit I	INTRODUCTION				9
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.					
Unit II	VAPOUR COMPRESSION REFRIGERATION SYSTEM				9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system –low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.															
Unit III		OTHER REFRIGERATION SYSTEMS												9	
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic Vortex and Pulse tube refrigeration systems.															
Unit IV		PSYCHROMETRIC PROPERTIES AND PROCESSES												9	
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.															
Unit V		AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION												9	
Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system;Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors,Actuators& Safety controls.															
Total periods:45 PERIODS															
Text Books:															
1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010															
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi 10 February 2019															
References:															
1. ASHRAE Hand book, Fundamentals, 2010															
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007															
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.															
4. Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.															
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput 1 January 2013															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the basic concepts of Refrigeration													Understanding (K2)		
CO2: Explain the Vapor compression Refrigeration systems and to solve problems													Apply / Analyze (K3/K4)		
CO3: Discuss the various types of Refrigeration systems													Understanding (K2)		
CO4: Calculate the Psychrometric properties and its use in psychrometric processes													Apply (K3)		
CO5: Explain the concepts of Air conditioning and to solve problems													Apply / Analyze (K3/K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1		1			1		1	3	2	3
CO2	3	3	3	2	2		1			1		2	3	3	3
CO3	3	2	2	1	1	1	2			1		1	3	2	3
CO4	3	3	2	2	2	1	1			1		2	3	3	3
CO5	3	3	3	3	2	2	2	1		2	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE057	DYNAMICS OF GROUND VEHICLES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Engineering Mechanics - Theory of Machines / Dynamics of Machinery - Vibrations and Vehicle Systems Fundamentals - Mathematics and Differential Equations					
Course Objectives: The objective of this course is to make the students to Develop physical and mathematical models to predict the dynamic response of vehicles					
Unit I	CONCEPT OF VIBRATION				9
Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed.					
Unit II	TYRES				9
Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre.					
Unit III	VERTICAL DYNAMICS				9
Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. Design and analysis of Passive, Semi active and Active suspension using Quarter car, Bicycle Model, half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties.					
Unit IV	LONGITUDINAL DYNAMICS AND CONTROL				9
Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Estimation of CG location. Stability of vehicles resting on slope. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.					
Unit V	LATERAL DYNAMICS				9
Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.					
Total periods:45 PERIODS					
Text Books:					
1. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008					
2. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010					
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014					
References:					
1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013					
2. Hans B Pacejka, "Tyre and Vehicle Dynamics," Second edition, SAE International, 2005					
3. John C. Dixon, "Tyres, Suspension, and Handling, " Second Edition, Society of Automotive Engineers Inc, 1996					
4. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics",Elsevier Limited, 2004					
5. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013					
Course Outcomes:					Blooms Taxonomy
CO1:Develop physical and mathematical models to predict the dynamic response of					Apply / Analyze

vehicles													(K3/K4)		
CO2:Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response													Apply / Evaluate (K3/K5)		
CO3:Use dynamic analyses in the design of vehicles.													Analyze / Create (K4/K6)		
CO4:Understand the principle behind the lateral dynamics.													Understand (K2)		
CO5:Evaluate the longitudinal dynamics and control in an automobile													Apply / Evaluate (K3/K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2					1		2	3	3	2
CO2	3	3	3	3	2	1				1		2	3	3	2
CO3	3	3	3	3	3					1		2	3	3	3
CO4	2	2	2	1	1					1		1	2	2	2
CO5	3	3	3	3	3	1	1			2	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

VERTICAL 9

23MEE058	TURBO MACHINES	Category: PEC			
		L	T	P	C
		3	0	0	3
- Prerequisites - Engineering Thermodynamics - Fluid Mechanics - Applied Thermodynamics / Thermal Engineering - Basics of Energy Conversion Systems					
Course Objectives: - To study the energy transfer in rotor and stator parts of the turbo machines. - To study the function of various elements of centrifugal fans and blowers. - To evaluating the working and performance of centrifugal compressor - To analyzing flow behavior and flow losses in axial flow compressor. - To study the types and working of axial and radial flow turbines.					
Unit I	WORKING PRINCIPLES				9
Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction.Dimensionless parameters for Turbomachines.					
Unit II	CENTRIFUGAL FANS AND BLOWERS				9
Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-sdiagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan –bearings, drives and noise					
Unit III	CENTRIFUGAL COMPRESSOR				9
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction.Performance characteristics and various losses. Geometry and performancecalculation.					
Unit IV	AXIAL FLOW COMPRESSOR				9
Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor.Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forcedvortexflow.					
Unit V	AXIAL AND RADIAL FLOW TURBINES				9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types– Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.															
Total periods:45 PERIODS															
Text Books:															
1. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011. .															
2. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.															
References:															
1. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, ButterworthHeinemann, 2014.															
2. Gopalakrishnan. G and Prithvi Raj. D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.															
3. Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996.															
4. Saravanamuttoo, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.															
5. Venkanna, B.K., “Fundamentals of Turbomachinery”, PHI Learning Pvt. Ltd., 2009															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the energy transfer in rotor and stator parts of the turbo machines.													Understand (K2)		
CO2: Explain the function of various elements of centrifugal fans and blowers													Understand (K2)		
CO3: Evaluate the working and performance of centrifugal compressor.													Analyze / Evaluate (K4/K5)		
CO4: Analyze flow behavior and flow losses in axial flow compressor.													Analyze (K4)		
CO5: Explain the types and working of axial and radial flow turbines													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1					1		1	3	2	
CO2	3	2	2	1	1					1		1	3	2	
CO3	3	3	3	2	2					1		2	3	3	2
CO4	3	3	3	2	2					1		2	3	3	2
CO5	3	2	2	1	1	1				1		1	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE059	NON-TRADITIONAL MACHINING PROCESSES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Manufacturing Processes / Machining Fundamentals • Material Science • Engineering Drawing & Design					
Course Objectives: • To classify non-traditional machining processes and describe mechanical energy based nontraditional Machining processes. • To differentiate chemical and electro chemical energy-based processes. • To describe thermo-electric energy-based processes • To explain nano finishing processes. • To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes					
Unit I	INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES				9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.															
Unit II		CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES												9	
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.															
Unit III		THERMO-ELECTRIC ENERGY BASED PROCESSES												9	
Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.															
Unit IV		NANO FINISHING PROCESSES												9	
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.															
Unit V		HYBRID NON-TRADITIONAL MACHINING PROCESSES												9	
Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, application															
Total periods:45 PERIODS															
Text Books:															
1. Adithan. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458															
2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.															
References:															
1. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.															
2. Carl Sommer, “Non-Traditional Machining Handbook”, Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.															
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., “Non-traditional Micromachining Processes: Fundamentals and Applications”, Springer International Publishing., Switzerland, 2017, ISBN:978-3319 52008-7.															
4. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.															
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., “Hybrid Machining Processes: Perspectives on Machining and Finishing”, 1st edition, Springer International Publishing., Switzerland, 2016, ISBN13: 978-3319259208.															
Course Outcomes:													Blooms Taxonomy		
CO1: Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.													Analyze / Evaluate (K4/K5)		
CO2: Illustrate chemical and electro chemical energy based processes.													Understand / Apply (K2/K3)		
CO3: Evaluate thermo-electric energy based processes.													Evaluate (K5)		
CO4: Interpret nano finishing processes.													Understand / Analyze (K2/K4)		
CO5: Analyse hybrid non-traditional machining processes and differentiate non- traditional machining processes.													Analyze / Evaluate (K4/K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1					1		1	3	2	2
CO2	3	2	2	1	1					1		1	3	2	2
CO3	3	2	3	1	1					1		2	3	2	2
CO4	3	2	2	1	1					1		2	3	2	2

CO5	3	3	3	2	2					1		2	3	3	3
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE060	INDUSTRIAL SAFETY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of Mechanical Engineering - Manufacturing Processes / Workshop Practice - Material Science					
Course Objectives: - To study the fundamental concept and principles of industrial safety - To study the principles of maintenance engineering. - To Analyzing the wear and its reduction. - To study the faults in various tools, equipments and machines. - To study the periodic maintenance procedures in preventive maintenance.					
Unit I	INDUSTRIAL SAFETY				9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.					
Unit II	MAINTENANCE ENGINEERING				9
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.					
Unit III	WEAR AND CORROSION AND THEIR PREVENTION				9
Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.					
Unit IV	FAULT TRACING				9
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.					
Unit V	PERIODIC AND PREVENTIVE MAINTENANCE				9
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.					
Total periods:45 PERIODS					
Text Books:					
1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.					
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.					
3.Er. SushilKumar Srivastava, Maintenance Engineering (Principles,Practicesand Management) ,S.Chand& Company PVT Ltd. New Delhi.					
References:					

1. Edward Ghali, V. S. Sastri, M. Elboudjaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.															
2. Garg, HP, Maintenance Engineering, S. Chand Publishing.															
3. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.															
4. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.															
5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the fundamental concept and principles of industrial safety													Understand		
CO2: Apply the principles of maintenance engineering.													Apply		
CO3: Analyze the wear and its reduction.													Analyze		
CO4: Evaluate faults in various tools, equipments and machines													Evaluate		
CO5: Apply periodic maintenance procedures in preventive maintenance.													Apply / Analyze		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	3	2	2	2	1							1	3	2	1
CO3	3	2	3	2	1							2	3	2	1
CO4	3	2	3	2	2							2	3	3	2
CO5	3	2	3	2	2							2	3	3	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE061	DESIGN OF TRANSMISSION SYSTEM	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Knowledge of Strength of Materials • Knowledge of Theory of Machines • Basic understanding of Design of Machine Elements					
Course Objectives: • To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components. • To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears. • To learn the design bevel, worm and cross helical gears of Transmission system. • To learn the concepts of design multi and variable speed gear box for machine tool applications. • To learn the concepts of design to cams, brakes and clutches					
Unit I	DESIGN OF FLEXIBLE ELEMENTS				9
Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.					
Unit II	SPUR GEARS AND PARALLEL AXIS HELICAL GEARS				9
Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear					
Unit III	BEVEL, WORM AND CROSS HELICAL GEARS				9
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical:					
Unit IV	GEAR BOXES				9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.															
Unit V		CAMS, CLUTCHES AND BRAKES												9	
Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.															
Total periods:45 PERIODS															
Text Books:															
1. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.															
2. Jalaludeen.Md.S.”Machine design volume –II” Anuradha publications ,2018															
References:															
1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.															
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.															
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.															
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley,2005															
5.Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications,Chennai, 2003.															
Course Outcomes:														Blooms Taxonomy	
CO 1: Apply the concepts of design to belts, chains and rope drives.														Apply (K3)	
CO2: Apply the concepts of design to spur, helical gears.														Apply (K3)	
CO3: Apply the concepts of design to worm and bevel gears.														Apply (K3)	
CO4: Apply the concepts of design to gear boxes.														Analyze (K4)	
CO5: Apply the concepts of design to cams, brakes and clutches														Create (K6)	
CO-PO Mapping															
Particular	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1							1	3	2	
CO2	3	2	3	2	2							1	3	2	
CO3	3	2	3	2	2							1	3	3	
CO4	3	3	3	3	3							2	3	3	
CO5	3	3	3	3	2							2	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE062	THERMAL POWER ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Thermodynamics • Basic knowledge of Fluid Mechanics • Familiarity with Heat Transfer principles					
Course Objectives: • To study the fuel properties and arrive at proximate and ultimate analysis of fuels. • To study the different types of boilers and compute their performance parameters. • To study the performance parameters of an air compressor • To study the working principles of various refrigeration systems and perform cop calculations • To study the psychrometric properties and how they are utilized in arriving at calculations to determine					

heating loads															
Unit I	FUELS AND COMBUSTION													9	
Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value -Gross & Net Calorific Values															
Unit II	BOILERS													9	
Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.															
Unit III	AIR COMPRESSORS													9	
Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.															
Unit IV	REFRIGERATION SYSTEMS													9	
Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration.															
Unit V	PSYCHROMETRY AND AIR-CONDITIONING													9	
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.															
Total periods:45 PERIODS															
Text Books:															
1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.															
2. Ballaney. P, “ Thermal Engineering”, 25th Edition, Khanna Publishers, 2017															
References:															
1. Ananthanarayanan P.N, “ Basic Refrigeration and Air-Conditioning”, 4th Edition, Tata McGraw Hill, 2013.															
2. Arora, “ Refrigeration and Air-Conditioning”, 2nd Edition, Prentice Hall of India, 2010.															
3. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd,															
4. Nag P.K, “ Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2010															
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels.													Evaluate (K5)		
CO2:Analyze different types of boilers and compute their performance parameters.													Analyze (K4)		
CO3: Evaluate the performance parameters of an air compressor													Evaluate		
CO4: Apply the working principles of various refrigeration systems and perform cop calculations.													Apply (K3)		
CO5:Analyze the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1							1	3	2	
CO2	3	3	3	3	2							2	3	2	
CO3	3	3	3	3	2							2	3	3	
CO4	3	2	3	2	2							1	3	3	
CO5	3	3	3	3	2							2	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE063	DESIGN FOR MANUFACTURING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Materials • Manufacturing Processes (Casting, Forming, Machining, Welding basics) • Engineering Graphics / Machine Drawing • Basic Engineering Mechanics					
Course Objectives: • To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products. • To learn design consideration principles of forming in the design of extruded, stamped, and forged products. • To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products. • To learn design consideration principles of welding in the design of welded products. • To learn design consideration principles of assembly in the design of assembled products.					
Unit I	INTRODUCTION AND CASTING				9
Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.					
Unit II	FORMING				9
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts.					
Unit III	MACHINING				9
Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.					
Unit IV	WELDING				9
Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.					
Unit V	ASSEMBLY				9
Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.					
TOTAL:45 PERIODS					
Text Books:					
1. James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill, 1986.					
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.					
References:					
1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.					
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.					
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.					
4. Henry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.					
5. Matousek, “Engineering Design”, Blackie & Sons, 1956.					
Course Outcomes:					Blooms Taxonomy
CO1: Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.					Understand & Apply (K2/K3)
CO2: Explain design consideration principles of forming in the design of extruded, stamped, and forged products.					Understand (K2)

CO3: Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.													Understand (K2)		
CO4: Explain design consideration principles of welding in the design of welded products.													Understand (K2)		
CO5: Explain design consideration principles of assembly in the design of assembled products.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1					1		1	3	2	
CO2	3	2	2	1	1					1		1	3	2	
CO3	3	2	3	1	2					1		1	3	3	
CO4	2	2	3	1	1					1		1	2	3	
CO5	2	1	3	1	2				1	2		1	2	3	
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MEE064	POWER GENERATION EQUIPMENT DESIGN	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Thermodynamics • Basic knowledge of Fluid Mechanics and Heat Transfer • Familiarity with Thermal Engineering concepts					
Course Objectives: • To introduce the power generation equipmentstypes layouts working cycles. • To learn the fuels, combustion and burning methods of combustion system. • To study the various boilers and its boilers parts of steam power plant. • To study the basics of nuclear fuels and reactor classification. • To study of techno economics and operating cost and safety of power plant.					
Unit I	INTRODUCTION				9
Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine					
Unit II	COMBUSTION SYSTEM				9
Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system.					
Unit III	STEAM POWER PLANT				9
Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmade, Hortmen and Velox boilers, Fluidised Bed & Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers.					
Unit IV	NUCLEAR POWER PLANT				9
Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled					

Unit V	TECHNO ECONOMICS OF POWER PLANT												9		
Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant.															
Total periods:45 PERIODS															
Text Books:															
1. Power Plant Engineering - PK Nag															
2. A Textbook of Power Plant Engineering - Rajput															
References:															
1. Basics of Boiler and HRSG Design - Brad Buecker															
2. Steam Plant Operation-Everett B. Woodruff,Herbert B. Lammers,Thomas F. Lammers															
3. Nuclear Power Plant Design and Analysis Codes Development Validation and Application 2020 Edition by Jun Wang, Xin Li, Chris Allison, Judy Hohorst , Elsevier															
4. A Techno-Economic Analysis of Solar Thermal Power Plant by Malik Monu and Saini R P 8 November 2012															
5. Power Plant Engineering by Dilip Vairagkar 1 January 2019															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss the power generation equipmentstypes layouts working cycles.													Understand (K2)		
CO2: Explain the fuels, combustion and burning methods of combustion system.													Understand (K2)		
CO3: Discuss the various boilers and its boilers parts of steam power plant.													Understand (K2)		
CO4: Explain the basics of nuclear fuels and reactor classification.													Understand (K2)		
CO5: Discuss of techno economics and operating cost and safety of power plant.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1							1	3	2	
CO2	3	2	2	2	1							1	3	2	
CO3	3	2	2	2	2							1	3	3	
CO4	3	2	2	2	1							1	3	2	
CO5	3	3	3	3	2	2		2				2	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL 10

23MEE065	ADVANCED VEHICLE ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Fundamentals of Automobile Engineering • Basics of Electrical Machines and Control Systems • Knowledge of Vehicle Dynamics and Sensors & Actuators					

Course Objectives:																
- To introduce the basic concepts of electric vehicle and their characteristics - To introduce different types of motors and the selection of motor for vehicle applications. - To acquaint the student with different sensors and systems used in autonomous and connected vehicles. - To give an overview of networking with sensors and systems. - To introduce the modern methods of diagnosing on-board the vehicle troubles.																
Unit I		ELECTRIC VEHICLES												9		
EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.																
Unit II		ELECTRIC VEHICLE MOTORS												9		
Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.																
Unit III		AUTONOMOUS AND CONNECTED VEHICLES												9		
Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.																
Unit IV		AUTOMOTIVE NETWORKING												9		
Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.																
Unit V		ON-BOARD TESTING												9		
Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system.																
Total periods:45 PERIODS																
Text Books:																
1 John G Hayes and G AbaasGoodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2018																
2 Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020.																
References:																
1 Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2007.																
2 Hong Cheng, —Autonomous Intelligent Vehicles: Theory, Algorithms & Implementation, Springer, 2011																
3 Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures)by Andrew M Wright and Harrison R Scott 5 September 2012																
4 Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT 17 July 2002																
5 Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey 1 September																
Course Outcomes:														Blooms Taxonomy		
CO1: Acquire an overview of electric vehicles and their importance in automotive.														Understand (K2)		
CO2: Discuss the characteristics and the selection of traction motor.														Apply (K3)		
CO3: Comprehend the vehicle-to-vehicle and autonomous technology.														Apply (K3)		
CO4: Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.														Analyze (K4)		
CO5: Be familiar with on-board diagnostics systems.														Understand (K2)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1				2	1				1	3	2		
CO2	3	3	2	1	2		1					1	3	2		

CO3	2	2	2	2	3		2	1		1		2	2	3	
CO4	2	3	3	3	3		2	1	1	2		3	3	3	2
CO5	1	2	2	3	3		3	2	-	1		2	2	3	2
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MEE066	ADVANCED INTERNAL COMBUSTION ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Thermodynamics – Understanding of energy, heat, and work. • Fluid Mechanics – Knowledge of flow properties relevant to fuel injection and air motion. • Engineering Thermodynamics / IC Engines – Introductory knowledge of internal combustion engines, combustion process, and engine components. • Mechanical Measurements & Instrumentation – For emission measurement techniques.					
Course Objectives: • To study the working of Gasoline fuel injection systems and SI combustion. • To study the working of Diesel fuel injection systems and CI combustion. • To Identifying the source and measure it; explain the mechanism of emission formation and control methods. • To study the Selecting alternative fuel resources and its utilization techniques in IC engines. • To study the advanced combustion modes and future power train systems.					
Unit I	SPARK IGNITION ENGINES				9
Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.					
Unit II	COMPRESSION IGNITION ENGINES				9
Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.					
Unit III	EMISSION FORMATION AND CONTROL				9
Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.					
Unit IV	ALTERNATIVE FUELS				9
Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.					
Unit V	ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM				9
Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles – Fuel Cells.					
Total periods:45 PERIODS					
Text Books:					
1. V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012					
2. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.					
References:					
1. B.P. Pundir, “IC Engines Combustion & Emission”, Narosa Publishing House, 2014.					
2. Duffy Smith, “Auto Fuel Systems”, The Good Heart Wilcox Company, Inc., 2003.					

3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.															
4.K.K. Ramalingam, “Internal Combustion Engine Fundamentals”, SciTech Publications, 2011.															
5. R.B. Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai& Sons, 2007															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the working of Gasoline fuel injection systems and SI combustion.													Understand (K2)		
CO2: Explain the working of Diesel fuel injection systems and CI combustion.													Understand (K2)		
CO3: Identify the source and measure it; explain the mechanism of emission formation and control methods.													Analyze (K4)		
CO4: Select alternative fuel resources and its utilization techniques in IC engines													Apply/Analyze (K3/K4)		
CO5: Explain advanced combustion modes and future power train systems.													Understand/Analyze (K2/K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1		1							2		
CO2	2	2		1		1							2		
CO3	3	2	2	2	-	2							3	2	
CO4	2	2	2	2	2	2							2	3	
CO5	2	2	2	2	2	2							2	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE067	CASTING AND WELDING PROCESSES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Materials Science and Engineering – Knowledge of crystal structures, phase diagrams, and mechanical properties. • Manufacturing Processes – Familiarity with basic casting and welding techniques. • Metallurgy of Ferrous and Non-Ferrous Metals – Understanding of steel and alloy behavior. • Mechanical Measurements & Quality Control – For evaluating defects and standards					

Course Objectives:		
- To study the ferrous casting metallurgy and its applications. - To study the nonferrous casting metallurgy and its applications. - To study the ferrous welding metallurgy and its applications. - To study the welding metallurgy of alloy steels and nonferrous metals and its applications - To Identifying the causes and remedies of various welding defects; applying welding standards and codes.		
Unit I	FERROUS CAST ALLOYS	9
Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus sizeSuper cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family &microstructuresAlloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels- Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurizationdephosphorization, specifications for carbon steels- low alloy steels and stainless steels		
Unit II	NON-FERROUS CAST ALLOYS	9
Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stressesdefects in castings		
Unit III	PHYSICAL METALLURGY OF WELDING	9
Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition,formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.		
Unit IV	WELDING OF ALLOY STEELS AND NON-FERROUS METALS	9
Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions		
Unit V	DEFECTS, WELDABILITY AND STANDARDS	9
Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes		
Total periods:45 PERIODS		
Text Books:		
1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017.		
2. A.K.Chakrabarthi, „Casting Technology and Cast Alloys,Prentice Hall, 2005.		
References:		
1. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International,2008.		
2. Baldev Raj, Shankar V, Bhaduri A K, “Welding Technology for Engineers”, Narosa Publications, 2009		
3. Beeley P, “Foundry Technology" Butterworth-Heinemann, 2001.		
4. R.S.Parmar, „Welding Engineering and Technology“, Khanna Publishers, 2010		
5. John Campbell, “Casting", Butterworth-Heinemann, 2003.		
Course Outcomes:		Blooms Taxonomy
CO1: Explain the ferrous casting metallurgy and its applications.		Understand (K2)
CO2: Explain the non ferrous casting metallurgy and its applications.		Understand (K2)
CO3: Explain the ferrous welding metallurgy and its applications.		Understand (K2)
CO4: Explain the welding metallurgy of alloy steels and non ferrous metals and its		Understand (K2)

applications.															
CO5: Identify the causes and remedies of various welding defects; apply welding standards and codes.													Apply/Analyze (K3/K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1		2							2		
CO2	2	2		1		2							2		
CO3	2	2	2	2		2							3	2	
CO4	2	2	2	2	1	2							3	2	
CO5	3	2	2	2	2	2							3	3	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE068	PROCESS PLANNING AND COST ESTIMATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Manufacturing Processes – Understanding of machining, welding, casting, and forming operations. • Engineering Drawing – Ability to interpret manufacturing drawings and tolerances. • Production Technology / Workshop Practice – Familiarity with tools, machines, and production workflows. • Engineering Economics – Basic costing, depreciation, and material cost concepts.					
Course Objectives: • To introduce the process planning concepts to make cost estimation for various products after process planning • To Learn the various Process Planning Activities • To provide the knowledge of importance of costing and estimation. • To provide the knowledge of estimation of production costing. • To learn the knowledge of various Machining time calculations					
Unit I	INTRODUCTION TO PROCESS PLANNING				9
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection					
Unit II	PROCESS PLANNING ACTIVITIES				9
Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies					
Unit III	INTRODUCTION TO COST ESTIMATION				9
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost					
Unit IV	PRODUCTION COST ESTIMATION				9
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop,Estimation of Foundry Shop					
Unit V	MACHINING TIME CALCULATION				9
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling,Shaping and Planning - Machining Time Calculation for Grinding.					
Total periods:45 PERIODS					
Text Books:					
1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002					

2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.															
3.M.Adhithan, “Production Planning Control and Industrial Management”, New Age International (P) Limited Publishers 2007															
References:															
1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002															
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.															
3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.															
4.Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”,Pearson Education 2001.															
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, KhannaPublishers 1990.															
Course Outcomes:													Blooms Taxonomy		
CO1: Discuss select the process, equipment and tools for various industrial products.													Apply (K3)		
CO2: Explain the prepare process planning activity chart.													Apply (K3)		
CO3: Explain the concept of cost estimation.													Understand (K2)		
CO4: Compute the job order cost for different type of shop floor.													Apply/Analyze (K3/K4)		
CO5: Calculate the machining time for various machining operations.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2								3	2	
CO2	3	2	2	3	2								3	2	
CO3	2	2	1	2	-								2	2	
CO4	3	2	3	3	2								3	3	
CO5	3	2	2	3	3								3	3	
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEE069	SURFACE ENGINEERING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of material science and mechanical engineering fundamentals • Understanding of metals, alloys, and polymers • Introductory knowledge of tribology and corrosion					

Course Objectives:																
- To study the fundamentals of surface features and different types of friction associated with metals and non-metals - To study the different types of wear mechanism and its standard measurement. - To study the different types of corrosion and its preventive measures - To study the different types of surface properties and surface modification techniques - To study the various types of materials used in the friction and wear applications																
Unit I		SURFACES AND FRICTION												9		
Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.																
Unit II		WEAR												9		
Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements.																
Unit III		CORROSION												9		
Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.																
Unit IV		SURFACE TREATMENTS												9		
Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano engineered coatings – Other coatings, Corrosion resistant coatings.																
Unit V		ENGINEERING MATERIALS												9		
Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology																
Total periods:45 PERIODS																
Text Books:																
1. G.W.Stachowiak and A.W.Batchelor, “Engineering Tribology”, Butterworth-Heinemann, 2005.																
2. S.K.Basu, S.N.Sengupta and B.B.Ahuja,”Fundamentals of Tribology”, Prentice Hall of India, 2005.																
References:																
1. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985.																
2. Halling, J. (Editor), “Principles of Tribology “, MacMillian, 1984.																
3. Rabinowicz.E., “Friction and Wear of materials”, John Willey & Sons,1995.																
4. Williams J.A., “Engineering Tribology”, Oxford University Press, 1994.																
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.																
Course Outcomes:														Blooms Taxonomy		
CO1:Describe the fundamentals of surface features and different types of friction associated with metals and non-metals														Understand (K2)		
CO2:Analyze the different types of wear mechanism and its standard measurement.														Analyze (K4)		
CO3:Analyze the different types of corrosion and its preventive measures														Analyze (K4)		
CO4:Analyze the different types of surface properties and surface modification techniques														Analyze (K4)		
CO5:Analyze the various types of materials used in the friction and wear applications.														Analyze (K4)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	2			2							3	2		

CO2	3	3	3			2	2						3	3	
CO3	3	3	3	2		2	2						3	3	
CO4	3	3	3	2		2	3						3	3	
CO5	3	3	3	2		2	3						3	3	

1 - Low, 2 - Medium, 3 - High, '-' No correlation

23MEE070	PRECISION MANUFACTURING	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Materials Science and Engineering – Crystal structure, microstructure, and material properties. - Manufacturing Processes – Basic surface finishing and heat treatment processes. - Engineering Chemistry / Corrosion Basics – Fundamentals of corrosion and surface reactions. - Engineering Mechanics / Tribology Fundamentals – Understanding of friction, wear, and lubrication concepts.					
Course Objectives: - To study the need, significance and progress of precision manufacturing and the different levels of manufacturing. - To study the principle and working of different methods of precision machining. - To study the special construction requirements of precision machine tools. - To study the errors involved in precision machine tools and calculate the error budgets for a given situation. - To study the Selecting a suitable measurement solution to measure and characterize precision machined features.					
Unit I	PRECISION ENGINEERING				9
Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.					
Unit II	PRECISION MACHINING				9
Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micromilling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.					
Unit III	MACHINE DESIGN FOR PRECISION MANUFACTURING				9
Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.					
Unit IV	MECHANICAL AND THERMAL ERRORS				9
Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.					
Unit V	MEASUREMENT AND CHARACTERISATION				9
Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology-Fringe projection method, Measurement of Typical Nano features. Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.					
Total periods:45 PERIODS					

Text Books:															
1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2018															
2. Venkatesh V.C., SudinIzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007.															
References:															
1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.															
2. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.															
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002															
4. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.															
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.													Understand (K2)		
CO2: Explain the principle and working of different methods of precision machining.													Analyze (K4)		
CO3: Explain the special construction requirements of precision machine tools.													Analyze (K4)		
CO4: Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.													Analyze (K4)		
CO5: Select a suitable measurement solution to measure and characterize precision machined features.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2			1						3	2	
CO2	3	3	2	2			1						3	3	
CO3	3	3	2	2			2						3	3	
CO4	3	3	2	3	2		2						3	3	
CO5	3	3	2	2	2		2						3	3	
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEE071	GAS DYNAMICS AND JET PROPULSION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Thermodynamics – Basic laws, energy equations, and flow processes. • Fluid Mechanics – Fundamental fluid flow principles, continuity, momentum, and Bernoulli’s equation. • Heat and Mass Transfer (Basic Knowledge) – Energy exchange and thermodynamic property relations.					

- Mathematics for Engineers – Differential equations and vector calculus for flow analysis.

Course Objectives:

- To study the fundamentals of compressible flow concepts and the use of gas tables.
- To learn the compressible flow behaviour in constant area ducts.
- To study the development of shock waves and its effects.
- To study the types of jet engines and their performance parameters.
- To learn the types of rocket engines and their performance parameters.

Unit I	BASIC CONCEPTS AND ISENTROPIC FLOWS												9		
Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.															
Unit II	COMPRESSIBLE FLOW THROUGH DUCTS												9		
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.															
Unit III	NORMAL AND OBLIQUE SHOCKS												9		
Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.															
Unit IV	JET PROPULSION												9		
Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.															
Unit V	SPACE PROPULSION												9		
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.															
Total periods:45 PERIODS															
Text Books:															
1. Anderson, J.D., “Modern Compressible flow”, Third Edition, McGraw Hill, 2003.															
2. S.M. Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 4th Edition, 2012.															
References:															
1. R. D. Zucker and O Biblarz, “Fundamentals of Gas Dynamics”, 2nd edition, Wiley, 2011															
2. Balachandran, P., “Fundamentals of Compressible Fluid Dynamics”, Prentice-Hall of India, 2007.															
3. Radhakrishnan, E., “Gas Dynamics”, Printice Hall of India, 2006.															
4. Hill and Peterson, “Mechanics and Thermodynamics of Propulsion”, Addison – Wesley, 1965.															
5. Babu, V., “Fundamentals of Compressible Flow”, CRC Press, 1st Edition, 2008.															
Course Outcomes:													Blooms Taxonomy		
CO1: Apply the fundamentals of compressible flow concepts and the use of gas tables.													Apply (K3)		
CO2: Analyze the compressible flow behaviour in constant area ducts.													Analyze (K4)		
CO3: Analyze the development of shock waves and its effects.													Analyze (K4)		
CO4: Explain the types of jet engines and their performance parameters.													Understand (K2)		
CO5: Explain the types of rocket engines and their performance parameters.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2								3	2	
CO2	3	3	2	3	2								3	3	

CO3	3	3	2	3	2								3	3	
CO4	3	2	1	2	1								2	2	
CO5	3	2	1	2	1								2	2	
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MEE072	OPERATIONAL RESEARCH		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Basic knowledge of mathematics, including algebra, simultaneous equations, and graphical interpretation. • Understanding of fundamental optimization concepts, such as maximizing or minimizing functions. • Basic analytical and problem-solving skills required for modelling real-world situations.						
Course Objectives: • To learn Selecting the constraints on the availability of resources and developing a model and rendering an optimal solution for the given circumstances. • To study Appraising the challenges in the transportation and production problems and furnishing a rational solution to maximize the benefits. • To learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the customer demands. • To Analysing the queue discipline and exploring the avenues for better customer service. • To Investigating the nature of the project and offering methodical assistance towards decision making in maintenance.						
Unit I	INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING					9
Operation Research: Definition – Models – Steps – Important topics – Scope - Tools. Linear Programing (LP): Introduction – Concept (Problem mix, Assumption, Properties) –Development (Problem formulation) – Problems in: Graphical method, Simplex methods, Big M method.						
Unit II	TRANSPORTATION, ASSIGNMENT AND PRODUCTION SCHEDULING PROBLEMS					9
Transportation problems: Introduction, Model, Types – Problems in: Initial Basic (feasible) solution: Northwest Corner Cell method; Least Cost Cell method; Vogel’s Approximation method and Optimal solution MODI (U-V) method. Assignment problems: Introduction,Types, Problems in Hungarian method. Production Scheduling problems: Introduction –Problems in Single Machine Scheduling: SPT; WSPT, EDD methods – Problems inJohnson’s Algorithm: n job 2 machines, n job 3 machines.						
Unit III	INVENTORY CONTROL MODELS & SYSTEMS					9
Inventory Control: Introduction, Models – Problems in Purchase and Production(Manufacturing) models with and without shortages – Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.						
Unit IV	QUEUING THEORY					9
Queuing Theory: Introduction; Applications; Terminology, Poisson process and exponential distribution – Problems in Single Server and Multi Server Queuing Models –Case study on simulation using Monte Carlo technique.						
Unit V	PROJECT MANAGEMENT AND REPLACEMENT MODELS					9
Project Management: Introduction; Guidelines for Networking AOA Diagrams – Problems in Critical Path Method (CPM) & Program Evaluation Review Technique (PERT) – Differences of CPM & PERT. Replacement Problems: Types – Problems in: Determination of Economic Life of an Asset – Problems in: Individual and Group Replacement Policies , Apply OR software						
TOTAL:45 PERIODS						
Text Books:						
1.Pannerselvam R, “Operations Research”, 2nd Edition, PHI, 2009.						
2.Hamdy A. Taha, “Operations Research an Introduction”, 10th Edition, PHI/Pearson Education, 2017.						
References:						
1.Ravindran, Phillips and Solberg, “Operations Research Principles and Practice”, 2nd Edition, Wiley India, 2007.						

2.Srinivasan G, “Operations Research Principles and Applications”, 3 rd Edition EEEPHI, 2017.															
3.Sharma J K, “Operations Research Theory and Applications”,5th Edition, Macmillan India, 2013.															
4.Premkumar Gupta and D.S.Hira, “Problems in Operations Research”, S.Chand,2009.															
5.Wayne L. Winston, “Operations Research Applications and Algorithms”, 4th Edition, Cengage Learning, 2004.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Discuss the selection of the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.													Apply / Analyze (K3/K4)		
CO2: Explain the appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.													Analyze / Evaluate (K4/K5)		
CO3: Explain plan the purchase/ manufacturing policies, manage the spares/ stocks, and meet the customer demands.													Apply / Analyze (K3/K4)		
CO4: Analyze the queue discipline and explore the avenues for better customer service.													Analyze (K4)		
CO5: Investigate the nature of the project and offer methodical assistance towards decision making in maintenance.													Analyze / Evaluate (K4/K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO2	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO3	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO4	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
CO5	2	3	3	2	2	1	1	1	1	1	2	2	2	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

OPEN ELECTIVE I AND II

23CSO001	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTAL	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites Basic programming knowledge (Python or C/C++ preferred)					

• Fundamentals of Data Structures and Algorithms • Basic Mathematics: ▪ Linear Algebra ▪ Probability and Statistics • Fundamentals of Logic and Discrete Mathematics		
Course Objectives: • Understand the importance, principles, and search methods of AI • Provide knowledge on predicate logic and Prolog. • Introduce machine learning fundamentals • Study of supervised learning algorithms. • Study about unsupervised learning algorithms		
Unit I	INTELLIGENT AGENT AND UNINFORMED SEARCH	6
Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniformcost search - Depth First Search - Depth Limited Search		
Unit II	PROBLEM SOLVING WITH SEARCH TECHNIQUES	6
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP		
Unit III	LEARNING	6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression		
Unit IV	SUPERVISED LEARNING	6
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM)		
Unit V	UNSUPERVISED LEARNING	6
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm		
LIST OF EXPERIMENTS		
Programs for Problem solving with Search		
1	Implement breadth first search	
2	Implement depth first search	
3	Analysis of breadth first and depth first search in terms of time and space	
4	Implement and compare Greedy and A* algorithms.	
Supervised learning		
5	Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	
6	Write a program to demonstrate the working of the decision tree based algorithm.	
7	Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets	
8	Write a program to implement the naïve Bayesian classifier.	
Unsupervised learning		
9	Implementing neural network using self-organizing maps	
10	Implementing k-Means algorithm to cluster a set of data.	
11	Implementing hierarchical clustering algorithm.	

Lecture :30						Practical :30						Total periods:60			
Text Books:															
1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021															
2.S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,															
References:															
1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997															
2. I. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.															
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.															
Course Outcomes:													Blooms Taxonomy		
CO1:Understand the foundations of AI and the structure of Intelligent Agents													Understand (K2)		
CO2:Use appropriate search algorithms for any AI problem													Apply (K3)		
CO3:Study of learning methods													Understand / Apply (K2/K3)		
CO4:Solving problem using Supervised learning													Apply / Analyze (K3/K4)		
CO5: Solving problem using Unsupervised learning													Apply / Analyze (K3/K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							1	3	2	
CO2	3	3	2	2	1							1	3	2	
CO3	3	2	2	2	2							1	3	3	
CO4	3	3	3	2	2							2	3	3	2
CO5	3	2	3	2	2							2	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CSO002	IOT CONCEPTS AND APPLICATIONS	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites • C / Python Programming • Fundamentals of Computer Networks • Basic Electronics: Sensors, microcontrollers, GPIO concepts • Embedded system basics (preferred but not mandatory)					
Course Objectives: • To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IOT • To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms. • To introduce the technologies behind Internet of Things(IoT). • To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform. • To apply the concept of Internet of Things in real world scenario.					
Unit I	INTRODUCTION TO INTERNET OF THINGS				5
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT					
Unit II	COMPONENTS IN INTERNET OF THINGS				5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)															
Unit III		PROTOCOLS AND TECHNOLOGIES BEHIND IOT											6		
IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.															
Unit IV		OPEN PLATFORMS AND PROGRAMMING											7		
IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.															
Unit V		IOT APPLICATIONS											7		
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture															
LIST OF EXPERIMENTS															
1	Introduction to Arduino platform and programming														
2	Interfacing Arduino to Zigbee module														
3	Interfacing Arduino to GSM module														
4	Interfacing Arduino to Bluetooth Module														
5	Introduction to Raspberry PI platform and python programming														
6	Interfacing sensors to Raspberry PI														
7	Communicate between Arduino and Raspberry PI using any wireless medium														
8	Setup a cloud platform to log the data														
9	Log Data using Raspberry PI and upload to the cloud platform														
10	Design an IOT based system														
Lecture :30 Practical 30 Total periods:60															
Text Books:															
1. 1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017															
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015															
References:															
1. Perry Lea, “Internet of things for architects”, Packt, 2018															
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012															
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.															
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.															
5.ArshdeepBahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015															
6. https://www.arduino.cc/ https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the concept of IoT.													Understand (K2)		
CO2:Understand the communication models and various protocols for IoT.													Understand (K2)		
CO3:Design portable IoT using Arduino/Raspberry Pi /open platform													Apply (K3)		
CO4:Apply data analytics and use cloud offerings related to IoT.													Apply (K3)		
CO5:Analyze applications of IoT in real time scenario.													Analyze (K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1							1	2	2	
CO2	3	2	2	2	1							1	3	2	
CO3	3	2	3	2	3							2	3	3	2

CO4	3	2	3	3	2							2	3	3	2
CO5	3	3	3	2	2							3	3	3	3
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23CSO003	DATA SCIENCE FUNDAMENTALS		Category: OEC			
			L	T	P	C
			2	0	2	3
Prerequisites • Basic Python programming • Foundations of Probability and Statistics • Basic Linear Algebra concepts • Understanding of data formats and basic computer usage						
Course Objectives: • Familiarize students with the data science process. • Understand the data manipulation functions in Numpy and Pandas. • Explore different types of machine learning approaches. • Understand and practice visualization techniques using tools. • Learn to handle large volumes of data with case studies.						
Unit I	INTRODUCTION					6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data						
Unit II	DATA MANIPULATION					9
Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance						
Unit III	MACHINE LEARNING					5
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis						
Unit IV	DATA VISUALIZATION					5
Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn						
Unit V	HANDLING LARGE DATA					5
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation						
LIST OF EXPERIMENTS						
1	Download, install and explore the features of Python for data analytics.					
2	Working with Numpy arrays					
3	Working with Pandas data frames					
4	Basic plots using Matplotlib					
5 Statistical and Probability measures						
a)	Frequency distributions					
b)	Mean, Mode, Standard Deviation					
c)	Variability					

d)	Normal curves														
e)	Correlation and scatter plots														
f)	Correlation coefficient														
g)	Regression														
6 Use the standard benchmark data set for performing the following															
a)	Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.														
b)	Bivariate Analysis: Linear and logistic regression modelling														
7	Apply supervised learning algorithms and unsupervised learning algorithms on any data set.														
8	Apply and explore various plotting functions on any data set.														
Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.															
Lecture :30				Practical :30				Total periods:60							
Text Books:															
1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.															
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.															
References:															
1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.															
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.															
Course Outcomes:													Blooms Taxonomy		
CO1: Gain knowledge on data science process.													Understand (K2)		
CO2:Perform data manipulation functions using Numpy and Pandas													Apply (K3)		
CO3:Understand different types of machine learning approaches.													Understand (K2)		
CO4:Perform data visualization using tools.													Apply (K3)		
CO5:Handle large volumes of data in practical scenarios.													Apply / Analyze (K3/K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							1	3	2	
CO2	3	2	2	2	3							1	3	3	2
CO3	3	2	2	2	1							1	3	3	
CO4	3	2	3	2	3							2	3	3	2
CO5	3	3	3	3	2							3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CSO004	AUGMENTED REALITY /VIRTUAL REALITY	Category: OEC			
		L	T	P	C
		2	0	2	3
Prerequisites Basic Programming Knowledge (C/C++/Python)					

• Fundamentals of Computer Graphics • Basic Mathematics (Linear algebra, transformations) • Basic understanding of hardware components (sensors, input devices)		
Course Objectives: • To impart the fundamental aspects and principles of AR/VR technologies. • To know the internals of the hardware and software components involved in the development of AR/VR enabled applications. • To learn about the graphical processing units and their architectures. • To gain knowledge about AR/VR application development. • To know the technologies involved in the development of AR/VR based applications.		
Unit I	INTRODUCTION	7
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I’s of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.		
Unit II	VR MODELING	6
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – BehaviorModeling – Model Management.		
Unit III	VR PROGRAMMING	6
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D		
Unit IV	APPLICATIONS	6
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		
Unit V	AUGMENTED REALITY	5
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices		
LIST OF EXPERIMENTS		
1	Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender	
2	Use the primitive objects and apply various projection types by handling camera	
3	Download objects from asset store and apply various lighting and shading effects	
4	Model three dimensional objects using various modelling techniques and apply textures over them	
5	Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity	
6	Add audio and text special effects to the developed application	
7	Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity	
8	Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
9	Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
10	Develop simple MR enabled gaming applications.	
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018		

2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016															
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.															
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003															
References:															
1.Augmented Reality: Principles & Practice — Dieter Schmalstieg, Tobias Höllerer Very good for AR fundamentals: tracking, sensors, display, interaction.															
2.Developing Virtual Reality Applications: Foundations of Effective Design — Alan B. Craig, William R. Sherman, Jeffrey D. Will															
3.Virtual and Augmented Reality Technology-Enhanced Learning: Research and Applications — Edited by Yiyu Cai, Umesh Ramnarain, Jean Jieqiong ChenFocused on educational uses of VR/AR															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic concepts of AR and VR													Understand (K2)		
CO2: Understand the tools and technologies related to AR/VR													Understand (K2)		
CO3: Know the working principle of AR/VR related Sensor devices													Understand / Apply (K2/K3)		
CO4: Design of various models using modeling techniques													Apply / Create (K3/K6)		
CO5: Develop AR/VR applications in different domains													Apply / Create (K3/K6)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							1	2	2	
CO2	3	2	1	1	2							1	2	3	
CO3	3	2	2	2	3							1	2	3	2
CO4	3	2	3	2	3							2	3	3	2
CO5	3	3	3	3	3							3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

OPEN ELECTIVES – III

23HSO001	ENGLISH FOR COMPETITIVE EXAMINATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic proficiency in English grammar and vocabulary • Fundamental reading and writing skills • Ability to comprehend short texts and respond appropriately • Basic speaking and listening skills in English					

Course Objectives:		
- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS). - To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests. - To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing. - To improve students' confidence to express their ideas and opinions in formal contexts. - To create awareness of accuracy and precision in communication.		
Unit I		9
Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms/antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.		
Unit II		9
Grammar – Sentence improvement – Sentence completion – Rearranging phrases into sentences – Error identification – Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.		
Unit III		9
Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.		
Unit IV		9
Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices – Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.		
Unit V		9
Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency - Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion.		
Lecture :30 Practical :30 Total periods:60		
Text Books:		
1.R.P.Bhatnagar - General English for Competitive Examinations. Macmillan India Limited, 2009.		
References:		
1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.		
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.		
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.		
Course Outcomes:		Blooms Taxonomy
CO1: Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required		Understand / Apply (K2/K3)
CO2: Identify errors with precision and write with clarity and coherence		Apply / Analyze (K3/K4)
CO3: Understand the importance of task fulfilment and the usage of task-appropriate vocabulary		Understand / Apply (K2/K3)
CO4: Communicate effectively in group discussions, presentations and interviews		Apply / Evaluate (K3/K5)
CO5: Write topic based essays with precision and accuracy		Apply / Create (K3/K6)

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2								2		1			
CO2	1	2								3		1			
CO3	1	2								3		1			
CO4	–	–							2	3		1			
CO5	1	2								3		1			
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CEO001	LEAN CONCEPTS, TOOLS AND PRACTICES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of construction project management • Knowledge of planning, scheduling, and productivity measurement • Fundamentals of construction processes and resource management					
Course Objectives: • To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.					
Unit I	INTRODUCTION				9
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with resOEct to its management practices -construction project phases - The problems with current construction management techniques.					
Unit II	LEAN MANAGEMENT				9
Introduction to lean management - Toyota’s management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.					
Unit III	CORE CONCEPTS IN LEAN				9
Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.					
Unit IV	LEAN TOOLS AND TECHNIQUES				9
Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.					
Unit V	LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY				9
Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.					
Total Periods :45 PERIODS					
Text Books:					
1.Koskela, L. "Application of the New Production Philosophy to Construction", Stanford University, 1992.					
2.Howell, G. & Ballard, G. "Lean Construction Theory and Practice", Lean Construction Institute, 2000.					
References:					
1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.					
2.Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.					
3.Dave, B., Koskela, L., Kiviniemi, A., Owen, R., andTzortzopoulos, P.,Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.					
4.Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.					

5.Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.															
Course Outcomes:												Blooms Taxonomy			
CO1: Explains the contemporary management techniques and the issues in present scenario.												Understand (K2)			
CO2: Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.												Apply, Understand (K3/K2)			
CO3: Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.												Understand, Analyze (K2/K4)			
CO4: Apply lean techniques to achieve sustainability in construction projects.												Apply, Analyze (K3/K4)			
CO5: Apply lean construction techniques in design and modeling.												Apply, Evaluate (K3/K5)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				1			1	2			2	1	
CO2	2	3	2			1			2	2			2	2	
CO3	3	3	2			1			2	2			3	2	
CO4	2	2	2			2	2		2	2			2	3	
CO5	2	3	2	1	3	1			2	3			2	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MGO001	NGOS AND SUSTAINABLE DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of social science concepts • Awareness of environmental issues • General knowledge of Indian society and governance • Interest in sustainability, ecology, and community development					

Course Objectives:		
- To understand the importance of sustainable development - To acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management - To comprehend the role of NGOs in attaining sustainable development		
Unit I	ENVIRONMENTAL CONCERNS	9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes		
Unit II	ROLE OF NGOS	9
Role of NGO's in national development, NGO's and participatory management, Challenges and limitations of NGO's, Community Development programmes, Role of NGO's in Community Development programmes, Participation of NGO's in environment management, Corporate Social responsibility, NGO's and corporate social responsibility		
Unit III	SUSTAINABLE DEVELOPMENT	9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators		
Unit IV	NGO'S FOR SUSTAINABILITY	9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies		
Unit V	LEGAL FRAMEWORKS	9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO's in implementing environmental laws, Challenges in the implementation of environmental legislation		
Total periods:45 PERIODS		
Text Books:		
1. Environmental NGOs: Sustainability Stewardship Authors: S. Kulsange & R. Kamble Publisher: Lap Lambert Academic Publishing, 2019 ISBN: 978-6200442444 Why: This book focuses on the role of NGOs in sustainability, community development, and environmental stewardship, which aligns directly with Units II, III, and IV of your syllabus		
2. Indian Environmental Law: Key Concepts and Principles Editor: S. Ghosh Publisher: Orient BlackSwan, 2019 ISBN: 978-9352875795 Why: Covers the legal frameworks, environmental legislation, and enforcement mechanisms in India, which matches Unit V and aspects of Unit I of your syllabus.		
References:		
1. Kulsange, S and Kamble, R. (2019). Environmental NGO's: Sustainability Stewardship, Lap Lambert Academic Publishing, India, ISBN-13: 978-6200442444		
2. Dodds, F. (2007). NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations. Mit Press, Cambridge, ISBN-13: 978-0262524766..		
3. Ghosh, S. (Ed.). (2019). Indian environmental law: Key concepts and principles. Orient BlackSwan, India, ISBN-13: 978-9352875795.		
4. Alan Fowler and Chiku Malunga (2010) NGO Management: The Earthscan Companion, Routledge, ISBN-13 : 978-1849711197.		
Course Outcomes:		Blooms Taxonomy
CO1: Have a thorough grounding on the issues and challenges being faced in attaining sustainable development		Understand / Analyze (K2/K4)
CO2: Have a knowledge on the role of NGOs towards sustainable development		Understand (K2)

CO3: Present strategies for NGOs in attaining sustainable development													Apply / Analyze (K3/K4)		
CO4: Recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment													Analyze / Evaluate (K4/K5)		
CO5: Understand the environmental legislations													Understand / Analyze (K2/K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3				2	3	2		1		3			
CO2	2	2				2	3	3		1		3			
CO3	2	3	2			3	3	3	2	2		3			
CO4	2	3				3	3	3		2		3			
CO5	2	3				3	3	3		1		3			
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MGO002	DEMOCRACY AND GOOD GOVERNANCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic awareness of Indian polity and constitution • General understanding of social systems, governance, and civic structures • Interest in public policy, democracy, political economy, and social issues					
Course Objectives: • To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS). • To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests. • To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing. • To improve students' confidence to express their ideas and opinions in formal contexts. • To create awareness of accuracy and precision in communication.					
Unit I	Structure and Process of Governance				9
Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance					
Unit II	Regulatory Institutions				9
Regulatory Institutions – SEBI, TRAI, Competition Commission of India,					
Unit III	Lobbying Institutions				9
Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.					
Unit IV	Contemporary Political Economy of Development in India				9
Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E- governance					
Unit V	Dynamics of Civil Society				9
New Social Movements, Role of NGO's, Understanding the political significance of Media and Popular Culture.					
Total periods:45 PERIODS					
Text Books:					
1. The Success of India's Democracy Editor: Atul Kohli Publisher: Cambridge University Press, 2001 Focus: Indian democratic institutions, federalism, party politics, electoral behavior, and governance structures (Unit I & general					

course framework).															
2. India: Economic Development and Social Opportunity Authors: J. Dreze and A. Sen Publisher: Clarendon Press, 1995 Focus: Political economy, development models, social policy, and e-governance (Unit IV & related governance discussions).															
References:															
1. Atul Kohli (ed.): The Success of India’s Democracy, Cambridge University Press, 2001.															
2. Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.															
3. J.Dreze and A.Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.															
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013															
5. Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.															
6. Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.															
7. Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the structure and processes of governance in India, including democratic institutions and functioning.													Understand (K2)		
CO2: Gain knowledge of regulatory institutions and their role in governance and public administration.													Understand / Apply (K2/K3)		
CO3: Analyse the functioning of lobbying institutions and their influence on policy-making.													Analyze (K4)		
CO4: Evaluate policy debates and contemporary political–economic issues related to India’s development model and e-governance.													Evaluate / Analyze (K5/K4)		
CO5: Understand the role of civil society, social movements, NGOs, media, and popular culture in shaping democracy and governance													Understand / Analyze (K2/K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				2	3	2	1	2		3			
CO2	2	3	1			3	2	2		2		3			
CO3	2	3	2			3	3	3		2		3			
CO4	2	3	2			3	3	3		2		3			
CO5	2	3				3	3	3	1	3		3			
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MEO002	REVERSE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering materials and their properties • Manufacturing processes • Basics of CAD modeling • Fundamentals of engineering design					

Course Objectives:		
- The main learning objective of this course is to prepare students for: - Applying the fundamental concepts and principles of reverse engineering in product design and development. - Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development. - Applying the concept and principles of material identification and process verification in reverse engineering of product design and development. - Analysing the various legal aspect and applications of reverse engineering in product design and development. - Understand about 3D scanning hardware & software operations and procedure to generate 3D model		
Unit I	INTRODUCTION & GEOMETRIC FORM	9
Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.		
Unit II	MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION	9
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.		
Unit III	DATA PROCESSING	9
Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.		
Unit IV	3D SCANNING AND MODELLING	9
Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.		
Unit V	INDUSTRIAL APPLICATIONS	9
Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering.Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.		
Total periods:45 PERIODS		
Text Books:		
1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014		
2.Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011		
References:		
1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022		
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001		
3. Kathryn, A. Ingle, “Reverse Engineering”, McGraw-Hill, 1994.		
4. Linda Wills, “Reverse Engineering”, Kluwer Academic Publishers, 1996		
5. Vinesh Raj and Kiran Fernandes, “Reverse Engineering: An Industrial Perspective”, SpringerVerlag London Limited 2008.		
Course Outcomes:		Blooms Taxonomy
CO1: Apply the fundamental concepts and principles of reverse engineering in product design and development		Apply (K3)
CO2: Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development		Apply (K3)
CO3: Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.		Apply (K3)
CO4: Apply the concept and principles of data processing, part performance and system		Apply / Analyze

compatibility in reverse engineering of product design and development.													(K3/K4)		
CO5: Analyze the various legal aspect													Analyze (K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3					1		3	3	2	2
CO2	3	3	3	2	2		2					3	3	3	2
CO3	3	3	3	2	2							3	3	3	2
CO4	2	3	3	3	2					1		3	3	2	3
CO5						3	2	3		2	2	3			2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23ECO002	SPACE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Physics (Mechanics, Thermodynamics) • Engineering Mathematics (Calculus, Linear Algebra) • Fundamentals of Aerodynamics (recommended but not mandatory)					
Course Objectives: • Use the standard atmosphere tables and equations. • Find lift and drag coefficient data from NACA plots. • Apply the concept of static stability to flight vehicles. • Describe the concepts of stress, strain, Young’s modulus, Poisson’s ratio, yield strength. • Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.					
Unit I	STANDARD ATMOSPHERE				9
History of aviation – standard atmosphere - pressure, temperature and density altitude.					
Unit II	AERODYNAMICS				9
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.					
Unit III	PERFORMANCE AND PROPULSION				9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.					
Unit IV	AIRCRAFT STABILITY AND STRUCTURAL THEORY				9
Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke’s Law- brittle and ductile materials - moment of inertia - section modulus					
Unit V	SPACE APPLICATIONS				9
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newtons law of gravitation.					
Total periods:45 PERIODS					
Text Books:					
1.Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003					
2. Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2005.					
References:					
1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons,2003					
2. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications,2005					
3. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005					
Course Outcomes:					Blooms Taxonomy

CO1: Illustrate the history of aviation & developments over the years													Understand (K2)		
CO2: Ability to identify the types & classifications of components and control systems													Understand (K2)		
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere													Understand/Apply (K2/K3)		
CO4: Identify the types of fuselage and constructions.													Apply (K3)		
CO5: Analyze the energy and design requirement for hybrid and electric vehicles.													Analyze (K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												1		
CO2	2	2											1	1	
CO3	2		2										1		
CO4	2	-	1											1	
CO5	3	2	2										2	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MGO003	QUALITY ENGINEERING		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Basic knowledge of statistics and probability • Fundamentals of manufacturing processes • Basic mathematical skills						
Course Objectives: • Developing a clear knowledge in the basics of various quality concepts. • Facilitating the students in understanding the application of control charts and its techniques. • Developing the special control procedures for service and process oriented industries. • Analyzing and understanding the process capability study.						
Unit I		INTRODUCTION				9
Quality Dimensions–Quality definitions–Inspection–Quality control–Quality Assurance–Quality planning–Quality costs–Economics of quality– Quality loss function						
Unit II		CONTROL CHARTS				9
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- $\bar{X}$, R and S charts, attribute control charts - p, np, c and u- Construction and application.						
Unit III		SPECIAL CONTROL PROCEDURES				9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.						
Unit IV		STATISTICAL PROCESS CONTROL				9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.						
Unit V		ACCEPTANCE SAMPLING				9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS 2500 standards.						
Total periods: 45 PERIODS						
Text Books:						
1. Douglas C. Montgomery, “Introduction to Statistical Quality Control”, 7th Edition, Wiley, 2012						
2. E.L. Grant & Richard S. Leavenworth, “Statistical Quality Control”, 7th Edition, McGraw-Hill, 1996						
References:						
1. Juran, J.M. & Gryna, F.M., “Juran’s Quality Planning and Analysis”, McGraw-Hill, 2001.						

2.Kume, H., “Statistical Methods for Quality Improvement”, 3rd Edition, Asian Productivity Organization, 1998.															
Course Outcomes:														Blooms Taxonomy	
CO1: Control the quality of processes using control charts for variables in manufacturing industries														Apply (K3)	
CO2: Control the occurrence of defective product and the defects in manufacturing companies														Analyze (K4)	
CO3: Control the occurrence of defects in services.														Evaluate (K5)	
CO4: Analyzing and understanding the process capability study.														Analyze (K4)	
CO5: Developing the acceptance sampling procedures for incoming raw material.														Create (K6)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3				1	2		2	3	2	
CO2	3	3	2	3	3				1	2		2	3	2	
CO3	2	2	1	2	2				2	2		1	2	1	
CO4	3	3	2	3	3				1	2		3	3	3	
CO5	3	3	2	3	3				1	2		3	3	3	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO001	FIRE SAFETY ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of civil / structural engineering materials • Basic understanding of building design and construction methods • Fundamentals of engineering safety & hazard identification					
Course Objectives: • To enable the students to acquire knowledge of Fire and Safety Studies • To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance • To learn about fire area, fire stopped areas and different types of fire-resistant doors • To learn about the method of fire protection of structural members and their repair due to fire damage. • To develop safety professionals					
Unit I	INHERENT SAFETY CONCEPTS				9
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.					
Unit II	PLANT LOCATIONS				9
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.					
Unit III	WORKING CONDITIONS				9
Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;					
Unit IV	FIRE SEVERITY AND REPAIR TECHNIQUES				9
Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and					

slabs, Repair to steel structural members, Repair to masonry structures.															
Unit V		WORKING AT HEIGHTS												9	
Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.															
Total periods:45 PERIODS															
Text Books:															
1.Roytman, M. Y, "Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975															
2.John A. Purkiss, "Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.															
References:															
1. Smith, E.E. and Harmathy, T.Z. (Editors), "Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.															
2.Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.															
3.Jain, V.K, "Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010. 4. Hazop&Hazan, "Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999															
4.Frank R. Spellman, Nancy E. Whiting, "The Handbook of Safety Engineering: Principles and Applications", 2009															
Course Outcomes:														Blooms Taxonomy	
CO1:Understand the effect of fire on materials used for construction														Apply (K3)	
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.														Analyze (K4)	
CO3:To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.														Evaluate (K5)	
CO4:To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.														Analyze (k4)	
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.														Create (K6)	
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1					1		1	3	2	
CO2	3	3	3	2	2					1		2	3	3	
CO3	2	2	3	3	2				1	2		2	2	3	
CO4	2	3	2	3	2			1	1	2		3	3	3	
CO5	1	2	1	2	1	3	2	3	3	3		2	2	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO006	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of Physics (mechanics, basic forces) - Basic Engineering Mathematics (algebra, vectors, units)					

Basics of materials and mechanical systems																
Course Objectives: - To acquire the knowledge on the Historical evaluation of Airplanes - To learn the different component systems and functions - To know the concepts of basic properties and principles behind the flight - To learn the basics of different structures & construction - To learn the various types of power plants used in aircrafts																
Unit I		HISTORY OF FLIGHT												8		
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.																
Unit II		AIRCRAFT CONFIGURATIONS AND ITS CONTROLS												10		
Different types of flight vehicles, classifications-Components of an airplane and their functions- Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.																
Unit III		BASICS OF AERODYNAMICS												9		
Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton’s Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.																
Unit IV		BASICS OF AIRCRAFT STRUCTURES												9		
General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke’s law- stress-strain diagrams- elastic constants- Factor of Safety.																
Unit V		BASICS OF PROPULSION												9		
Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.																
Total periods:45 PERIODS																
Text Books:																
1.Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015																
2.E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021																
3.Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.																
References:																
1. Sadhu Singh, “Internal Combustion Engines and Gas Turbine”-, SS Kataria& Sons, 2015																
2. Kermode , “Flight without Formulae”, -, Pitman; 4th revised edition 1989																
Course Outcomes:														Blooms Taxonomy		
CO1: Illustrate the history of aircraft &developments over the years														Apply (K3)		
CO2: Ability to identify the types & classifications of components and control systems														Analyze (K4)		
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere.														Evaluate (K5)		
CO4: Identify the types of fuselage and constructions. .														Analyze (K4)		
CO5: Distinguish the types of Engines and explain the principles of Rocket														Create (K6)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1				2				1			2			
CO2	3	2	2									1	3	2		
CO3	3	3		2	2							1	3	2		
CO4	3	3	2									1	3	3		
CO5	3	2	–	2	1					1		1	3	2		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

23CEO002	REMOTE SENSING CONCEPTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of physics (Electromagnetic waves, basic optics) - Basic mathematics (algebra, trigonometry, calculus) - Earth science fundamentals (landforms, soil, water, vegetation) - Basic computer skills for handling digital data					
Course Objectives: - To introduce the concepts of remote sensing processes and its components. - To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation					
Unit I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION				9
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck’s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff’s law – Radiation sources: active & passive - Radiation Quantities					
Unit II	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL				9
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.					
Unit III	ORBITS AND PLATFORMS				9
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.					
Unit IV	SENSING TECHNIQUES				9
Classification of remote sensors – Resolution concept; spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites					
Unit V	DATA PRODUCTS AND INTERPRETATION				9
Photographic and digital products – Types, levels and open source satellite data products – selection and procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification					
Total periods:45 PERIODS					
Text Books:					
1.Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.					
2.George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018					
References:					
1.Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, American Society of Photogrametry, Virginia, USA, 2002.					
2.Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995					
3.Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.					
4.Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and Jacob Van Zyl, 2006 Edition II, Wiley Publication.					

5.Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the concepts and laws related to remote sensing													Understand (K2)		
CO2: Understand the interaction of electromagnetic radiation with atmosphere and earth material													Understand (K2)		
CO3: Acquire knowledge about satellite orbits and different types of satellites													Understand, Remember (K2/K1)		
CO4: Understand the different types of remote sensors													Understand (K2)		
CO5: Gain knowledge about the concepts of interpretation of satellite imagery													Apply ,Analyze (K3/K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1							1	2	1	
CO2	3	2			1							1	3	1	
CO3	3	1										1	2	2	
CO4	3	2		1	2							1	3	2	
CO5	2	2	1	2	3							2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CEO003	URBAN AGRICULTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of plant biology (photosynthesis, growth, nutrients) - Basic environmental science (soil, water, climate) - General science knowledge at higher secondary level - Basic understanding of urban environment & sustainability concepts					
Course Objectives: - To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways. - To delineate the role of agricultural engineers in relation to various crop production practices.					
Unit I	INTRODUCTION				9
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.					
Unit II	VERTICAL FARMING				9
Vertical farming- types, green facade, living/green wall-modular green wall, vegetated mat wall- Structures and components for green wall system: plant selection, growing media, irrigation and plant nutrition: Design, light, benefits of vertical gardening. Roof garden and its types. Kitchen garden, hanging baskets: The house plants/ indoor plants					
Unit III	SOIL LESS CULTIVATION				9
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping					
Unit IV	MODERN CONCEPTS				9
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops					
Unit V	WASTE MANAGEMENT				9

Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.															
Total periods:45 PERIODS															
Text Books:															
1. Martellozzo F and J S Landry. 2020. Urban Agriculture. Scitus Academics Llc.															
2. Rob Roggema. 2016. Sustainable Urban Agriculture and Food Planning. Routledge Taylor and Francis Group.															
3. Akrong M O. 2012. Urban Agriculture. LAP Lambert Academic Publishing.															
References:															
1.Agha Rokh A. 2008. Evaluation of ornamental flowers and fishes breeding in Bushehr urban wastewater using a pilot-scale aquaponic system. Water and Wastewater, 19 (65): 47–53.															
2.Agrawal M, Singh B, Rajput M, Marshall F and Bell J. N. B. 2003. Effect of air pollution on peri-urban agriculture: A case study. Environmental Pollution, 126 (3): 323–329. https://www.sciencedirect.com/science/article/pii/S0269749103002458#aep-section-id24 .															
3.Jac Smit and Joe Nasr. 1992. Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources. Environment and Urbanization, 4 (2):141-152.															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate the principles behind crop production and various parameters that influencethe crop growth on roof tops													Understand, Apply (K2/K3)		
CO2: Explain different methods of crop production on roof tops													Understand (K2)		
CO3: Explain nutrient and pest management for crop production on roof tops													Understand, Apply (K2/K3)		
CO4: Illustrate crop water requirement and irrigation water management on roof tops													Apply (K3)		
CO5: Explain the concept of waste management on roof tops													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		2					1	2	1	
CO2	3	2			1		2					1	2	1	
CO3	2	2			1		2					2	2	2	
CO4	2	2	1	1	2		2					2	3	2	
CO5	2	1			1		3					2	2	1	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CE0004	DRINKING WATER SUPPLY AND TREATMENT	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites																
• Fundamentals of environmental science • Basic chemistry (pH, alkalinity, hardness, reactions) • Basic fluid mechanics (pressure, flow, continuity) • Fundamentals of civil engineering materials																
Course Objectives:																
• To equip the students with the principles and design of water treatment units and distribution system.																
Unit I		SOURCES OF WATER												9		
Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.																
Unit II		CONVEYANCE FROM THE SOURCE												9		
Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.																
Unit III		WATER TREATMENT												9		
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection —Construction, Operation and Maintenance aspects.																
Unit IV		ADVANCED WATER TREATMENT												9		
Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects																
Unit V		WATER DISTRIBUTION AND SUPPLY												9		
Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.																
Total periods:45 PERIODS																
Text Books:																
1.Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.																
2.Punmia B.C, Arun K.Jain, Ashok K.Jain, “ Water supply Engineering” Lakshmi publication private limited, New Delhi, 2016.																
3.Rangwala "Water Supply and Sanitary Engineering", February 2022																
4.Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.																
References:																
1.Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.																
2.Babbitt.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.																
3.Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.																
Course Outcomes:														Blooms Taxonomy		
CO1: An understanding of water quality criteria and standards, and their relation to public health														Understand (K2)		
CO2: The ability to design the water conveyance system														Apply, Analyze (K3/K4)		
CO3: The knowledge in various unit operations and processes in water treatment														Understand (K2)		
CO4: An ability to understand the various systems for advanced water treatment														Understand (K2)		
CO5: An insight into the structure of drinking water distribution system														Understand, Apply (K2/K3)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2			1	2	3	1				2	2			

CO2	3	3	2	2	2		1	1				2	3	2	
CO3	3	2			1	1	2					2	2		
CO4	2	2	1		2	1	2					2	2		
CO5	2	2	1	1	2	–	2					3	2	2	

1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation

23CHO002	NANO TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic knowledge of Chemistry
- Fundamentals of Materials Science
- Basic understanding of Physics (structure of matter, properties of materials)

Course Objectives:

- To introduce the fundamental concepts and significance of nanomaterials.
- To understand the various synthesis methods of nanomaterials.
- To study the different types and properties of nanocomposites.
- To learn the classification and characterization techniques of nanostructured materials.
- To understand the applications of nanomaterials in engineering, electronics, biology, and environmental fields.

Unit I	INTRODUCTION	8

General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.

Unit II	SYNTHESIS OF NANOMATERIALS	8

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering

Unit III	NANO COMPOSITES	10

Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.

Unit IV	NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES	10

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

Unit V	APPLICATIONS OF NANO MATERIALS	9

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

Total periods:45 PERIODS

Text Books:

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, “ Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas Press
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications” Imperial College Press, 2004
3. William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3rd Edition, CRC Taylor and Francis group 2012.

References:

1. R.H.J.Hannink&A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.															
2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gbtl& Co															
3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication',Springer International Edition,2010															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.													Understand (K2)		
CO2: Able to acquire knowledge about the different types of nano material synthesis													Knowledge (K1)		
CO3: Describes about the shape, size,structure of composite nano materials and their interference													Understand (K2)		
CO4: Understand the different characterization techniques for nanomaterials													Understand (K2)		
CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2		1			1		1	2	1	
CO2	3	2	1	1	2		-			-		1	2	1	
CO3	2	2	1	1	2		1			1		1	2	1	
CO4	3	2	1	2	2		1			1		1	2	2	
CO5	3	2	2	2	3		1			2	1	2	3	2	1
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23MEO007	FUNCTIONAL MATERIALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Chemistry • Fundamentals of Materials Science • Basic understanding of polymers and molecular interactions					
Course Objectives: • The course emphasis on the molecular safe assembly and materials for polymer electronics					
Unit I	NTRODUCTION				9
Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact					
Unit II	MOLECULAR SELF ASSEMBLY				9
Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly-Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs					
Unit III	BIO-INSPIRED MATERIALS				9
Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, ‘Bionics’- Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.					
Unit IV	SMART OR INTELLIGENT MATERIALS				9
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composities.					
Unit V	MATERIALS FOR POLYMER ELECTRONICS				9

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.															
Total periods: 45 PERIODS															
Text Books:															
1.Vijayamohanan K. Pillai and MeeraParthasarathy, “Functional Materials: A chemist’s perspective”, Universities Press Hyderabad (2012).															
References:															
1. Stephen Manne “Biomimetic Materials Chemistry” Wiley-VCH Newyork, 1966															
Course Outcomes:													Blooms Taxonomy		
CO1:Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.													Analyze (K4)		
CO2: Understand the concepts and mechanisms behind molecular self-assembly and its technological relevance.													Understand (K2)		
CO3: Explain the principles of bio-inspired materials and relate natural phenomena to functional material design.													Understand (K2)		
CO4: Identify and describe different smart/intelligent materials and evaluate their significance in advanced engineering applications.													Understand (K2)		
CO5: Apply the knowledge of polymer electronics to analyze materials used in OLEDs, FETs, LCDs, and data-storage systems.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1			1		2	3	2	1
CO2	2	2	1	1	2		1			1		1	2	1	
CO3	2	2	1	1	2		1			1		1	2	1	
CO4	2	2	1	1	2		1			1		1	2	1	
CO5	3	2	2	2	3	1	1			2	1	2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23BTO001	TRADITIONAL INDIAN FOODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of food science and nutrition. • Familiarity with processing methods and cultural food practices.					
Course Objectives: • To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.					
Unit I	HISTORICAL AND CULTURAL PERSPECTIVES				9

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.															
Unit II		TRADITIONAL METHODS OF FOOD PROCESSING											9		
Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.															
Unit III		TRADITIONAL FOOD PATTERNS											9		
Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods															
Unit IV		COMMERCIAL PRODUCTION OF TRADITIONAL FOODS											9		
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters															
Unit V		HEALTH ASPECTS OF TRADITIONAL FOODS											9		
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments / illnesses															
Total periods: 45 PERIODS															
Text Books:															
1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.															
2. Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.															
References:															
1. Colleen Taylor Sen, Food Culture in India, Greenwood Press, 2005.															
2. Ruth N. Davidar, Indian Food Science: A Health and Nutrition Guide to Traditional Recipes, East West Books, 2001.															
3. K.T. Achaya, Indian Food: A Historical Companion, Oxford University Press.															
4. K.T. Achaya, The Illustrated Foods of India, Penguin Books.															
5. R. Chandrasekhar, Traditional Foods: Processing, Quality and Shelf Life, Springer.															
Course Outcomes:													Blooms Taxonomy		
CO1: To understand the historical and traditional perspective of foods and food habits													Comprehension (K2)		
CO2: To understand the wide diversity and common features of traditional Indian foods and meal patterns.													Comprehension (K2)		
CO3: Apply the knowledge of traditional food processing methods to compare traditional vs modern techniques.													Application (K3)		
CO4: Analyze commercial production methods of traditional Indian foods and beverages.													Analysis (K4)		
CO5: Evaluate the health benefits and nutritional aspects of traditional Indian foods in comparison with fast foods.													Evaluation (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1	-	1	1		2		1	2	1	
CO2	3	3			1	-	1	1		2		1	3	1	1
CO3	3	3	2		2	-	1	1		2		1	3	2	1

CO4	3	3	2	1	2		1	1	1	3		1	3	2	1
CO5	3	3	1	1	2	1	2	2		3		2	3	2	1
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23BTO002	INTRODUCTION TO FOOD PROCESSING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic knowledge of food science and nutrition. - Understanding of agricultural raw materials and basic microbiology.					
Course Objectives: The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.					
Unit I	PROCESSING OF FOOD AND ITS IMPORTANCE				9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.					
Unit II	METHODS OF FOOD HANDLING AND STORAGE				9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.					
Unit III	LARGE-SCALE FOOD PROCESSING				12
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.					
Unit IV	FOOD WASTES IN VARIOUS PROCESSES				6
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment					
Unit V	FOOD HYGIENE				9
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.					
Total periods:45 PERIODS					
Text Books/ References:					
1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.					
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.					
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.					
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005					
Course Outcomes:					Blooms Taxonomy
CO1: Be aware of the different methods applied to processing foods.					Knowledge (K1)

CO2: Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.													Comprehension (K2)		
CO3: Apply basic processing techniques to evaluate various food processing operations.													Application (K3)		
CO4: Analyze food waste generation and waste-handling systems in food industries.													Analysis (K4)		
CO5: Evaluate food hygiene, safety, and sanitation procedures in food handling and processing.													Evaluation (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		1	1		2		1	2	1	-
CO2	3	3			1		1	1		2		1	2	1	1
CO3	3	3	2	1	2		1	1		3		1	3	2	1
CO4	3	3	2	1	2		1	1	1	3		1	3	2	1
CO5	3	3	1	1	2	1	2	2		3		2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23BTO003	IPR FOR PHARMA INDUSTRY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of pharmaceutical sciences • Basic knowledge of laws or regulations in pharma (desired but not mandatory) • Ability to read and understand legal/technical documents					
Course Objectives: • To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level. • To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications. • This paper is to study significance of the amended patent act on pharma industry.					
Unit I	INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS				9
Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.					
Unit II	PATENTS				9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non- obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.					
Unit III	PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS				9
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position					
Unit IV	ENFORCEMENT AND PRACTICAL ASPECTS OF IPR				9
Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements.					
Unit V	INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY				9
International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT).					

Total periods:45 PERIODS															
Text Books:															
1.N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, “Intellectual Property Rights” Edu creation Publishing, New Delhi, 2017.															
2.The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi: Universal Law Publishing Company Pvt. Ltd. 2012.															
3.B.S. Rao, P.V. Appaji, “Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice”, 2015.															
References:															
1.Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.															
2.Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005															
3.S. Lakshmana Prabu, TNK. Suriyaprakash, “Intellectual Property Rights”, 1st ed., In Tech open access, Croatia, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1: Understand and differentiate the categories of intellectual property rights.													Understanding (K2)		
CO2: Describe about patents and procedure for obtaining patents.													Applying (K3)		
CO3: Distinguish plant variety, traditional knowledge and geographical indications under IPR.													Analyzing (K4)		
CO4: Provide the information about the different enforcements and practical aspects involved in protection of IPR.													Evaluating (K5)		
CO5: Provide different organizations role and responsibilities in the protection of IPR in the international level.													Understanding (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1					1		1	2		
CO2	3	3	2		1					2		1	2		
CO3	3	2	2	1	1					2		1	2		
CO4	3	3	2	1	2					3		1	3	1	
CO5	2	2	-	1	1					2		1	2	1	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO003	BASICS OF TEXTILE FINISHING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of textile materials and textile processing • Familiarity with fibres, yarns, and fabric manufacturing • Basic understanding of chemical processing in textiles (desirable but not mandatory)					
Course Objectives: • To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.					
Unit I	RESIN FINISHING				9

Importance of finishing and its classification. Resin finishing: Mechanism of creasing, Types of Resins .Anti crease, wash and wear, durable press resin finishing. Study about eco friendly method of anti crease finishing.															
Unit II		FLAME PROOF & WATERPROOF												9	
Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.															
Unit III		SOIL RELEASE AND ANTISTATIC FINISHES												9	
Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical and mechanical methods to produce anti pilling. Concept of UV Protection finishes- Concept of antistatic finishes.															
Unit IV		MECHANICAL FINISHES												9	
Mechanical finishing of textile materials - calendaring, compacting, Sanforising, Peach finishing. Object of Heat setting. Various methods of heat setting and mechanism of heat setting.															
Unit V		STIFFENING AND SOFTENING												9	
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET.Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.															
Total periods:45 PERIODS															
Text Books:															
1.V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai															
2.Perkins, W.S., “Textile colouration and finishing”, Carolina Academic Press., U.K, ISBN: 0890898855.2004.															
References:															
1.Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62															
2.Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3															
3.W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England,2004.															
Course Outcomes:												Blooms Taxonomy			
CO1: Basics of Resin Finishing Process.												Knowledge / Understanding (K1/K2)			
CO2: Concept of Flame proof & flame retardancy, waterproof and water repellent Antimicrobial finishes.												Application (K3)			
CO3: Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.												Analysis (K4)			
CO4: Concept of Mechanical finishing.												Understanding (K2)			
CO5: Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.												Evaluation (K5)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1					1		1	2	1	
CO2	3	3	2		1					2		1	2	1	
CO3	3	2	3	1	2					3		1	3	2	1
CO4	2	2	1	1	1					2		1	2	1	
CO5	3	3	2	1	2					3		1	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO004	INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of garment manufacturing processes. • Familiarity with sewing operations and production workflow (recommended).					
Course Objectives: • To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry					

Unit I	INTRODUCTION	9
Scope of industrial engineering in apparel Industry, role of industrial engineers. Productivity: Definition - Productivity, Productivity measures Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.		
Unit II	WORK STUDY	9
Definition, Purpose, Basic procedure and techniques of work-study. Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.		
Unit III	METHOD STUDY	9
indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.		
Unit IV	WORK MEASUREMENT	9
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD		
Unit V	WORK STUDY APPLICATION	9
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.		
Total periods: 45 PERIODS		
Text Books:		
1.George Kanwaty, “Introduction to Work Study “, ILO, Geneva, 1996, ISBN: 9221071081 ISBN-13: 9789221071082		
2.Enrick N. L., “Time study manual for Textile industry”, Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 ISBN-13: 9780898740448		
3.Khanna O. P., and Sarup A., “Industrial Engineering and Management”, Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353		
References:		
1.Norberd Lloyd Enrick., “Industrial Engineering Manual for Textile Industry”, Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 ISBN-13: 9780882756318		
2.Chuter A. J., “Introduction to Clothing Production Management”, Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 ISBN-13: 9780632039395		
3.GordanaColovic., “Ergonomics in the garment industry”, Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 ISBN-13: 9780857098221		
4.Rajesh Bheda, “Managing Productivity in Apparel Industry “CBS Publishers & Distributors, 2008		
Course Outcomes:		Blooms Taxonomy
CO1: Fundamental concepts of industrial Engineering and productivity		Knowledge / Understanding (K1/K2)
CO2: Method study		Application (K3)
CO3: Motion analysis		Analysis (K4)
CO4: Work measurement and SAM		Application (K3)
CO5: Ergonomics and its application to garment industry		Understanding / Evaluation (K2/K5)
CO-PO Mapping		

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		1		1	1		2		1	2	1	1
CO2	3	3	2	1	2		1	2	1	2		1	3	2	1
CO3	3	3	2	1	2		1	2	1	3		1	3	2	2
CO4	3	3	2	2	3		1	2	1	3		1	3	2	2
CO5	3	2	1	1	2	1	2	2	1	2		2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CHO005	BASICS OF TEXTILE MANUFACTURE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamental knowledge of basic physics and chemistry – Students should understand basic concepts of matter, polymers, chemical bonding, and material properties. - Basic understanding of mathematics – Ability to perform simple calculations related to yarn numbering, production sequences, and machine parameters. - General awareness about textiles – Familiarity with common textile products and everyday textile materials (helpful but not mandatory). - Interest in material science and manufacturing processes – Useful for understanding fibre formation, yarn production, weaving, knitting, and fabric-related processes.					
Course Objectives: To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing					
Unit I	NATURAL FIBRES				9
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres..					
Unit II	REGENERATED AND SYNTHETIC FIBRES				9
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.					
Unit III	BASICS OF SPINNING				9
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations					
Unit IV	BASICS OF WEAVING				9
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,					
Unit V	BASICS OF KNITTING AND NONWOVEN				9
Knitting – classification, principle, types of fabrics; nonwoven process –classification, principle, types of fabrics.					
Total periods:45 PERIODS					
Text Books:					
1.Mishra S. P. , “A Text Book of Fibre Science and Technology”, New Age Publishers, 2000, ISBN: 8122412505					
2.Marks R., and Robinson. T.C., “Principles of Weaving”, The Textile Institute, Manchester, 1989, ISBN: 0 900739 258.					
3.Spencer D.J., “Knitting Technology”, III Ed., Textile Institute, Manchester, 2001, ISBN: 185573 333 1. 7					
References:					
1.Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., “Clothing Technology: From Fibre to Fabric”, Europa LehrmittelVerlag, 2008, ISBN: 3808562250 / ISBN: 978-3808562253.					
2.Wynne A., “Motivate Series-Textiles”, Maxmillan Publications, London, 1997.					

3.Carr H. and Latham B., "The Technology of Clothing Manufacture" Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483.Klein W., "The Rieter Manual of Spinning, Vol.1", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-1-4 / ISBN 13 978-3-9523173-1-0.															
4.Klein W., "The Rieter Manual of Spinning, Vol.2", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-2-2 / ISBN 13 978-3-9523173-2-7.															
5.Klein W., "The Rieter Manual of Spinning, Vol.1-3", Rieter Machine Works Ltd., Winterthur, 2014, ISBN 10 3-9523173-3-0 / ISBN 13 978-3-9523173-3-4.															
6.Talukdar. M.K., Sriramulu. P.K., and Ajgaonkar. D.B., "Weaving: Machines, Mechanisms, Management", Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0.															
7.Morton W. E., and Hearle J. W. S., "Physical Properties of Textile Fibres", The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95															
8.Gohl E. P. G., "Textile Science", CBS Publishers and distributors, 1987, ISBN 0582685958															
Course Outcomes:												Blooms Taxonomy			
CO1: Classification of fibres and production of natural fibres												Knowledge / Understanding (K1/K2)			
CO2: Regenerated and synthetic fibres												Understanding (K2)			
CO3: Yarn spinning												Application (K3)			
CO4: Weaving												Analysis / Understanding (K3/K2)			
CO5: Knitting and nonwoven												Understanding / Application (K2/K3)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		1	1		1		1	3	2	1
CO2	3	3	1		1		1	1		1		1	3	2	1
CO3	3	3	2	1	1		1	1		2		1	3	3	2
CO4	3	3	2	1	2		1	2	1	2		1	3	3	2
CO5	3	2	1	1	2		2	2	1	2		1	3	3	2
1 - Low, 2 - Medium, 3 - High , '-' No correlation															

23CHO006	INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Chemistry • Introduction to Chemical Engineering / Process Calculations • Thermodynamics and Fluid Mechanics (basic concepts)					
Course Objectives: • The course is aimed to • Gain knowledge about petroleum refining process and production of petrochemical products.					

Unit I	ORIGIN, FORMATION AND REFINING OF CRUDE OIL												9		
Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum - Atmospheric and Vacuum Distillation															
Unit II	CRACKING												9		
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen															
Unit III	REFORMING AND HYDROTREATING												9		
Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance															
Unit IV	INTRODUCTION TO PETROCHEMICALS												9		
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.															
Unit V	PRODUCTION OF PETROCHEMICALS												9		
Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black															
Total periods:45 PERIODS															
Text Books:															
1..Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edition. McGraw Hill, New York,1985.															
2.Wiseman. P., "Petrochemicals", UMIST Series in Science and Technology, John Wiley & Sons,1986															
References:															
1.Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edition, Oxford and IBH Publishing Company, New Delhi, 1990.															
2.. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edition, Khanna Publishers															
Course Outcomes:												Blooms Taxonomy			
CO1:Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process Learn the												Understand (K2)			
CO2:Understand the insights of primary treatment processes to produce the precursors												Understand (K2)			
CO3:Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.												Analyze (K3)			
CO4:Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.												Evaluate (K5)			
CO5:Understand the societal impact of petrochemicals and learn their manufacturing processes.												Understand (K2)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1												1		
CO2	1												1	1	
CO3	1	1		1									1	1	
CO4	1			1									1	1	
CO5	1	1		1	1								1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23EEO005	ENERGY CONSERVATION AND MANAGEMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites Basic knowledge of thermodynamics, heat transfer, mechanical and electrical engineering concepts					
Course Objectives: - understand and analyse the energy data of industries - carryout energy accounting and balancing - conduct energy audit and suggest methodologies for energy savings and - utilise the available resources in optimal ways					
Unit I	INTRODUCTION				9
Energy - Power – Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers.Role of Energy Managers. Instruments for energy auditing					
Unit II	ELECTRICAL SYSTEMS				9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.					
Unit III	THERMAL SYSTEMS				9
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories					
Unit IV	ENERGY CONSERVATION IN MAJOR UTILITIES				9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – D.G. sets					
Unit V	ECONOMICS				9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept					
Total periods:45 PERIODS					
Text Books: 1.Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com . a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.					
References: 1.Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988. 2.Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981 3.Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982 4.Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982. 5.. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987					
Course Outcomes:					Blooms Taxonomy

CO 1:1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment													Remember (K1)		
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion													Understand (K2)		
CO3: Skills on combustion thermodynamics and kinetics													Apply (K3)		
CO4: Apply calculation and design tube still heaters													Analyze (K4)		
CO5: Studied different heat treatment furnace													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1					1					1	1		
CO2	1	1		1			1					1	1		
CO3	1	1	1	1			1					1	1		
CO4	1	1	1	1	1		1					1	1	1	
CO5	1	1	1		1		1					1	1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEE072	BASICS OF PLASTICS PROCESSING	Category: BSC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of polymer science, including types of polymers and their fundamental properties. • Understanding of basic material science concepts, such as mechanical, thermal, and rheological behavior of materials. • Awareness of manufacturing processes, especially conventional metal/ceramic forming processes, for comparison with polymer processing.					

Course Objectives:		
- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on - To gain practical knowledge on the polymer selection and its processing - Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting) - To understand suitable additives for plastics compounding - To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques		
Unit I	INTRODUCTION TO PLASTICS PROCESSING	9
Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization..		
Unit II	EXTRUSION	9
Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooning. Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications. Applications of extrusion and new developments.		
Unit III	INJECTION MOLDING	9
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures- Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting		
Unit IV	COMPRESSION AND TRANSFER MOLDING	9
Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding		
Unit V	BLOW MOLDING, THERMOFORMING AND CASTING	9
Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.		
TOTAL:45 PERIODS		
Text Books:		
1.A. Brent Strong, Plastics: Materials and Processing, Pearson Education		
References:		
1.S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).		
2.F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).		
3.W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).		
4.M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).		
5.I. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).		
6. D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).		
7. M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).		
8. B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).		

9. D.V Rosato, Blow Molding Hand Book, Carl Hanser Verlag GmbH & Co (2003).															
Course Outcomes:													Blooms Taxonomy		
CO1: Ability to find out the correlation between various processing techniques with product properties.													Analyze(K4)		
CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.													Understand (K2)		
CO3: Acquire knowledge on additives for plastic compounding and methods employed for the same													Apply / Understand (K3/K2)		
CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.													Apply (K3)		
CO5: Select an appropriate processing technique for the production of a plastic product													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	2	1	2	3	2	2
CO2	2	2	2	1	1	1	1	1	1	2	1	1	2	2	2
CO3	2	2	2	2	2	1	1	1	1	2	1	1	2	3	2
CO4	2	2	3	2	3	1	1	1	1	2	2	1	3	3	3
CO5	3	3	3	2	3	1	1	1	2	3	2	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23ECO003	SIGNALS AND SYSTEMS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Mathematics (Calculus, differential equations) • Basic Electrical Engineering • Fourier series and transforms (introductory exposure) • Basic circuit theory (Kirchhoff's laws, linear circuits)					
Course Objectives: • To understand the basic properties of signal & systems • To know the methods of characterization of LTI systems in time domain • To analyze continuous time signals and system in the Fourier and Laplace domain • To analyze discrete time signals and system in the Fourier and Z transform domain					
Unit I	CLASSIFICATION OF SIGNALS AND SYSTEMS				9
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals -Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal& Non-causal, Stable & Unstable.					
Unit II	ANALYSIS OF CONTINUOUS TIME SIGNALS				9
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties					
Unit III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS				9
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel					
Unit IV	ANALYSIS OF DISCRETE TIME SIGNALS				9
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties					
Unit V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS				9

Impulse response–Difference equations–Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel															
Total periods:45 PERIODS															
Text Books:															
1.Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)															
2.Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002															
References:															
References:															
1.B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.															
2.M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.															
3.John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.															
Course Outcomes:													Blooms Taxonomy		
CO1: Determine if a given system is linear/causal/stable													Apply (K3)		
CO2: Determine the frequency components present in a deterministic signal													Apply (K3)		
CO3: Characterize continuous LTI systems in the time domain and frequency domain													Analyze (K4)		
CO4: Characterize discrete LTI systems in the time domain and frequency domain													Analyze (K4)		
CO5: Compute the output of an LTI system in the time and frequency domains													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1									1	1		
CO2	1	1	1	1								1	1		
CO3	1	1	1	1	1							1	1	1	
CO4	1	1	1	1	1							1	1	1	
CO5	1	1	1	1	1							1	1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23ECO004	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of electrical circuits and semiconductor fundamentals • High school physics on current, voltage, and resistance • Understanding of basic electronic components like resistors, capacitors, and diodes					
Prerequisites • Basic knowledge of electrical circuits and semiconductor fundamentals					

- High school physics on current, voltage, and resistance - Understanding of basic electronic components like resistors, capacitors, and diodes															
Course Objectives: - To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits - To analyze the frequency response of small signal amplifiers - To design and analyze single stage and multistage amplifier circuits - To study about feedback amplifiers and oscillators principles - To understand the analysis and design of multi vibrators															
Unit I		SEMICONDUCTOR DEVICES											9		
PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator															
Unit II		AMPLIFIERS											9		
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.															
Unit III		MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER											9		
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.															
Unit IV		FEEDBACK AMPLIFIERS AND OSCILLATORS											9		
Advantages of negative feedback – Analysis of Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.															
Unit V		POWER AMPLIFIERS AND DC/DC CONVERTERS											9		
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design															
Total periods:45 PERIOD															
Text Books:															
1.David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010															
2.Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.															
3.Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.															
References:															
1Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.															
2.D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989															
3.Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the structure and working operation of basic electronic devices													Understand (K2)		
CO2: Design and analyze amplifiers													Apply (K3)		
CO3: Analyze frequency response of BJT and MOSFET amplifiers													Analyze (K4)		
CO4: Design and analyze feedback amplifiers and oscillator principles													Apply (K3)		
CO5: Design and analyze power amplifiers and supply circuits													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						1			3	2	1
CO2	3	3	3	2	1					2		1	3	3	2
CO3	3	3	3	2	1					2		1	3	3	2
CO4	3	3	3	2	1					2		1	3	3	2
CO5	3	3	3	2	1					2		1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23MEO008	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of engineering design - Basic project management concepts - Ability to work in teams and communicate effectively					
Course Objectives: - To understand the global trends and development methodologies of various types of products and services - To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems - To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification - To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics - To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer					
Unit I	BASICS OF PRODUCT DEVELOPMENT				9
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management					
Unit II	REQUIREMENTS AND SYSTEM DESIGN				9
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design &Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.					
Unit III	DESIGN AND TESTING				9
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation					
Unit IV	SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT				9
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal					
Unit V	BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY				9
The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management					
Total periods: 45 PERIODS					
Text Books:					
1.Book specially prepared by NASSCOM as per the MoU					
2.Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011					
3.John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.					
References:					

1.Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.															
2.Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.															
3.Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.															
4.Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013															
Course Outcomes:													Blooms Taxonomy		
CO1: Define, formulate, and analyze a problem													Analyze (K4)		
CO2: Solve specific problems independently or as part of a team													Apply (K3)		
CO3: Gain knowledge of the Innovation & Product Development process in the Business Context													Understand (K2)		
CO4: Work independently as well as in teams													Apply (K3)		
CO5: Manage a project from start to finish													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1					1	1	1	1	1	1	-
CO2	1	1	1	1				1	1	1	1	1	1	1	-
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23BMO002	ASSISTIVE TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic human anatomy and physiology • Fundamentals of biomedical instrumentation • Basic electrical and electronic devices					
Course Objectives: • To know the hardware requirement various assistive devices • To understand the prosthetic and orthotic devices • To know the developments in assistive technology					
Unit I	CARDIAC ASSIST DEVICES				9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker					
Unit II	HEMODIALYSERS				9
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters					
Unit III	HEARING AIDS				9
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids					
Unit IV	PROSTHETIC AND ORTHODIC DEVICES				9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices					
Unit V	RECENT TRENDS				9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery					
Total periods:45 PERIODS					

Text Books:															
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006															
2. Marion. A. Hersh, Michael A. Johnson, Assistive Technology for visually impaired and blind, Springer Science & Business Media, 1st edition, 12-May-2010															
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition, 2010.															
References:															
1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1st edition, 2011.															
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.															
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019 ISBN 978 -0-323-662116															
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1															
Course Outcomes:													Blooms Taxonomy		
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.													Understand (K2)		
CO2: Describe the underlying principles of hemodialyzer machine.													Understand (K2)		
CO3: Indicate the methodologies to assess the hearing loss.													Apply (K3)		
CO4: Evaluate the types of assistive devices for mobilization													Evaluate (K5)		
CO5: Explain about TENS and biofeedback system.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	1	1				1	3	2	1
CO2	3	2	2	1	1	1	1	1				1	3	2	1
CO3	2	2	2	2	1	1	1	1	1	2	1	1	3	2	1
CO4	3	3	3	2	1	1	2	2	1	2	1	2	3	3	2
CO5	2	2	2	1	1	1	1	1		1		1	2	2	1
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

23MAO001	OPERATIONS RESEARCH	Category: OEC			
		L	T	P	C
Prerequisites • Engineering Mathematics (Algebra, Calculus) • Matrices and linear algebra operations • Basic optimization concepts (introductory)					

Course Objectives: - Determine the optimum solution for Linear programming problems. - Study the Transportation and assignment models and various techniques to solve them. - Acquire the knowledge of optimality, formulation and computation of integer programming problems. - Acquire the knowledge of optimality, formulation and computation of dynamic programming problems. - Determine the optimum solution for non-linear programming problems.																
Unit I		LINEAR PROGRAMMING												9		
Formulation of linear programming models – Graphical solution – Simplex method - Big M Method – Two phase simplex method - Duality - Dual simplex method.																
Unit II		TRANSPORTATION AND ASSIGNMENT PROBLEMS												9		
Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution – Transportation algorithm – Assignment problem – Unbalanced assignment problems																
Unit III		INTEGER PROGRAMMING												9		
Introduction – All and mixed I.P.P – Gomory’s method – Cutting plane algorithm – Branch and bound algorithm – Zero – one programming.																
Unit IV		DYNAMIC PROGRAMMING PROBLEMS												9		
Recursive nature of computation – Forward and backward recursion – Resource Allocation model – Cargo – loading model – Work – force size model - Investment model – Solution of L.P.P by dynamic programming																
Unit V		NON - LINEAR PROGRAMMING PROBLEMS												9		
Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.																
Total periods45 PERIODS																
Text Books:																
1.Kanti Swarup, P.K.Gupta and Man Mohan, " Operations Research " , Sultan Chand & Sons, New Delhi, Fifth Edition , 1990.																
2.Taha. H.A, " Operations Research – An Introduction , Pearson Education, Ninth Edition , New Delhi, 2012.																
References:																
1.J.K.Sharma , " Operations Research - Theory and Applications " Mac Millan India Ltd , Second Edition , New Delhi , 2003																
2.Richard Bronson &GovindasamiNaadimuthu , " Operations Research " (Schaum’s Outlines – TMH Edition) Tata McGraw Hill, Second Edition, New Delhi, 2004.																
3.Pradeep Prabhakar Pai , " Operations Research and Practice", Oxford University Press, New Delhi , 2012.																
4.J.P.Singh and N.P.Singh , " Operations Research , Ane Books Pvt.Ltd, New Delhi , 2014.																
5.F.S.Hillier and G.J. Lieberman, " Introduction to Operations Research " , Tata McGraw Hill, Eighth Edition , New Delhi, 2005.																
Course Outcomes:														Blooms Taxonomy		
CO1: Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.														Apply (K3)		
CO2: Analyze the concept of developing, formulating, modeling and solving transportation and assignment problems														Analyze (K4)		
CO3: Solve the integer programming problems using various methods.														Apply (K3)		
CO4: Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming														Analyze (K4)		
CO5: Determine the optimum solution for non linear programming problems														Apply (K3)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	

CO1	3	3	3	2	1					1		2	3	2	1
CO2	3	3	3	3	2					1		2	3	2	1
CO3	3	3	3	2	2					1		2	3	3	1
CO4	3	3	3	3	2					1		2	3	3	2
CO5	3	3	2	2	3					1		2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23MAO002	ALGEBRA AND NUMBER THEORY	Category: OEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic algebra (sets, functions, relations)
- Elementary number theory concepts (divisibility, primes)
- Basic proof techniques (mathematical induction, direct & indirect proofs)

Course Objectives:

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

Unit I	GROUPS AND RINGS	9
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.		
Unit II	FINITE FIELDS AND POLYNOMIALS	9
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.		
Unit III	DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS	9
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM		
Unit IV	DIOPHANTINE EQUATIONS AND CONGRUENCES	9
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems		
Unit V	CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS	9
Wilson's theorem – Fermat's Little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.		
Total periods:45 PERIODS		

Text Books:

- 1.Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
- 2.Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi , 2002.

References:

- 1.San Ling and Chaoping Xing, "Coding Theory – A first Course", Cambridge Publications, Cambridge, 2004.
- 2.Niven.I, Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons , Singapore, 2004.
- 3.Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition , 2006

Course Outcomes:

CO1: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.	Blooms Taxonomy Understand (K2)
CO2: Demonstrate accurate and efficient use of advanced algebraic techniques	Apply (K3)
CO3: The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements	Analyze (K4)

proven by the text															
CO4: Apply algebraic and number-theoretic methods to solve Diophantine equations, linear congruences, and related problems.													Apply (K3)		
CO5: Analyze classical theorems (Wilson, Fermat, Euler) and multiplicative functions (Euler's Phi, Tau, Sigma) to solve advanced number-theoretic problems.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1					1		1	3	2	1
CO2	3	3	2	1	1					1		1	3	2	1
CO3	3	3	3	2	1					1		2	3	3	2
CO4	3	3	2	2	1					1		2	3	2	2
CO5	3	3	3	2	1					1		2	3	3	2
1 - Low, 2 - Medium, 3 - High, - No correlation															

23MAO003	LINEAR ALGEBRA	Category: OEC			
		L	T	P	C
Prerequisites • Basic algebra and arithmetic operations • Elementary matrices and determinants • High school level vector operations					
Course Objectives: • To test the consistency and solve system of linear equations. • To find the basis and dimension of vector space. • To obtain the matrix of linear transformation and its eigenvalues and eigenvectors. • To find orthonormal basis of inner product space and find least square approximation. • To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.					
Unit I	MATRICES AND SYSTEM OF LINEAR EQUATIONS				9
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method					
Unit II	VECTOR SPACES				9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension					
Unit III	LINEAR TRANSFORMATION				9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.					
Unit IV	INNER PRODUCT SPACES				9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation					
Unit V	EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION				9
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.					
Total periods: 45 PERIODS					
Textbooks:					
1.Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.					
2.Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th Edition,2019					
References:					
1.Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8th Edition, 2009.					
2.Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7th Edition, 2007.					
3.Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010					

4.Richard Branson, Matrix Operations, Schaum's outline series, 1989.															
5.Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4th Edition, 2005.															
6.Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014															
Course Outcomes:													Blooms Taxonomy		
CO1: Test the consistency and solve system of linear equations													Apply (K3)		
CO2: Find the basis and dimension of vector space													Apply (K3)		
CO3: Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.													Analyze (K4)		
CO4: Find orthonormal basis of inner product space and find least square approximation													Analyze (K4)		
CO5: Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-					1			3	2	1
CO2	3	3	2	2	1					1		1	3	2	2
CO3	3	3	3	2	1					1		1	3	3	2
CO4	3	3	3	2	1					1		1	3	3	2
CO5	3	3	3	2	1					1		1	3	3	2
1 - Low, 2 - Medium, 3 - High, -'No correlation															

OPEN ELECTIVES – IV

23HSO002	PROJECT REPORT WRITING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic English grammar knowledge • Fundamental writing skills (paragraph writing, coherence, cohesion) • Understanding of general communication skills					

Course Objectives: - Understand the essentials of project writing. - Perceive the difference between general writing and technical writing - Assimilate the fundamental features of report writing. - Understand the essential differences that exist between general and technical writing. - Learn the structure of a technical and project report.															
Unit I													9		
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.															
Unit II													9		
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.															
Unit III													9		
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.															
Unit IV													9		
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations -Recommendations – Conclusion – Bibliography.															
Unit V													9		
Proofreading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.															
Total Periods:45 PERIODS															
Textbooks:															
1. Gerson, S. J., & Gerson, S. M. Technical Communication: Process and Product, 7th Edition, Prentice Hall, 2012.															
2. Riordan, Daniel. Technical Report Writing Today, Cengage Learning, 1998.															
References:															
1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012)															
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012)															
3. Daniel Riordan - Technical Report Writing Today (1998)															
Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.															
Course Outcomes:													Blooms Taxonomy		
CO1: Write effective project reports.													Apply / Analyze (K3/K4)		
CO2: Use statistical tools with confidence.													Understand / Apply (K2/K3)		
CO3: Explain the purpose and intension of the proposed project coherently and with clarity.													Understand / Apply (K2/K3)		
CO4: Create writing texts to achieve the intended purpose.													Apply / Analyze (K3/K4)		
CO5: Master the art of writing winning proposals and projects.													Understand / Apply (K2/K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	2	2	3	3	3	3	-	-	-
CO2	2	2	2	1	1	1	2	1	2	3	2	3			
CO3	2	2	3	3	2	3	2	2	2	3	2	3			

CO4	3	3	3	3	3	3	3	3	3	3	3	3			
CO5	3	3	3	3	3	3	3	3	3	3	3	3			
1- Low, 2- Medium, 3- High, - -No correlation															

23CEO008	BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT		Category: OEC			
			L	T	P	C
			3	0	0	3
Prerequisites Basic understanding of water resources and environmental studies.						
Course Objectives: - To introduce the interdisciplinary approach of water management. - To develop knowledge base and capacity building on IWRM.						
Unit I	OVERVIEW OF IWRM					9
Facts about water - Definition – Key challenges - Paradigm shift - Water management Principles - Social equity - Ecological sustainability – Economic efficiency - SDGs - World Water Forums.						
Unit II	WATER USE SECTORS: IMPACTS AND SOLUTION					9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.						
Unit III	WATER ECONOMICS					9
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.						
Unit IV	RECENT TREANDS IN WATER MANAGEMENT					9
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.						
Unit V	IMPLEMENTATION OF IWRM					9
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.						
Total Periods :45 PERIODS						
Textbooks:						
1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.						
2.Mollinga P. et al. “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.						
References:						
1. Technical Advisory Committee, Background Papers No: 1, 4 and 7, Stockholm, Sweden. 2002.						
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).						
3. Tutorial on Basic Principles of Integrated Water Resources Management, CAP-NET. http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/introduction%20to%20iwrn/Tutorial_text.pdf						
4. Pramod R. Bhave, 2011, Water Resources Systems, Narosa Publishers.						
5. The 17 Goals, United Nations, https://sdgs.un.org/goals .						
Course Outcomes:					Blooms Taxonomy	
CO1: Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.					Apply / analyses (K3/K4)	
CO2: Discuss the different water uses; how it is impacted and ways to tackle these impacts.					Understand / Apply (K2/K3)	
CO3: Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.					Understand / Apply (K2/K3)	

CO4: Illustrate the recent trends in water management.													Apply / analyses (K3/K4)		
CO5: Understand the implementation hitches and the institutional frameworks.													Understand / Apply (K2/K3)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	1	1	1	3			
CO2	3	3	3	3	3	2	2	1	1	1	1	3			
CO3	3	3	3	3	3	2	2	1	1	1	1	3			
CO4	3	3	3	3	3	2	2	1	1	1	1	3			
CO5	3	3	3	3	3	2	2	1	1	1	1	3			
1- Low, 2- Medium, 3- High, - ‘No correlation															

23MAO004	ADVANCED NUMERICAL METHODS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Understanding of calculus and linear algebra. • Knowledge of ordinary and partial differential equations. • Familiarity with basic numerical methods and programming concepts.					
Course Objectives: • To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.					
Unit I	ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM				9
System of nonlinear equations: Fixed point iteration method - Newton's method; System of linear equations: Thomas algorithm for tri diagonal system - SOR iteration methods; Eigen value problems: Given's method - Householder's method.					
Unit II	INTERPOLATION				9
Central difference: Stirling and Bessel's interpolation formulae; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline; Least square approximation for continuous data (up to 3rd degree).					
Unit III	NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS				9
Explicit Adams - Bashforth Techniques - Implicit Adams - Moulton Techniques, Predictor -Corrector Techniques - Finite difference methods for solving two - point linear boundary value problems - Orthogonal Collocation method.					
Unit IV	FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS				9
Laplace and Poisson’s equations in a rectangular region: Five-point finite difference schemes - Liebmann’s iterative methods - Dirichlet's and Neumann conditions – Laplace equation in polar coordinates: Finite difference schemes.					
Unit V	FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS				9
Parabolic equations: Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – First order hyperbolic equations - Method of characteristics - Different explicit and implicit methods; Wave equation: Explicit scheme – Stability of above schemes.					
Total Periods :45 PERIODS					
Textbooks:					
1. Grewal, B.S., "Numerical Methods in Engineering & Science ", Khanna Publications, Delhi, 2013.					
2. Gupta, S.K., "Numerical Methods for Engineers", (Third Edition), New Age Publishers, 2015.					

3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Computational Methods for Partial Differential Equations", New Age Publishers, 1994.															
References:															
1. Saum yen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.															
2. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9 th Edition, Cengage Learning, New Delhi, 2016.															
3. Gupta S.K., "Numerical Methods for Engineers", 4th Edition, New Age Publishers, 2019.															
4. Sastry, S.S., "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning, 2015.															
5. Morton, K.W. and Mayers D.F., "Numerical solution of Partial Differential equations", Cambridge University press, Cambridge, 2002.															
Course Outcomes:													Blooms Taxonomy		
CO1: Demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems													Understand (K2)		
CO2: Understand the interpolation theory													Understand (K2)		
CO3: Understand the concepts of numerical methods for ordinary differential equations													Understand (K2)		
CO4: Demonstrate the understandings of common numerical methods for elliptic equations													Understand (K2)		
CO5: Understand the concepts of numerical methods for time dependent partial differential equations													Understand (K2)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	1	1	1	3			
CO2	3	3	3	3	3	2	2	1	1	1	1	3			
CO3	3	3	3	3	3	2	2	1	1	1	1	3			
CO4	3	3	3	3	3	2	2	1	1	1	1	3			
CO5	3	3	3	3	3	2	2	1	1	1	1	3			
1- Low, 2- Medium, 3- High, - '-No correlation															

23MAO005	RANDOM PROCESSES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

- Probability and Statistics – Understanding of probability theory, random variables, and basic distributions. - Linear Algebra – Knowledge of matrices, vectors, and operations on them. - Signals and Systems / Calculus – Familiarity with linear systems, differential equations, and basic signal analysis.		
Course Objectives: - To introduce the basic concepts of probability, one- and two-dimensional random variables with applications to engineering which can describe real life phenomenon. - To understand the basic concepts of random processes which are widely used in communication networks. - To get to know socialized random processes which are apt for modelling the real time scenario. - To understand the concept of correlation and spectral densities. - To understand the significance of linear systems with random inputs.		
Unit I	RANDOM VARIABLES	9
Discrete and continuous random variables – Moments – Moment generating functions – Joint Distribution- Covariance and Correlation – Transformation of a random variable.		
Unit II	RANDOM PROCESSES	9
Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.		
Unit III	SOECIAL RANDOM PROCESSES	9
Bernoulli Process – Gaussian Process - Poisson process – Random telegraph process.		
Unit IV	CORRELATION AND SOECTRAL DENSITIES	9
Auto correlation functions – Cross correlation functions – Properties – Power spectrally density – Cross spectrally density – Properties.		
Unit V	LINEAR SYSTEMS WITH RANDOM INPUTS	9
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.		
Total Periods :45 PERIODS		
Textbooks:		
1. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.		
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.		
References:		
1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.		
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.		
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.		
4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.		
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.		
Course Outcomes:		Blooms Taxonomy
CO1: Understand the basic concepts of one- and two-dimensional random variables and apply them in engineering applications.		Understand / Apply (K2/K3)
CO2: Apply the concept of random processes in engineering disciplines.		Apply (K3)
CO3: Understand and apply the concept of correlation and spectrally densities.		Understand / Apply (K2/K3)
CO4: Get exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.		analyses (K4)

CO5: analyses the response of random inputs to linear time invariant systems.													analyses / Evaluate (K4/K5)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	0	0	0	0	0	0	3	0	0	2			
CO2	3	3	0	0	0	0	0	0	3	0	0	2			
CO3	3	3	0	0	0	0	0	0	3	0	0	2			
CO4	3	3	0	0	0	0	0	0	3	0	0	2			
CO5	3	3	0	0	0	0	0	0	3	0	0	2			
1- Low, 2- Medium, 3- High, - -No correlation															

23MAO006	QUEUEING AND RELIABILITY MODELLING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Probability theory – basic understanding of probability, random variables, and distributions. • Random processes – familiarity with stationary processes, Poisson processes, and Markov chains. • Basic mathematics – calculus and linear algebra to handle system modeling and reliability calculations.					
Course Objectives: • To provide necessary basic concepts in probability and random processes for applications such as random signals and linear systems in communication engineering. • To understand the concept of queueing models and apply engineering. • To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering. • To study the system reliability and hazard function for series and parallel systems. • To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.					
Unit I	RANDOM PROCESSES				9
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.					
Unit II	MARKOVIAN QUEUEING MODELS				9
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.					
Unit III	ADVANCED QUEUEING MODELS				9
M/G/1 queue – Placzek Khin chin formula - M/D/1 and M/EK/1 as social cases – Series queues – Open Jackson networks.					
Unit IV	SYSTEM RELIABILITY				9
Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.					
Unit V	MAINTAINABILITY AND AVAILABILITY				9
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.					
Total Periods :45 PERIODS					
Textbooks:					
1. Shortle J.F, Gross D, Thompson J.M,Harris C.M., “Fundamentals of Queueing Theory”, John Wiley and Sons, New York,2018					
2. BalaguruSamy E., “Reliability Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi,2010.					
References:					

1. Medhi J,” Stochastic models of Queueing Theory”, Academic Press, Elsevier, Amsterdam, 2003.															
2.Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016.															
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.															
4. Govil A.K., “Reliability Engineering”, Tata-McGraw Hill Publishing Company Ltd., New Delhi,1983.															
Course Outcomes:													Blooms Taxonomy		
CO1: Enable the students to apply the concept of random processes in engineering disciplines.													Apply (K3)		
CO2: Students acquire skills in analysing various queueing models.													analyses (K4)		
CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.													Understand / analyses (K2/K4)		
CO4: Students can analyse reliability of the systems for various probability distributions.													analyses / Evaluate (K4/K5)		
CO5: Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.													Apply / Evaluate (K3/K5)		
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	0	0	0	0	0	0	2	0	0	2			
CO2	3	3	2	0	0	0	0	0	2	0	0	2			
CO3	3	3	0	2	0	0	0	0	2	0	0	2			
CO4	3	3	2	0	0	0	0	0	2	0	0	2			
CO5	3	3	3	2	0	0	0	0	2	0	0	2			
1- Low, 2- Medium, 3- High, - -No correlation															

23MGO004	PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of business and management principles • Fundamentals of production processes and operations • Basic mathematics for planning and optimization					
Course Objectives: • To know the basic concept and function of Production and Operation Management for entrepreneurship. • To understand the Production process and planning. • To understand the Production and Operations Management Control for business owners.					
Unit I	INTRODUCTION TO PRODUCTION AND OPERATIONS MANGEMENT				9
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organization of production function, recent trends in production /operations management - production as an organizational function, decision making in production Operations research					
Unit II	PRODUCTION & OPERATION SYSTEMS				9
Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry					
Unit III	PRODUCTION & OPERATIONS PLANNING				9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning															
Unit IV		PRODUCTION & OPERATIONS MANAGEMENT PROCESS												9	
Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters – Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation - Forecasting methods.															
Unit V		CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT												9	
Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.															
Total Periods :45 PERIODS															
Textbooks:															
1. K. Aswathappa & K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing, 2010.															
2. R. Panneerselvam, Production and Operations Management, PHI Learning, 2010.															
References:															
1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.															
2. Amitabh Raturi, Production and Inventory Management, , 2008.															
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.															
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.															
5. Chary S.N, Production and Operations Management, TMH Publications, 2010.															
6. Terry Hill, Operation Management. Pal Grave McMillan (Case Study).2005.															
Course Outcomes:														Blooms Taxonomy	
CO1: To understand the basics and functions of Production and Operation Management for business owners														Understand (K2)	
CO2: To learn about Production & Operation Systems.														Understand / Apply (K2/K3)	
CO3: To acquaint them with the Production & Operations Planning Techniques followed by entrepreneurs in Industries.														Apply / analyses (K3/K4)	
CO4: To. known about the Production & Operations Management Processes in organisations.														Understand / analyses (K2/K4)	
CO5: To comprehend the techniques of controlling, Production and Operations in industries.														analyses / Evaluate (K4/K5)	
CO-PO Mapping															
Particular	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	1	2	1	1	1			
CO2	3	2	2	1	1	1	1	1	2	1	1	1			
CO3	3	3	2	2	2	1	1	1	2	2	1	1			
CO4	3	2	2	2	2	1	1	1	2	2	1	1			
CO5	3	3	3	2	2	1	1	1	2	2	1	1			
1- Low, 2- Medium, 3- High, - ‘No correlation															

23MGO005	MULTIVARIATE DATA ANALYSIS												Category: OEC			
													L	T	P	C
													3	0	0	3
Prerequisites • Basic knowledge of Statistics • Fundamentals of Probability • Understanding of Data Collection and Sampling Techniques																
Course Objectives: • To know various multivariate data analysis techniques for business research																
Unit I		INTRODUCTION												9		
Univariate, Bi-variate and multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation																
Unit II		PREPARING FOR MULTIVARIATE ANALYSIS												9		
Conceptualization of research model with variables, collection of data –Approaches for dealing with missing data Testing the assumptions of multivariate analysis																
Unit III		MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS												9		
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. - Approaches to factor analysis – interpretation of results.																
Unit IV		LATENT VARIABLE TECHNIQUES												9		
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.																
Unit V		ADVANCED MULTIVARIATE TECHNIQUES												9		
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling																
Total period:45 PERIODS																
Textbook																
1. Joseph F. Hair, William C. Black, Barry J. Babin, Rolph E. Anderson, Multivariate Data Analysis, 8th Edition, Pearson Education, 2019.																
References:																
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Educa																
2. 2. Barbara G. Tabachnick, Linda S. Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012																
3.. Richard A Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall,																
4.. Richard A Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall,																
Course Outcomes:													Blooms Taxonomy			
CO1: Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.													Understand (K2)			
CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information													Analyze (K4)			
CO3: Show substantial understanding of real problems; conduct deep analysis using correct methods; draw reasonable conclusions with sufficient explanation and elaboration													Understand (K2)			
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing detail													Analyze (K4)			
CO5: Make better business decisions by using advanced techniques in data analytics.													Understand (K2)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	2	1	2	1								2	1	1	
CO2	2	3	2	3	2								3	2	2	

CO3	2	3	2	3	2				1				3	2	2
CO4	1	1	1	2	2			1	2	2	1	1	2	2	1
CO5	2	3	2	2	1				1				1	2	2
1- Low, 2- Medium, 3- High, - 'No correlation															

23MEO012	MICRO AND PRECISION ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Manufacturing Processes • Fundamentals of Machine Tools • Basics of Metrology and Measurements					
Course Objectives: • Learn about the precision machine tools • Learn about the macro and micro components. • Understand handling and operating of the precision machine tools. • Learn to work with miniature models of existing machine tools/robots and other instruments. • Learn metrology for micro system					
Unit I	INTRODUCTION TO MICROSYSTEMS				9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.					
Unit II	FABRICATION PROCESSES FOR MICRO-SYSTEMS				9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices					
Unit III	INTRODUCTION TO PRECISION ENGINEERING				9
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.					
Unit IV	PRECISION MACHINING PROCESSES				9
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes					
Unit V	METROLOGY FOR MICRO SYSTEMS				9
Metrology for micro systems - Surface integrity and its characterization					
Total period:45 PERIODS					
Textbooks:					
1. David, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development. Woodhead Publishing, 2017					
2. Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017					
References:					
1. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer					
2. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press					
3.Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA, 1994.					
4. Murthy. R.L, Precision Engineering in Manufacturing, New Age International, New Delhi, 2005					
Course Outcomes:					Blooms Taxonomy
CO1: Select suitable precision machine tools and operates					Understand (K2)
CO2: Apply the macro and micro components for fabrication of micro systems					Analyze (K4)
CO3: Apply suitable machining process					Understand (K2)

CO4: Able to work with miniature models of existing machine tools/robots and other instruments.													Apply (K3)		
CO5: Apply metrology for micro system													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3				1	1			3	3	2
CO2	2	2	3	2	2				1	1			3	3	3
CO3	2	2	3	2	3				1	1			3	3	3
CO4	1	1	2	2	3			1	2	2	1	1	2	2	2
CO5	2	1	2	2	2				1	1			3	3	3

23ECO005	SPACE VEHICLES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Aerodynamics • Fundamentals of Propulsion • Engineering Mechanics • Introduction to Aircraft / Space Systems • Basics of Thermodynamics					
Course Objectives: • To interpret the missile space stations, space vs earth environment. • To explain the life support systems, mission logistics and planning. • To deploy the skills effectively in the understanding of space vehicle configuration design. • To explain Engine system and support of space vehicle • To interpret nose cone configuration of space vehicle					
Unit I	FUNDAMENTAL ASPECTS				9
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity					
Unit II	SELECTION OF ROCKET PROPULSION SYSTEMS				9
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and them role in launch vehicle configuration design.					
Unit III	ENGINE SYSTEMS, CONTROLS, AND INTEGRATION				9
Propellant Budget – Performance of Complete or Multiple Rocket Propulsion Systems – Engine Design – Engine Controls – Engine System Calibration – System Integration and Engine Optimization					
Unit IV	THRUST VECTOR CONTROL				9
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment					
Unit V	NOSE CONE CONFIGURATION				9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism					
Total periods:45 PERIODS					
Textbook					
1.R. K. Jain and Sunil S. Rao, <i>Industrial Safety, Health and Environment Management Systems</i>, Khanna Publishers, New Delhi, 2006					

2.Slote L., <i>Handbook of Occupational Safety and Health</i> , John Wiley & Sons, New York															
References															
1.Jeanne Mager Stellman, <i>Encyclopaedia of Occupational Health and Safety (ILO)</i> , Ms. Irma Jourdan Publication															
2. Frank P. Lees, <i>Loss Prevention in Process Industries</i> , Vol. 1 & 2, Butterworth-Heinemann Ltd., London.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.													Understand (K2)		
CO2: Apply knowledge in selecting the appropriate rocket propulsion systems													Analyze (K4)		
CO3: interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.													Understand (K2)		
CO4: analyses aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.													Analyze (K4)		
CO5: Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.													Analyze (K4)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1					1	1	2	3	2	2
CO2	3	3	3	2	2					2	2	2	3	3	3
CO3	3	3	2	2	2					2	2	2	3	3	3
CO4	2	2	3	1	2					1	1	2	3	3	3
CO5	1	3	2	1	2					2	2	2	3	3	2

23MGO006	MANAGEMENT SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Economics • Fundamentals of Engineering Management • Basic Mathematical Skills • Introductory knowledge of Production / Operations • Fundamentals of Business and Communication					
Course Objectives: • To introduce fundamental concepts of management and organization to students. • To impart knowledge to students on various aspects of marketing, quality control and marketing strategies. • To make students familiarize with the concepts of human resources management. • To acquaint students with the concepts of project management and cost analysis. • To make students familiarize with the concepts of planning process and business strategies.					
Unit I	INTRODUCTION TO MANAGEMENT AND ORGANISATION				9
Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's TheoryX and TheoryY-HertzbergTwoFactorTheoryofMotivation-LeadershipStyles, Social responsibilities of Management, Designing Organisational Structures: Basic concepts related to Organisation - Departmentation and Decentralisation					
Unit II	OPERATIONS AND MARKETING MANAGEMENT				9
Principles and Types of Plant Layout-Methods of Production (Job, batch and Mass Production), Work Study - Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering (BPR)-Statistical Quality Control:control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System,Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on ProductLifeCycle.					

Unit III	HUMAN RESOURCES MANAGEMENT												9		
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.															
Unit IV	PROJECT MANAGEMENT												9		
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems)															
Unit V	STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES												9		
Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Cardas Contemporary Business Strategies.															
Total periods: 45 PERIODS															
Textbooks:															
1.KanishkaBedi, Production and Operations Management,Oxford University Press,2007															
2.Stoner,Freeman, Gilbert, Management,6th Ed, PearsonEducation, NewDelhi,2004.															
3.ThomasN.Duening& John M.Ivancevich Management Principles and Guidelines, Biztantra, 2007.															
4.P.VijayKumar,N.Appa Rao and Ashnab, Chnalill, Cengage Learning India,2012															
References:															
1. P. Vijaykumar, Nappa Rao and Ashnab, Chnalill, CengageLearning India,2012															
2.KoontzandWeihrich: Essentials of Management, McGraw-Hill, 2012.															
3.Lawrence RJauch, R. Gupta and William F. Glueck: Business Policy and Strategic Management Science, McGrawHill,2012.															
4.SamuelC.Certo:Modern Management,2012.															
Course Outcomes:													Blooms Taxonomy		
CO1:Plan an organizational structure for a given context in the organization to carry out production operations through Work-study													Understand (K2)		
CO2: Survey the markets, customers and competition better and price the given products appropriately													Analyze (K4)		
CO3: Ensure quality for a given product or service													Understand (K2)		
CO4: Plan, schedule and control projects through PERTandCPM.													Apply (K3)		
CO5: Evaluate strategy for a business or service organisation													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2				2	1	1	2	2	2	2
CO2	1	2	2	2	3				2	2	1	2	3	2	2
CO3	2	2	3	2	3				1	1	1	2	3	1	3
CO4	2	3	2	3	2				2	1	2	2	2	3	3
CO5	1	3	2	2	2				3	3	2	3	3	2	2

23BMO002	INDUSTRIAL HYGEINE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Knowledge of Occupational Health and Safety (OHS) • Fundamental understanding of environmental science concepts • Introductory knowledge of industrial processes and workplace hazards • Awareness of basic biology and human physiology related to health impacts					
Course Objectives: • Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety. • Compare and contrast the roles of environmental and biological monitoring in work health and safety • Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates • Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures • Provide high-level advice on managing and controlling noise and noise-related hazards					
Unit I	INTRODUCTION AND SCOPE				9
Occupational Health and Environmental Safety Management - Principles practices. Comm on Occupational diseases: Occupational Health Management Services at the workplace. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records					
Unit II	MONITORING FOR SAFETY, HEALTH & ENVIRONMENT				9
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures					
Unit III	OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION				9
Element of training cycle, Assessment of needs, Techniques of training, design and development of training programs, Training methods and strategy types of training.Evaluation and review of training programs. Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limits.					
Unit IV	OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT				9
Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department,					
Unit V	INDUSTRIAL HAZARDS				9
Radiation: Types and effects of radiation on human body, Measurement and detection of radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation ii. Noise and Vibration: Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise, Different air pollutants in industries, Effect of different gases and particulate matter, acid fumes, smoke, fog on human health, Vibration: effects.					
Total period:45 PERIODS					
Textbooks:					
1.R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006)					
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York.					
References:					
1.Jeanne MagerStellman, Encyclopaedia of Occupational Health and Safety (ILO) Ms. Irma Jourdan publication					
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2					

3.Butterworth Heinemann Ltd., London (1991). 2. Industrial Safety - National Safety Council of India															
4.Frank P Lees – Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth- Heinemann Ltd., London															
5.R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006).															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems													Understand (K2)		
CO2: Specify designs that avoid occupation related injuries													Analyze (K4)		
CO3: Define and apply the principles of work design, motion economy, and work environment design													Understand (K2)		
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.													Analyze (K4)		
CO5: Acknowledge the impact of workplace design and environment on productivity													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	2	3	2	1	2	1	3	2	2	2
CO2	3	3	2	2	1	2	3	2	1	2	1	3	3	2	3
CO3	3	3	3	2	2	2	3	2	1	2	1	3	3	3	3
CO4	2	2	2	3	2	3	3	2	1	2	1	3	2	3	2
CO5	2	3	2	2	3	2	3	2	2	2	1	3	2	3	2

23CHO008	CHEMICAL PROCESS SAFETY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Chemistry and Chemical Engineering Fundamentals • Thermodynamics and Process Engineering • Material & Energy Balances (recommended)					
Course Objectives: • Teach the principles of safety applicable to the design, and operation of chemical process plants. • Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy. • Learn about the hazardous chemicals into locations that could expose employees and others to serious harm. • Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals. • Ensure that the general design of the plant can comply with the dose limits in force and with the radioactive releases.					
Unit I	SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES				9
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories					
Unit II	CHEMICAL REACTION HAZARDS				9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,					

Unit III	SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS												9		
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specification's - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non-destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.															
Unit IV	SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS												9		
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.															
Unit V	SAFETY AND ANALYSIS												9		
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.															
Total periods:45 PERIODS															
Textbooks:															
1. David A Crowl& Joseph F Louvar,"Chemical Process safety", Pearson publication, 3rd Edition,2014															
2. Maurice Jones. A, "Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015															
References:															
1. Ralph King and Ron Hirst, "King's safety in the process industries", Arnold, London, 1998.															
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.															
3. National Safety Council," Accident prevention manual for industrial operations". Chicago, 1982.															
4. Lewis, Richard. J., Sr,"Sax's dangerous properties of materials". (Ninth edition). Van Nostrand Reinhold, New York, 1996.															
5. Roy E Sanders," Chemical Process Safety",3rd Edition, Gulf professional publishing, 2006															
Course Outcomes:												Blooms Taxonomy			
CO1: Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants												Understand/analyses (K2/K4)			
CO2: Develop thorough knowledge about safety in the operation of chemical plants.												Understand/Apply (K2/K3)			
CO3: Apply the principles of safety in the storage and handling of gases												Apply (K3)			
CO4: Identify the conditions that lead to reaction hazards and adopt measures to prevent them.												analyses/Apply (K4/K3)			
CO5: Develop thorough knowledge about												Understand/analyses (K2/K4)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	2	2	1										2	1	
CO3	3	2	1										3	2	
CO4	3	2	2										2	2	
CO5	2	2	1										2	2	1
1- Low, 2- Medium, 3- High, - -No correlation															

23EEO007	ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Physics (Electricity, Magnetism, and Solid-State Physics) • Materials Science fundamentals • Semiconductor devices (recommended but not mandatory)					
Course Objectives: • Understanding the importance of various materials used in electrical, electronics and magnetic applications Acquiring knowledge on the properties of electrical, electronics and magnetic materials. • Gaining knowledge on the selection of suitable materials for the given application • Knowing the fundamental concepts in Semiconducting materials • Getting equipped with the materials used in optical and optoelectronic applications.					
Unit I	DIELECTRIC MATERIALS				9
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials					
Unit II	MAGNETIC MATERIALS				9
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis					
Unit III	SEMICONDUCTOR MATERIALS				9
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large-scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications					
Unit IV	MATERIALS FOR ELECTRICAL APPLICATIONS				9
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.					
Unit V	OPTICAL AND OPTOELECTRONIC MATERIALS				9
Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - Hetero, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials - photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.					
Total periods:45 PERIODS					
Textbooks:					
1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, Taylor and Francis, 2nd illustrated edition, 2017					
2. “R K Rajput”, “A course in Electrical Engineering Materials”, Laxmi Publications, 2009.					
References:					
1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009					
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.					
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.					
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhan pat Rai & amp; Sons, 2011					
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons, Singapore, (2006)					

Course Outcomes:													Blooms Taxonomy		
CO1: Understand various types of dielectric materials, their properties in various conditions.													Understand (K2)		
CO2: Evaluate magnetic materials and their behaviour.													analyses (K4)		
CO3: Evaluate semiconductor materials and technologies.													analyses (K4)		
CO4: Select suitable materials for electrical engineering applications.													Apply (K3)		
CO5: Identify right material for optical and optoelectronic applications													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1											2		
CO2	3	2	1										2	1	
CO3	3	2	2										2	2	
CO4	3	2	2										2	2	1
CO5	3	2	2										2	2	1
1- Low, 2- Medium, 3- High, - -No correlation															

23CHO009	NANOMATERIALS AND APPLICATIONS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic Materials Science • Solid-State Physics • Fundamentals of Chemistry (especially physical chemistry)					
Course Objectives: • Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications • Gaining knowledge on dimensionality effects on different properties of nanomaterials • Getting acquainted with the different processing techniques employed for fabricating nanomaterials • Having knowledge on the different characterisation techniques employed to characterise the nanomaterials • Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.					
Unit I	NANOMATERIALS				9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nanocomposites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.					
Unit II	THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS				9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.					
Unit III	PROCESSING				9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.					
Unit IV	STRUCTURAL CHARACTERISTICS				9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis					
Unit V	APPLICATIONS				9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoating's; applications in electronic, electrical and medical industries					
Total periods:45 PERIODS					

Textbooks:															
1. Bhushan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd edition, 2007															
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.															
References:															
1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003															
2. Nalwa H.S., Encyclopaedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004															
3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008															
4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000															
5. Gutkin Y., Ovid 'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate nanomaterials and understand the different types of nanomaterials													Understand / analyses (K2/K4)		
CO2: Recognise the effects of dimensionality of materials on the properties.													analyses (K4)		
CO3: Process different nanomaterials and use them in engineering applications													Apply (K3)		
CO4: Use appropriate techniques for characterising nanomaterials													Apply / analyses (K3/K4)		
CO5: Identify and use different nanomaterials for applications in different engineering fields.													Apply / Evaluate (K3/K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1											2	1	
CO2	3	2	1										2	2	
CO3	3	2	2										2	2	1
CO4	3	2	2										2	2	1
CO5	3	2	2										2	2	1
	2	1											2	1	
1- Low, 2- Medium, 3- High, - -No correlation															

23ECO006	CONCEPTS IN MOBILE ROBOTS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of Robotics and Control Systems - Elementary knowledge of Sensors and Signal Processing					
Course Objectives: - To introduce mobile robotic technology and its types in detail. - To learn the kinematics of wheeled and legged robot. - To familiarize the intelligence into the mobile robots using various sensors. - To acquaint the localization strategies and mapping technique for mobile robot. - To aware the collaborative mobile robotics in task planning, navigation and intelligence.					
Unit I	INTRODUCTION TO MOBILE ROBOTICS				9
Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Robots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles					
Unit II	KINEMATICS				9
Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots					

Unit III	PERCEPTION												9		
Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction.															
Unit IV	LOCALIZATION												9		
Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).															
Unit V	PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS												9		
Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.															
Total periods:45 PERIODS															
Textbooks:															
1. Roland Siegwart and IllahR. Nour Bakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.															
References:															
1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018															
2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.															
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017															
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.															
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.															
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.															
Course Outcomes:													Blooms Taxonomy		
CO1: Evaluate the appropriate mobile robots for the desired application.													Evaluate (K5)		
CO2: Create the kinematics for given wheeled and legged robot.													Create (K6)		
CO3: Analyse the sensors for the intelligence of mobile robotics.													analyses (K4)		
CO4: Create the localization strategies and mapping technique for mobile robot.													Create (K6)		
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										2	2	1
CO2	3	2	2										2	2	1
CO3	3	2	2										2	2	1
CO4	3	2	3										2	2	2
CO5	3	2	3										2	2	2
1- Low, 2- Medium, 3- High, - -No correlation															

23MEO015	MARINE PROPULSION	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of fluid mechanics - Basics of thermodynamics (thermodynamic cycles, energy conversion) - Basic engineering mechanics (forces, moments, motion)					
Course Objectives: - To impart knowledge on basics of propulsion system and ship dynamic movements - To educate them on basic layout and propulsion equipment's - To impart basic knowledge on performance of the ship - To impart basic knowledge on Ship propeller and its types - To impart knowledge on ship rudder and its types					
Unit I	BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS				9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion, screw propulsion.					
Unit II	SHIPS MOVEMENTS AND SHIP STABILIZATION				9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.					
Unit III	SHIPS SPEED AND ITS PERFORMANCE				9
Ship propulsion factors, factors affecting ships speed, various velocities of ships, hull drag, effects of fouling on ship's hull, ship wake, relation between powers, Fuel consumption of ships, cavitations - effects of cavitation's, ship turning radius.					
Unit IV	BASICS OF PROPELLER				9
Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, Kort nozzle, ducted propeller, Voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing-static and dynamic.					
Unit V	BASICS OF RUDDER				9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder					
Total periods: 45 PERIODS					
Textbooks:					
1.GP. Ghose, “Basic Ship propulsion”,2015					
2.E.A. Stokoe “Reeds Ship construction for marine engineers”, Vol. 5,2010					
3.E.A. Stokoe, “Reeds Naval architecture for the marine engineers”,4th Edition,2009					
References:					
1.DJ Eyers and GJ Bruse, “Ship Construction”, 7th Edition, 2006.					
2.KJ Rawson and EC Tupper, “Basic Ship theory I” Vol. 1,5th Edition,2001.					
Course Outcomes:					Blooms Taxonomy
CO1: Explain the basics of propulsion system and ship dynamic movements					Understand (K2)
CO2: Familiarize with various components assisting ship stabilization					Understand (K2)
CO3: Demonstrate the performance of the ship.					analyses (K4)
CO4: Classify the Propeller and its types, Materials etc.					Understand (K2)

CO5: Categories the Rudder and its types, design criteria of rudder.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		1							2	3	2	
CO2	2	2	1				2	1				2	2	1	
CO3	3	3	2	2	2							3	3	2	1
CO4	2	2	1	–	1							2	2	2	
CO5	2	2	1	–	1							2	2	2	
1- Low, 2- Medium, 3- High, - -No correlation															

23MEO016	MARINE MERCHANT VESSELS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Engineering Physics (fundamentals of forces, pressure, fluids) • Basic Mechanics (equilibrium, Centre of gravity) • Basic Engineering Materials • Introductory knowledge of transportation systems (optional but useful)					
Course Objectives: • Knowledge on basics of Hydrostatics • Familiarization on types of merchant ships • Knowledge of Shipbuilding Materials • Knowledge of marine propellers and rudder • Awareness on governing bodies in shipping industry					
Unit I	INTRODUCTION TO HYDROSTATICS				9
Archimedes Principle- Laws of floatation– Meta Centre – stability of floating and submerged bodies- Density, relative density - Displacement –Pressure –Centre of pressure.					
Unit II	TYPES OF SHIP				9
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships					
Unit III	SHIPBUILDING MATERIALS				9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminum alloys, Aluminum alloy sandwich panels, Fire protection especially for Aluminum Alloys, Fiber Reinforced Composites					
Unit IV	MARINE PROPELLER AND RUDDER				9
Types of rudders, construction of Rudder-Types of Propellers, Propeller material-Cavitations and its effects on propeller					
Unit V	GOVERNING BODIES FOR SHIPPING INDUSTRY				9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities					
Total periods:45 PERIODS					
Textbooks:					
1.D.J. Eyres, “Ship Constructions”, Seventh Edition, Butter Worth Heinemann Publishing, USA, 2015					
2.Dr. DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006					
3.EA Stokoe, E.A, “Naval Architecture for Marine Engineers”, Vol.4, Reeds Publications,2000					
References:					
1.Kemp & Young “Ship Construction Sketches & Notes”, Butter Worth Heinemann Publishing, USA, 2011					

2.MARPOL Consolidated Edition, Bhandarkar Publications, 2018															
3.SOLAS Consolidated Edition, Bhandarkar Publications, 2016															
Course Outcomes:													Blooms Taxonomy		
CO1: Acquire Knowledge on floatation of ships													Evaluate (K5)		
CO2: Acquire Knowledge on features of various ships													Create (K6)		
CO3: Acquire Knowledge of Shipbuilding Materials													analyses (K4)		
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder													Create (K6)		
CO5: Understand the Roles and responsibilities of governing bodies													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1						3	2	
CO2	3						2						3	2	
CO3	3	3	2				1						3	3	2
CO4	3	2	2				1						3	3	2
CO5						3	3	2				2	2	2	
1- Low, 2- Medium, 3- High, - -No correlation															

23MEO017	ELEMENTS OF MARINE ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of mechanics and thermodynamics • Basic understanding of IC engines • Familiarity with engineering materials • Fundamentals of fluid mechanics (helpful but not mandatory)					
Course Objectives: • Understand the role of Marine machinery systems • Be familiar with Marine propulsion machinery system • Acquaintance with Marine Auxiliary machinery system • Have acquired basics of Marine Auxiliary boiler system • Be aware of ship propellers and steering system					
Unit I	ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS				9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems					
Unit II	MARINE PROPULSION MACHINERY SYSTEM				9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system					
Unit III	MARINE AUXILIARY MACHINERY SYSTEM				9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications					
Unit IV	MARINE BOILER SYSTEM				9
Types of Boilers – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories					
Unit V	SHIP PROPELLERS AND STEERING MECHANISM				9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear					

Total periods:45 PERIODS															
Textbooks:															
1.Taylor, “Introduction to Marine engineering”, Revised Second Edition, Butterworth Heinemann, London, 2011															
2.J.K.Dhar, “Basic Marine Engineering”, Tenth Edition, G-Maritime Publications, Mumbai, 2011															
3. K.Ramaraj, “Textbook on Marine Engineering”, Eswar Press, Chennai, 2018															
References:															
1.Alan Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006															
2.A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015															
Course Outcomes:													Blooms Taxonomy		
CO1: Distinguish the role of various marine machinery systems													Evaluate (K5)		
CO2: Relate the components of marine propulsion machinery system													Create (K6)		
CO3: Explain the importance of marine auxiliary machinery system													analyses (K4)		
CO4: Acquire knowledge of marine boiler system													Create (K6)		
CO5: Understand the importance of ship propellers and steering system													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					2						3	2	
CO2	3	2	2				1						3	3	2
CO3	3	3					1						3	2	
CO4	3	2					2						3	2	1
CO5	3	2	2				2					2	3	3	2
1- Low, 2- Medium, 3- High, - -No correlation															

23CEO005	GEOGRAPHICAL INFORMATION SYSTEM	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of maps and spatial concepts • Basic knowledge of computer applications • Familiarity with data handling / database concepts (advantageous, not mandatory)					
Course Objectives: • To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.					
Unit I	FUNDAMENTALS OF GIS				9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open-source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.					
Unit II	SPATIAL DATA MODELS				9
Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.					
Unit III	DATA INPUT AND TOPOLOGY				9
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration					
Unit IV	DATA QUALITY AND STANDARDS				9

Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure																
Unit V		DATA MANAGEMENT AND OUTPUT												9		
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.																
Total periods:45 PERIODS																
Textbooks:																
1.Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.																
2.Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.																
References:																
1.Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.																
Course Outcomes:														Blooms Taxonomy		
CO1: Have basic ideas about the fundamentals of GIS.														Understand/Remember (K2/K1)		
CO2: Understand the types of data models.														Understand (K2)		
CO3: Get knowledge about data input and topology														Understand/Apply (K2/K3)		
CO4: Gain knowledge of data quality and standards														Understand/analyses (K2/K4)		
CO5: Understand data management functions and data output														Apply (K3)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2											3	2		
CO2	3	3		2									3	2		
CO3	3	3	2	-	2								3	3	2	
CO4	-	3	-	2			2					2	2	3		
CO5	-	3	2		3							3	3	3	2	
1- Low, 2- Medium, 3- High, ‘-’-No correlation																

23CEO006	AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of agriculture practices • Fundamental knowledge of economics and business concepts • Familiarity with rural development and government schemes • Basic skills in financial literacy and documentation					
Course Objectives: • To introduce the importance of Agri-business management, its characteristics and principles • Import knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.					
Unit I	ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT				9

Entrepreneur Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.															
Unit II		AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE												9	
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and Phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).															
Unit III		ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE												9	
Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing- Motivation-ordering-leading-supervision- communication and control-Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Argo-based industries-Project-Project cycle-Project appraisal and evaluation techniques-undiscounted measures- Payback period-proceeds per rupee of outlay, Discounted Measures-Net Present Value (NPV)-Benefit-Cost Ratio (BCR)-Internal Rate of Return (IRR)-Net benefit investment ratio (N/K ratio)-sensitivity analysis.															
Unit IV		ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE												9	
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.															
Unit V		ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT												9	
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.															
Total periods:45 PERIODS															
Textbooks:															
1. Joseph L. Massie, 1995, “Essentials of Management”, prentice Hall of India Pvt limited, New Delhi															
2. Khanka S, 1999, Entrepreneurial Development, S, Chand and Co, New Delhi															
3. Mohanty S K, 2007, Fundamentals of Entrepreneurship, Prentice Hall India, New Delhi															
References:															
1. Harih S B, Conner U J and Schwab G D, 1981, Management of the Farm Business, Prentice Hall Inc, New Jersey															
2. Omri Ralins, N.1980, Introduction to Agricultural: Prentice Hall Inc, New Jersey															
3. Gettinger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University, Press, London.															
4. Thomas W Zimmer and Norman M Scarborough, 1996, Entrepreneurship, Prentice Hall, New Jersey.															
5. Mar J Dollinger, 1999, Entrepreneurship strategies and resources, Prentice –Hall, Upper Siddal Rover, New Jersey.															
Course Outcomes:													Blooms Taxonomy		
CO 1:Judge about agricultural finance, banking and cooperation													Evaluate (K5)		
CO 2: Evaluate basic concepts, principles and functions of financial management													Understand (K2)		
CO 3: Improve the skills on basic banking and insurance schemes available to customers													Apply (K3)		
CO 4: analyses various financial data for efficient farm management													analyses (K4)		
CO 5: Identify the financial institutions													Remember (K1)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2							1	2	2	

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Course Outcomes:													Blooms Taxonomy		
CO1: An insight into the structure and function of diversity for ecosystem stability.													Understand (K2)		
CO2: Understand the concept of animal diversity and taxonomy													Understand (K2)		
CO3: Understand socio-economic issues pertaining to biodiversity													analyses (K4)		
CO4: An understanding of biodiversity in community resource management.													Apply (K3)		
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.													Apply (K3)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1		2	2	1				1	2	2	
CO2	2	2	1	1		1	2	-				1	2	2	
CO3	2	2	1	2		2	3	1				2	2	2	
CO4	2	2	2	2		2	3	2				2	2	3	
CO5	2	2	3	3		2	3	2				2	3	3	
1- Low, 2- Medium, 3- High, '-' -No correlation															

23EEO010	ENERGY TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of physics and chemistry • Fundamentals of thermodynamics • Awareness of energy sources and environmental issues • Basic mathematical skills • Elementary understanding of power plants and industrial processes					
Course Objectives: • To provide basic knowledge on various forms of energy and their global/Indian availability. • To impart understanding of conventional energy systems such as thermal, hydel, and nuclear power plants. • To introduce non-conventional and renewable energy technologies like solar, wind, tidal, geothermal, and biomass energy. • To develop knowledge on energy storage systems and fuel cell technologies. • To familiarize students with energy conservation techniques and energy audit methods in process industries.					
Unit I	INTRODUCTION				9
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources					
Unit II	CONVENTIONAL ENERGY				9
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.					
Unit III	NON-CONVENTIONAL ENERGY				9
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darious rotor and Graian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.					
Unit IV	BIOMASS ENERGY				9

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.															
Unit V		ENERGY CONSERVATION												9	
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.															
Total periods:45 PERIODS															
Textbooks:															
1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.															
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.															
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.															
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.															
References:															
1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.															
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.															
3. Sukhatme. S.P., Solar Energy - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.															
Course Outcomes:													Blooms Taxonomy		
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.													Understand (K2)		
CO2: Students will excel as professionals in the various fields of energy engineering													Apply (K3)		
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.													analyses (K4)		
CO4: Explain the technological basis for harnessing renewable energy sources.													Understand (K2)		
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	2	1	1	1	3	3	2	1
CO2	3	3	2	2	2	2	3	2	1	1	1	3	3	3	1
CO3	3	3	3	2	2	2	3	2	1	1	1	3	3	3	2
CO4	3	2	2	2	2	2	3	2	1	1	1	3	3	2	1
CO5	3	3	3	2	2	3	3	3	1	1	1	3	3	3	2
1- Low, 2- Medium, 3- High, - -No correlation															

23BTO004	FUNDAMENTALS OF FOOD ENGINEERING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic knowledge of Physics (mechanics, heat transfer) - Basic Chemistry (properties of materials) - Fundamentals of Mathematics					
Course Objectives: - Acquaint and equip the students with different techniques of measurement of engineering properties. - Make the students understand the nature of food constituents in the design of processing equipment					
Unit I					9

Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties		
Unit II		9
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foam mat dryers		
Unit III		9
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, ultra fine grinders, fluid jet pulveriser, colloid mill, cutting machines (slicing, dicing, shredding, pulping)		
Unit IV		9
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids		
Unit V		9
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.		
Total periods: 45 PERIODS		
Textbooks:		
1.R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Institute of Food Science & Technology, Nze. Warren L. McCabe, Julian Smith, Peter Harriott. 2004		
2.Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA. Christie John Geankoplis. 2003		
3.Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA		
4.George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science Business Media, New York, USA.		
References:		
1. R. L. Earle (2004) – <i>Unit Operations in Food Processing</i> , The New Zealand Institute of Food Science & Technology, New Zealand.		
2. Warren L. McCabe, Julian Smith & Peter Harriott (2004) – <i>Unit Operations of Chemical Engineering</i> , 7th Ed., McGraw-Hill, New York, USA.		
3. Christie John Geankoplis (2003) – <i>Transport Processes and Separation Process Principles (Includes Unit Operations)</i> , 4th Ed., Prentice-Hall, New York, USA.		
Course Outcomes:		Blooms Taxonomy
CO1: understand the importance of food polymers		
CO2: understand the effect of various methods of processing on the structure and texture of food materials		Understand (K2)
CO3: understand the interaction of food constituents with respect to thermal and electrical properties to develop new technologies for processing and preservation.		Understand (K2)
CO4: Explain the physical, thermal, mechanical, optical, and electromagnetic properties of food materials and their significance in designing food processing operations.		Understand (K2)
CO5: Analyses drying and dehydration mechanisms, interprets drying rate curves, and select appropriate dryers for various food materials.		analyses (K4)

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References:																
1. Handbook of food toxicology by S. S. Deshpande, 2002																
2. The food safety information handbook by Cynthia A. Robert, 2009																
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979																
4.Microbiological safety of Food by Hobbs BC, 1973																
5.Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003																
Course Outcomes:													Blooms Taxonomy			
CO1:Identify and evaluate physical, chemical, and biological food hazards and apply hygienic design, sanitation, and contamination control measures in food industries and service establishments.													Understand (K2)			
CO2:Explain food quality attributes and use instrumental, chemical, microbial, and sensory evaluation methods for assessing food quality.													Understand (K2)			
CO3:Apply HACCP principles, identify critical control points, and use risk assessment models (microbial risk, dose–response, exposure assessment) for ensuring food safety across processing stages.													Apply (K3)			
CO4:Understand the roles of Indian and international regulatory bodies such as FAO, WHO, OIE, and IPPC in global food safety and biosecurity.													Remember (K1)			
CO5:Interpret and apply Codex Alimentarius standards, understand the structure of Codex India, and the functioning of NCCP and national codex committees in setting and maintaining food safety standards.													Understand (K2)			
CO-PO Mapping																
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	3	2	2	2	3	2	2	1	2		2	3	2	1	
CO2	2	2	1	2	2	1			1	2		1	2	2		
CO3	3	3	3	3	2	2	2	2		2		3	3	3	2	
CO4	2	2	1	1	1	2	3	3		1		2	2	3	1	
CO5	2	2	2	1	1	2	3	3		1		2	3	3	2	
1- Low, 2- Medium, 3- High, - ‘No correlation																

23BTO006	NUTRACEUTICALS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of food science and chemistry - Fundamentals of human nutrition and biochemistry					
Course Objectives: - To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction. - To understand the role of Nutraceuticals and functional food in health and disease.					
Unit I	INTRODUCTION AND SIGNIFICANCE				9
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes.					
Unit II	PHYTOCHEMICALS AS NUTRACEUTICALS				9
Phytoestrogens in plants; isoflavones; flavanols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, is flavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues					
Unit III	ASSESSMENT OF ANTIOXIDANT ACTIVITY				9

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different <i>in vitro</i> methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources																
Unit IV		ROLE IN HEALTH AND DISEASE												9		
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.																
Unit V		SAFETY ISSUES												9		
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national																
Total periods:45 PERIODS																
Textbooks:																
1.Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.																
2.Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications. 2006																
3.WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006																
4.Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.																
References:																
1.Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007																
2.Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author), Blackwell Publishing, 2007																
3.Marketing Nutrition: Soy, Functional Foods, Biotechnology, and Obesity by Brian Wansink.																
4.Functional foods: Concept to Product: Edited by G R Gibson and C M Williams, Wood head Publ., 2000																
5.Hanson, James R. “Natural Products: The Secondary Metabolites”, Royal Society of Chemistry, 2003																
Course Outcomes:													Blooms Taxonomy			
CO 1: Acquire knowledge about nutraceuticals and functional foods, their classification and benefits.													Remember (K1)			
CO2: Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes													Remember (K1)			
CO3: Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.													Understand (K2)			
CO4: Distinguish the various <i>in vitro</i> and <i>in vivo</i> assessment of antioxidant activity of compounds from plant sources.													Understand (K2)			
CO5: Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases													Understand (K2)			
CO-PO Mapping																
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1	1	2	1	1	1		1	1	3	2	1	
CO2	3	2	1	1	1	2	1	1	1		1	1	3	2	1	
CO3	2	2	2	2	2	2	2	2	2		2	2	3	3	2	
CO4	2	3	2	3	2	2	2	2	2		2	2	3	3	2	
CO5	2	3	3	2	2	2	2	2	2		2	2	3	3	3	
1- Low, 2- Medium, 3- High, - ‘No correlation																

23CHO010	BASICS OF DYEING AND PRINTING	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basics of textile fibers and fabric structures - Elementary knowledge of chemistry of dyes and textile processing					
Course Objectives: To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.					
Unit I	INTRODUCTION				9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,					
Unit II	PRE TREATMENT				9
Desizing-Objective of Desizing- types of Desizing- Objective of Scouring- Mechanism of Scouring– Degumming of Silk, scouring of wool - Bio Scouring. Bleaching -Objective of Bleaching: Bleaching mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and Chemical changes of Mercerizing.					
Unit III	DYEING				9
Dye - Affinity, Substantively, Reactivity, Exhaustion and Fixation. Classification of dyes. Direct dyes: General properties, principles and method of application on cellulosic materials. Reactive dyes – principles and method of application on cellulosic materials hot brand, cold brand.					
Unit IV	PRINTING				9
Definition of printing – Difference between printing and dyeing- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing					
Unit V	MACHINERIES				9
Fabric Processing - winch, jigger and soft flow machines. Beam dyeing machines: Printing -flat bed screen - Rotary screen. Thermo transfer printing machinery. Garment dyeing machines					
Total periods: 45 PERIODS					
Textbooks:					
1.Trotman, E.R., Textile Scouring and Bleaching, Charless Griffins, Com. Ltd., London 1990.					
2.Shenai V.A. “Technology of Textile Processing Vol. IV” 1998, Sevak Publications, Mumbai.					
References:					
1.Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, Charles Griffin & Co. Ltd., U.K., 1984, ISBN: 0 85264 165 6.					
2.Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018					
3.Mathews Kolanjikombil.,” Dyeing of Textile substrates III –Fibres, Yarns and Knitted fabrics”, Wood head publishing India, 2021					
4.Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series					
5.Chakraborty, J.N, "Fundamentals and Practices in colouration of Textiles", Wood head Publishing India, 2009,					

ISBN-13:978-81-908001-4-															
Course Outcomes:													Blooms Taxonomy		
CO1: Basics of grey fabric													Remember (K1)		
CO2: Basics of pretreatment													Understand (K2)		
CO3: Concept of Dyeing													Understand (K2)		
CO4: Concept of Printing													Understand (K2)		
CO5: Machinery in processing industry													Understand (K2)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	1		1	1	3	1	1
CO2	3	2	2	2	2	2	1	1	1		1	1	3	2	1
CO3	2	2	2	2	2	2	1	1	1		1	1	3	2	2
CO4	2	2	2	2	2	2	1	1	1		1	1	3	2	2
CO5	2	2	3	2	2	2	2	1	1		1	1	3	2	2
1- Low, 2- Medium, 3- High, - -No correlation															

23CHO011	FIBRE SCIENCE	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Basic knowledge of polymers and chemistry of materials - Understanding of fundamental textile terms and processes					
Course Objectives: To enable the students to learn about the types of fibre and their properties					
Unit I	INTRODUCTION TO TEXTILE FIBRES				9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.					
Unit II	DESIGN OF CYLINDER AND PISTON COMPONENTS				9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel					
Unit III	SYNTHEITC FIBRES				9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization					
Unit IV	SOECIALITY FIBRES				9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardantfibres, Chemical resistant fibres					
Unit V	FUNCTIONAL SOECIALITY FIBRES				9
Properties and end use: Fibres for medical application – Biodegradable fibres based on PLA, Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.					
Total periods: 45					
Textbooks:					
1. Morton W. E., and Hearle J. W. S., “Physical Properties of Textile Fibres”, The Textile Institute, Washington D.C., 2008, ISBN 978-1-84569-220-95					
2. Meredith R., and Hearle J. W. S., “Physical Methods of Investigation of Textiles”, Wiley Publication, New York, 1989, ISBN: B00JCV6ZWU ISBN-13:					
3. Mukhopadhyay S. K., “Advances in Fibre Science”, The Textile Institute,1992, ISBN: 1870812379					
References:					
1.Meredith R., “Mechanical Properties of Textile Fibres”, North Holland, Amsterdam, 1986, ISBN: 1114790699, ISBN-13: 9781114790698					

2.Hearle J. W. S., Lomas B., and Cooke W. D., “Atlas of Fibre Fracture and Damage to Textiles”, The Textile Institute, 2nd Edition, 1998, ISBN: 1855733196.															
3.Raheel M. (ed.), “Modern Textile Characterization Methods”, Marcel Dekker, 1995, ISBN:0824794737															
4.Mukhopadhyay. S. K., “The Structure and Properties of Typical Melt Spun Fibres”, Textile Progress, Vol. 18, No. 4, Textile Institute, 1989, ISBN: 1870812115															
5.Hearle J.W.S., “Polymers and Their Properties: Fundamentals of Structures and Mechanics Vol 1”, Ellis Horwood, England, 1982, ISBN: 047027302X ISBN-13: 9780470273029 36															
Course Outcomes:												Blooms Taxonomy			
CO 1: Understand the process sequence of various fibers												Understand (K2)			
CO 2: Understand the properties of various fibers												Understand (K2)			
CO 3: Apply fibre science concepts to identify fibers and interpret their structural characteristics.												Apply (K3)			
CO 4: Analyze the performance behavior of sociality fibers under different conditions.												Analyse (K4)			
CO 5: Evaluate the suitability of functional sociality fibers for specific technical and medical applications.												Evaluate (K5)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2								1			3	2	
CO2	3	2								1			3	3	
CO3	2	2	2	1						1			2	3	2
CO4	2	3	2	3						1			3	3	3
CO5	1	3	2	3						1			3	3	3
1- Low, 2- Medium, 3- High, - -No correlation															

23CHO012	GARMENT MANUFACTURING TECHNOLOGY	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of textiles and garment components • Understanding of fabric structure and properties					
Course Objectives: • To enable the students to understand the basics of pattern making, cutting and sewing. • To expose the students to various problems & remedies during garment manufacturing					
Unit I	PATTERN MAKING, MARKER PLANNING, CUTTING				9
Anthropometry, sOECification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting					
Unit II	TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES				9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, sOECial needles, needlepoint					
Unit III	COMPONENTS AND TRIMS USED IN GARMENT				9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons					
Unit IV	GARMENT INSOECTION AND DIMENSIONAL CHANGES				9
Raw material, in process and final insOECTION; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.					
Unit V	GARMENT PRESSING, PACKING AND CARE LABELING				9
Garment pressing – categories and equipment, packing; care 68abelling of apparels					
Total periods: 45					
Textbooks:					
1. Carr H., and Latham B., “The Technology of Clothing Manufacture”, Blackwell Science Ltd., Oxford, 1994.					

2. Gerry Cooklin, "Introduction to Clothing Manufacture" Blackwell Science Ltd., 1995. 64															
3. Harrison.P.W Garment Dyeing, The Textile Institute Publication, Textile Progress, Vol .19 No.2,1988.															
References:															
1.Winifred Aldrich., "Metric Pattern Cutting", Blackwell Science Ltd., Oxford, 1994															
2.Peggall H., "The Complete Dress Maker", Marshall Caverdish, London, 1985															
3.Jai Prakash and Gaur R.K., "Sewing Thread", NITRA, 1994															
4.Ruth Glock, Grace I. Kunz, "Apparel Manufacturing", Dorling Kindersley Publishing Inc., New Jersey, 1995.															
5.Pradip V.Mehta, "An Introduction to Quality Control for the Apparel Industry", J.S.N. Internationals, 1992.															
Course Outcomes:												Blooms Taxonomy			
CO 1: Pattern making, marker planning, cutting												Understand (K2)			
CO 2: Types of seams, stitches and functions of needles												Understand (K2)			
CO 3: Components and trims used in garment												Apply (K3)			
CO 4: Garment construction and dimensional changes												Analyse / Evaluate (K4/K5)			
CO 5: Garment pressing, packing and care labelling												Understand (K2)			
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1		2		1	1		2	3	1	2	3	1
CO2	2	2	1	1	1		1	1		2	2	1	2	2	1
CO3	1	1	1	1	1	1	1	1		1	2	1	1	3	1
CO4	2	1	1	1	2	2	2	1	1	2	3	1	2	3	1
CO5	2	2	1	1	1	1	2	1		2	2	1	2	2	1
1- Low, 2- Medium, 3- High, - -No correlation															

23CHO013	UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of Physics and Chemistry • Fundamentals of Mathematics (Calculus, Differential equations) • Introductory knowledge of Chemical process principles					
Course Objectives: • To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.					
Unit I	FLUID MECHANICS CONCEPTS				9
Fluid definition and classification of fluids, types of fluids, Rheological behavior of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems), Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.					
Unit II	FLOW MEASUREMENTS & MECHANICAL OPERATIONS				9
Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis. Size reduction, crushing laws, working principle of ball mill. Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numericals.					
Unit III	CONDUCTIVE & CONVECTIVE HEAT TRANSFER				9

Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).															
Unit IV		BASICS OF MASS TRANSFER											9		
Diffusion-Fick’s law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Measurement of diffusivity, Mass transfer coefficients and their correlations. Conceptual numerical.															
Unit V		MASS TRANSFER OPERATIONS											9		
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.															
Total periods: 45															
Textbooks:															
1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriot McGraw-Hill Education (India) Edition 2014															
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008															
3. Introduction to Chemical Engineering Badger W.I. and Banchero, J.T., Tata McGraw Hill New York 1997															
References:															
1.Principles of Unit Operations Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson John Wiley & Sons 2nd edition 2008															
2.Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996															
3.Heat Transfer J P Holman McGraw Hill International Ed															
Course Outcomes:													Blooms Taxonomy		
CO 1: State and describe the nature and properties of the fluids.													Remember / Understand (K1/K2)		
CO 2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.													Understand / Apply (K2/K3)		
CO 3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.													Apply / Analyse (K3/K4)		
CO 4: Design the heat transfer equipment suitable for sOECific requirement.													Analyse / Evaluate / Create (K4/K5/K6)		
CO 5: Apply mass transfer principles in distillation, extraction and drying operations to solve chemical engineering problems.													Apply / Analyse (K3/K4)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						1		1	3	2	
CO2	3	2	2	2				1		1		1	3	3	1
CO3	3	3	2	3	1			1		1		2	3	3	2
CO4	3	3	3	3	2			1		2	1	2	3	3	3
CO5	3	3	2	3	1			1		1		2	3	3	2
1- Low, 2- Medium, 3- High, - -No correlation															

23MEO018	PLASTIC MATERIALS FOR ENGINEERS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of polymer chemistry • Fundamentals of material science • Understanding of molecular structures and material behavior					

Course Objectives:		
- Understand the advantages, disadvantages and general classification of plastic materials - To know the manufacturing, sources, and applications of engineering thermoplastics - Understand the basics as well as the advanced applications of various plastic materials in the industry - To understand the preparation methods of thermosetting materials - Select suitable sOEcialty plastics for different end applications		
Unit I	INTRODUCTION TO PLASTIC MATERIALS	9
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)		
Unit II	ENGINEERING THERMOPLASTICS AND APPLICATIONS	9
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)		
Unit III	THERMOSETTING PLASTICS	9
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.		
Unit IV	MISCELLANEOUS PLASTICS FOR END APPLICATIONS	9
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications		
Unit V	PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS	9
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanooates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications		
Total periods: 45		
Textbooks:		
1. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, 3rd Edition, McGraw Hill Education, 2011.		
2. V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International Publishers, 2017.		
3. R.K. Roy, Polymer Chemistry, New Age International Publishers, 2003.		
References:		
1.Marianne Gilbert (Ed.), Brydson's Plastics Materials, 8th Edn., Elsevier (2017).		
2.J.A.Brydson, Plastics Materials, 7th Edn., Butterworth Heinemann (1999).		
3.Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4th Edn., CRC press (2006).		
4.A. Brent Strong, Plastics: Materials and Processing, 3rd Edn., Pearson Prentice Hall (2006).		
5.Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd Edn., CRC press (2016).		
6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.		
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.		
Course Outcomes:		Blooms Taxonomy
CO 1: To study the importance, advantages and classification of plastic materials		Understand (K2)
CO 2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics		Understand (K2)
CO 3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins		Analyze (K4)
CO 4: Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU		Understand (K2)
CO 5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers		Evaluate (K5)

CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1					1	3	1	
CO2	3	2					1					1	3	2	
CO3	3	3	2	2								2	3	3	2
CO4	3	2					1					1	3	2	
CO5	3	2	1	2			2	1				2	3	3	2
1- Low, 2- Medium, 3- High, - -No correlation															

23MEO019	PROPERTIES AND TESTING OF PLASTICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamentals of polymer science – structure, types of polymers, and polymerization basics - Basic chemistry – chemical bonding, molecular structure, physical properties - Basic material science concepts – stress–strain, mechanical behavior, thermal behavior - Introductory plastics processing – molding, extrusion, shaping methods (at basic level)					
Course Objectives: - To understand the relevance of standards and sOECifications as well as the sOECimen preparation for polymer testing. - To study the mechanical properties and testing of polymer materials and their structural property relationships. - To understand the thermal properties of polymers and their testing methods. - To gain knowledge on the electrical and optical properties of polymers and their testing methods. - To study environmental effects and prevent polymer degradation.					
Unit I	INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS				9
Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and sOECifications. Importance of standards in the quality control of polymers and polymer products. Preparation of test pieces, conditioning and test atmospheres. Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.					
Unit II	MECHANICAL PROPERTIES				9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers					
Unit III	THERMAL RHEOLOGICAL PROPERTIES				9
Thermal properties: Transition temperatures, sOECific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.					
Unit IV	ELECTRICAL AND OPTICAL PROPERTIES				9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.					
Unit V	ENVIRONMENTAL AND CHEMICAL RESISTANCE				9
Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.					

Total periods: 45																
Textbooks:																
1. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edition, John Wiley & Sons, 2007.																
2. A. B. Mathur & I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., 2003.																
3. R. P. Brown, Plastic Test Methods, 2nd Edition, Harlond, Longman Scientific, 1981.																
References:																
1.F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.																
2.J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.																
3.R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.																
4.A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., New Delhi, 2003.																
5.Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.																
S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.																
Course Outcomes:														Blooms Taxonomy		
CO 1: Understand the relevance of standards and specifications.														Understand (K2)		
CO 2: Summarize the various test methods for evaluating the mechanical properties of the polymers.														Understand / Analyze (K2/K4)		
CO 3: To know the thermal, electrical & optical properties of polymers.														Understand (K2)		
CO 4: Identify various techniques used for characterizing polymers.														Apply / Analyze (K3/K4)		
CO 5: Distinguish the processability tests used for thermoplastics, thermosets and elastomers.														Analyze (K4)		
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1										1	2	1		
CO2	2	2	1									1	2	1		
CO3	2	1										1	2	1		
CO4	2	2	2	1								1	3	2	1	
CO5	2	2	1									1	2	2	1	
1- Low, 2- Medium, 3- High, - -No correlation																

23ECO008	VLSI DESIGN	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Digital Electronics • Fundamentals of Semiconductor Devices • Basic Knowledge of Logic Circuits					
Course Objectives: • Understand the fundamentals of IC technology components and their characteristics. • Understand combinational logic circuits and design principles. • Understand sequential logic circuits and clocking strategies. • Understand Interconnects and Memory Architecture. • Understand the design of arithmetic building blocks					
Unit I	MOS TRANSISTOR PRINCIPLES				9
MOS logic families (NMOS and CMOS), Ideal and Non-Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics, small signal analysis of MOSFET					
Unit II	COMBINATIONAL LOGIC CIRCUITS				9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore’s constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation.																
Unit III		SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES												9		
Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.																
Unit IV		INTERCONNECT, MEMORY ARCHITECTURE												9		
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.																
Unit V		DESIGN OF ARITHMETIC BUILDING BLOCKS												9		
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.																
Total periods: 45 PERIODS																
Textbooks:																
1.Jan D Rabaey, Anantha Chandrakasan, “Digital Integrated Circuits: A Design Perspective”, PHI, 2016.(Units II, III IV and V).																
2.Neil H E Weste, Kamran Eshranghian, “Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009. (Units - I)																
References:																
1.. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983																
2.. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001																
3. Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley 2000																
4.M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers,2000																
Course Outcomes:													Blooms Taxonomy			
CO1: Understand the working principle and characteristics of MOSFET													Understand (K2)			
CO2: Design Combinational Logic Circuits													Understand (K2)			
CO3: Design of Sequential Logic Circuits and Clocking systems													Apply (K3)			
CO4: Understand Memory architecture and interconnects													Apply (K3)			
CO5: Design of arithmetic building blocks.													Analyze (K4)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1	2							1	3	2	1	
CO2	3	3	3	2	2							1	3	3	2	
CO3	3	2	3	2	2							1	3	3	2	
CO4	2	2	2	2	2							1	2	2	2	
CO5	3	2	3	2	2							1	3	3	3	
1- Low, 2- Medium, 3- High, - -No correlation																

23ECO009	WEARABLE DEVICES	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Electronics and Sensors • Fundamentals of Wireless Communication • Basic Knowledge of Biomedical Engineering					

Course Objectives:																
- To know the hardware requirement of wearable systems - To understand the communication and security aspects in the wearable devices - To know the applications of wearable devices in the field of medicine																
Unit I	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS													9		
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor																
Unit II	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES													9		
Wearability issues -physical shape and placement of sensor, technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.																
Unit III	WIRELESS HEALTH SYSTEMS													9		
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.																
Unit IV	SMART TEXTILE													9		
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration.																
Unit V	APPLICATIONS OF WEARABLE SYSTEMS													9		
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine																
Total periods: 45 PERIODS																
Textbooks:																
1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011																
2.Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013																
3.Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014																
4.Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012																
References:																
1.. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.																
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006																
Course Outcomes:													Blooms Taxonomy			
CO1: Describe the concepts of wearable system.													Understand (K2)			
CO2: Explain the energy harvestings in wearable device.													Understand (K2)			
CO3: Use the concepts of BAN in health care.													Analyze (K4)			
CO4: Illustrate the concept of smart textile													Apply (K3)			
CO5: Compare the various wearable devices in healthcare system													Understand (K2)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1	1	1	2							1	2	1		
CO2	3	2	2	2	2							1	3	2	1	
CO3	3	2	3	2	2							1	3	3	1	
CO4	3	2	2	2	2							1	2	2	1	

CO5	3	2	2	2	2							1	3	2	2
1- Low, 2- Medium, 3- High, - 'No correlation															

23BMO004	MEDICAL INFORMATICS	Category: OEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basics of Computer Science • Fundamentals of Biology and Healthcare Systems • Basic Knowledge of Information Technology					
Course Objectives: • To study the applications of information technology in health care management. • This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.					
Unit I	INTRODUCTION TO MEDICAL INFORMATICS.				9
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics					
Unit II	COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING				9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance					
Unit III	COMPUTERISED PATIENT RECORD				9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients					
Unit IV	COMPUTER ASSISTED MEDICAL DECISION-MAKING				9
Neuro computers and Artificial Neural Networks application, Expert System-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped					
Unit V	RECENT TRENDS IN MEDICAL INFORMATICS				9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.					
Total periods: 45 PERIODS					
Textbooks:					
1. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003					
2.R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005					
References:					

1. 1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Explain the structure and functional capabilities of Hospital Information System.													Understand (K2)		
CO2: Describe the need for computers in medical imaging and automated clinical laboratory													Apply (K3)		
CO3: Articulate the functioning of information storage and retrieval in computerized patient record system.													Understand (K2)		
CO4: Apply a suitable decision support system for automated clinical diagnosis													Understand (K2)		
CO5: Discuss the application of virtual reality and telehealth technology in medical industry.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2							1	2	1	
CO2	3	2	2	2	2							1	2	2	1
CO3	3	2	2	2	2							1	2	2	1
CO4	3	3	3	2	2							1	3	3	2
CO5	2	3	2	2	2							1	3	2	2
1- Low, 2- Medium, 3- High, - ‘-No correlation															

VERTICAL I :FINTECH AND BLOCK CHAIN

23CMG001	FINANCIAL MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of commerce or accounting • Understanding of fundamental business concepts • Ability to perform simple mathematical and analytical calculations					
Course Objectives: • To acquire the knowledge of the decision areas in finance. • To learn the various sources of Finance • To describe about capital budgeting and cost of capital • To discuss on how to construct a robust capital structure and dividend policy • To develop an understanding of tools on Working Capital Management.					
Unit I	INTRODUCTION TO FINANCIAL MANGEMENT				9
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.					
Unit II	SOURCES OF FINANCE				9
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc					
Unit III	INVESTMENT DECISIONS				9
Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting – Payback - ARR – NPV – IRR –Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.					
Unit IV	FINANCING AND DIVIDEND DECISION				9

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy															
Unit V		WORKING CAPITAL DECISION												9	
Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.															
Total periods:45															
Text Books:															
1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill															
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd															
References:															
1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,.															
2. Prasanna Chandra, Financial Management,															
3.Srivatsava, Mishra, Financial Management, Oxford University Press, 2011															
Course Outcomes:													Blooms Taxonomy		
CO1:To acquire knowledge of major financial decision areas in organizations													Understand (K2)		
CO2:To understand various long-term and short-term sources of finance													Understand (K2)		
CO3:To learn capital budgeting techniques and cost of capital													Apply (K3)		
CO4: To understand capital structure and dividend policy decisions													Analyze (K4)		
CO5: To develop skills in working capital management tools and techniques													Evaluate (K5)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						2		2	3		
CO2	3	2	1	1						2		2	2		
CO3	3	3	2	3						2		3	3		
CO4	3	3	2	3						3		3	3		
CO5	3	3	2	3						2		3	3		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG002	FUNDAMENTALS OF INVESTMENT	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of financial terms • Fundamental knowledge of markets and economics • Ability to perform simple mathematical calculations					
Course Objectives: • Describe the investment environment in which investment decisions are taken. • Explain how to Value bonds and equities • Explain the various approaches to value securities • Describe how to create efficient portfolios through diversification • Discuss the mechanism of investor protection in India.					
Unit I	THE INVESTMENT ENVIRONMENT				9
The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.					
Unit II	FIXED INCOME SECURITIES				9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.																
Unit III		APPROACHES TO EQUITY ANALYSIS												9		
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.																
Unit IV		PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES												9		
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India																
Unit V		INVESTOR PROTECTION												9		
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism																
Total periods:45																
Text Books:																
1.Charles P. Jones – <i>Investments: Analysis and Management</i> , Wiley, 14th Edition, 2019																
2. Prasanna Chandra – <i>Investment Analysis and Portfolio Management</i> , McGraw Hill, 5th Edition, 2017																
3. R. P. Rustagi – <i>Investment Management: Theory and Practice</i> , Sultan Chand & Sons, 2021																
References:																
1. Charles P. Jones, Gerald R. Jensen. <i>Investments: analysis and management</i> . Wiley, 14TH Edition, 2019.																
2. Chandra, Prasanna. <i>Investment analysis and portfolio management</i> . McGraw-hill education, 5th, Edition, 2017																
3. Rustagi, R. P. <i>Investment Management Theory and Practice</i> . Sultan Chand & Sons, 2021.																
4.ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, <i>Investments</i> , McGraw Hill Education (India), 11 Edition(SIE), 2019																
Course Outcomes:													Blooms Taxonomy			
CO1:Explain the investment environment, types of investments, and functioning of securities markets													Understand (K2)			
CO2:Apply valuation methods for fixed-income securities and understand bond risks													Apply (K3)			
CO3:Analyze equity valuation using fundamental, technical, and EMH approaches													Analyze (K4)			
CO4:Evaluate portfolio construction, diversification, mutual funds, and derivatives													Evaluate (K5)			
CO5:Explain investor protection mechanisms, SEBI regulations, and grievance redressal													Understand (K2)			
CO-PO Mapping																
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1						2		2	3			
CO2	3	3	2	2						2		2	3			
CO3	3	3	2	3						2		3	3			
CO4	3	3	2	3						3		3	3			
CO5	2	2	1	2						2		2	2			
1 - Low, 2 - Medium, 3 - High , '-' No correlation																

23CMG003	BANKING, FINANCIAL SERVICES AND INSURANCE	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of money and financial systems • Fundamental knowledge of markets and financial institutions					
Course Objectives: • Understand the Banking system in India • Grasp how banks raise their sources and how they deploy it • Understand the development in banking technology • Understand the financial services in India • Understand the insurance Industry in India					

Unit I	INTRODUCTION TO INDIAN BANKING SYSTEM												9		
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.															
Unit II	MANAGING BANK FUNDS/ PRODUCTS												9		
Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA’s – Current issues on NPA’s – M&A’s of banks into securities market															
Unit III	DEVELOPMENT IN BANKING TECHNOLOGY												9		
Payment system in India – paper based – e payment –electronic banking –plastic money – e-money forecasting of cash demand at ATM’s –The Information Technology Act, 2000 in India – RBI’s Financial Sector Technology vision document – security threats in e-banking & RBI’s Initiative.															
Unit IV	FINANCIAL SERVICES												9		
Introduction – Need for Financial Services – Financial Services Market in India – NBFC — Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking															
Unit V	INSURANCE												9		
Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim															
Total periods:45															
Text Books:															
1. Padmalatha Suresh & Justin Paul — <i>Management of Banking and Financial Services</i> , Pearson, 2017															
2. Meera Sharma — <i>Management of Financial Institutions with Emphasis on Bank and Risk Management</i> , PHI Learning, 2010															
3. Peter S. Rose & Sylvia C. Hudgins — <i>Bank Management and Financial Services</i> , Tata McGraw Hill, 2017															
References:															
1. . Padmalatha Suresh and Justin Paul, “Management of Banking and Financial Services, Pearson, Delhi, 2017.															
2. Meera Sharma, “Management of Financial Institutions – with emphasis on Bank and Risk Management”, PHI Learning Pvt. Ltd., New Delhi 2010															
3. Peter S. Rose and Sylvia C. and Hudgins, “Bank Management and Financial Services”, Tata McGraw Hill, New Delhi, 2017															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the Indian banking system, structure, functions, and customer–banker relationship													Understand (K2)		
CO2:Apply knowledge of bank fund management, negotiable instruments, ALM, and NPAs													Apply (K3)		
CO3:Analyze developments in banking technology, e-payments, IT Act, and security issues													Analyze (K4)		
CO4:Understand major financial services such as NBFCs, leasing, factoring, mutual funds, merchant banking, and venture capital													Understand (K2)		
CO5:Explain the concepts of insurance, regulations, IRDA, policy lapse, revival, and settlement													Understand (K2)		
CO-PO Mapping															
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1						2		2	3		
CO2	3	3	2	2						2		2	3		
CO3	3	3	2	3						3		3	3		
CO4	2	2	1	2						2		2	2		
CO5	2	2	1	2						2		2	2		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG004	INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of computer networks • Understanding of cryptography fundamentals (helpful but not mandatory) • Familiarity with programming concepts					
Course Objectives: • Understand the fundamentals, architecture, and evolution of blockchain. • Explain decentralization, consensus mechanisms, and blockchain components. • Learn cryptocurrency concepts including Bitcoin, altcoins, mining, and wallets. • Explore Ethereum architecture, EVM, and smart contract development. • Understand Web3, Hyperledger frameworks, and emerging blockchain trends.					
Unit I	INTRODUCTION TO BLOCKCHAIN				9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.					
Unit II	INTRODUCTION TO CRYPTOCURRENCY				9
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain					
Unit III	ETHEREUM				9
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network					
Unit IV	WEB3 AND HYPERLEDGE				9
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.					
Unit V	EMERGING TRENDS				9
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.					
Total periods:45					
Text Books:					
1. Imran Bashir, <i>Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained</i> , Packt Publishing, 2nd Edition, 2018					
2. Peter Borovykh, <i>Blockchain Applications in Finance</i> , Blockchain Driven, 2nd Edition, 2018					
3. Arshdeep Bahga, Vijay Madiseti, <i>Blockchain Applications: A Hands-On Approach</i> , VPT, 2017					
References:					

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018															
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018															
3.ArshdeepBahga, Vijay Madiseti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain the fundamentals and architecture of blockchain systems													Understand (K2)		
CO2: Analyze cryptocurrencies, Bitcoin mechanics, and alternative coins													Analyze (K4)		
CO3: Develop and deploy smart contracts on Ethereum													Apply (K3)		
CO4: Utilize Web3 and Hyperledger tools for decentralized applications													Apply (K3)		
CO5: Evaluate emerging blockchain technologies, scalability, and privacy challenges													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1					2			3	2	1
CO2	3	3	2	2	1					2		1	3	2	1
CO3	2	2	3	3	2	1				3	1		3	3	2
CO4	2	2	3	3	3	1				3	1	1	3	3	2
CO5	3	3	2	3	3	1				3	1	2	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG005	FINTECH PERSONAL FINANCE AND PAYMENTS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of finance concepts • Familiarity with digital payments • Knowledge of basic computer and internet usage					
Course Objectives: • Understand cryptocurrencies, digital wallets, and modern payment systems • Learn the evolution and impact of digital and alternative finance • Understand InsureTech innovations using AI/ML and IoT • Explore peer-to-peer lending, crowdfunding, and marketplace lending • Study regulatory frameworks, RegTech, and fraud detection technologies					
Unit I	CURRENCY EXCHANGE AND PAYMENT				9
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets - Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations.Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues					
Unit II	DIGITAL FINANCE AND ALTERNATIVE FINANCE				9
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering					
Unit III	INSURETECH				9
InsurTechIntroduction , Business model disruption AI/ML in InsurTech IoT and InsurTech ,RiskModeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services					
Unit IV	PEER TO PEER LENDING				9
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies, Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations					

Unit V	REGULATORY ISSUES												9		
FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection															
Total periods:45															
Text Books:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the Power of Technology</i> , 2016															
2. Tanda & Models, <i>Fintech BigTech and Banks</i> , Springer, 2019															
3. Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts</i> , 2016															
4. Jacob William, <i>FinTech: The Beginner's Guide to Financial Technology</i> , 2016															
References:															
1. Swanson Seth, <i>Fintech for Beginners: Understanding and Utilizing the power of technology</i> , Createspace Independent Publishing Platform,2016.															
2. Models AuTanda, <i>Fintech BigtechAnd Banks Digitalization and Its Impact On Banking Business</i> , Springer, 2019															
3.Henning Diedrich, <i>Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations</i> , Wildfire Publishing, 2016															
4. Jacob William, <i>FinTech:TheBeginner's Guide to Financial Technology</i> , Createspace Independent Publishing Platform, 2016															
5. IIBF, <i>Digital Banking</i> , Taxmann Publication, 2016															
6. Jacob William, <i>Financial Technology</i> , Create space Independent Pub, 2016															
7. Luke Sutton, <i>Financial Technology: Bitcoin & Blockchain</i> , Createspace Independent Pub, 2016															
Course Outcomes:													Blooms Taxonomy		
CO1: Explain cryptocurrencies, digital wallets, and modern payment systems													Understand (K2)		
CO2:Analyze digital finance, alternative finance, and ICO mechanisms													Analyze (K4)		
CO3: Apply InsureTech tools such as AI, ML, and IoT in insurance operations													Apply (K3)		
CO4: Evaluate P2P lending, crowdfunding models, and SME lending innovations													Evaluate (K5)		
CO5: Examine regulatory frameworks, RegTech applications, and fraud detection systems													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2					2			3	2	1
CO2	3	3	2	3	2					2	1	1	3	2	1
CO3	2	2	3	3	3	1				3	1		3	3	2
CO4	3	3	3	3	3	1				3	1	2	3	3	3
CO5	3	3	2	3	3	1				3	1	3	3	3	3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG006	INTRODUCTION TO FINTECH	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

• Basic knowledge of financial systems • Basic understanding of digital technology and internet usage		
Course Objectives: • To learn about history, importance and evolution of Fintech • To acquire the knowledge of Fintech in payment industry • To acquire the knowledge of Fintech in insurance industry • To learn the Fintech developments around the world • To know about the future of Fintech		
Unit I	INTRODUCTION	9
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.		
Unit II	PAYMENT INDUSTRY	9
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.		
Unit III	INSURANCE INDUSTRY	9
FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.		
Unit IV	FINTECH AROUND THE GLOBE	9
FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.		
Unit V	FUTURE OF FINTECH	9
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.		
Total periods:45		
Text Books:		
1.Arner D., Barbers J., Buckley R. The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015		
2.Susanne Chishti, Janos Barberis. The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016		
3.Richard Hayen. FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016		
4.Parag Y Arjunwadkar. FinTech: The Technology Driving Disruption in the financial service industry. CRC Press, 2018		
References:		
1.Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015		
2.Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016		
3.Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance		

Industry, 2016															
4.Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018															
5.Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020															
6.Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the fundamentals of FinTech including definition, history, significance, architecture and evolution													Understand (K2)		
CO2:Analyze the role of FinTech in payment and lending industries													Analyze (K4)		
CO3:Apply FinTech concepts in wealth management and insurance industries													Apply (K3)		
CO4:Evaluate global FinTech developments and regulatory frameworks													Evaluate (K5)		
CO5:Assess the future of FinTech including emerging technologies, BankTech and ethics													Evaluate (K5)		
CO-PO Mapping															
CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1					1			2	1	
CO2	2	3	2	2	2					1			3	2	1
CO3	2	2	3	2	3					1			3	3	2
CO4	1	2	2	3	2	1				2		1	2	2	
CO5	1	2	3	3	3	1				2		1	3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

VERTICAL II : ENTREPRENERUSHIP

23CMG007	FOUNDATIONS OF ENTREPRENERUSHIP	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of business concepts and organizational structure. • Fundamental knowledge of economics and market environment. • Awareness of innovation, creativity, and problem-solving concepts. • Basic communication and interpersonal skills. • Interest in technology-driven business and entrepreneurial thinking.					

Course Objectives:		
- To develop and strengthen the entrepreneurial quality and motivation of learners. - To impart the entrepreneurial skills and traits essential to become successful entrepreneurs. - To apply the principles and theories of entrepreneurship and management in Technology oriented businesses. - To empower the learners to run a Technology driven business efficiently and effectively - To familiarize learners with emerging trends and modern practices in entrepreneurship locally and globally.		
Unit I	INTRODUCTION TO ENTREPRENEURSHIP	9
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.		
Unit II	BUSINESS OWNERSHIP & ENVIRONMENT	9
Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration		
Unit III	FUNDAMENTALS OF TECHNOPRENEURSHIP	9
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends		
Unit IV	APPLICATIONS OF TECHNOPRENEURSHIP	9
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies		
Unit V	EMERGING TRENDS IN ENTREPRENEURSHIP	9
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.		
Total periods: 45		
Text Books:		
1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.		
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.		
References:		
1. Daniel Mankani. 2003. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall		
2. Edward Elgar. 2007. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Ed: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub.		
3. Lang, J. 2002, The High Tech Entrepreneur's Handbook, Ft.com.		
4. David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,		
5. HarperBusiness, https://fanny.staff.uns.ac.id/files/2013/12/Technopreneur-BASED-EDUCATION-REVOLUTION.pdf		
6. JumpStart: A Technopreneurship Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009		
7. Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP		
8. Journal articles pertaining to Entrepreneurship		
Course Outcomes:		Blooms Taxonomy
CO1: Learn the basics of Entrepreneurship		Remember (K1), Understand (K2)
CO2: Understand the business ownership patterns and environment		Understand (K2)
CO3: Understand the Job opportunities in Industries relating to Technopreneurship		Understand (K2), Apply (K3)
CO4: Learn about applications of technopreneurship and successful technopreneurs		Apply (K3), Analyze

													(K4)		
CO5: Acquaint with the recent and emerging trends in entrepreneurship													Analyze (K4), Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							1	2					
CO2	2	2	1						2	2		1			
CO3	1	2	2						2	2		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG008	TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of organizational structure and communication. • Awareness of human behavior and group dynamics. • Basic knowledge of business management concepts. • Interest in leadership development and team-based activities. • Fundamental interpersonal and decision-making skills.					
Course Objectives: • To develop and strengthen the Leadership qualities and motivation of learners. • To impart the Leadership skills and traits essential to become successful entrepreneurs. • To apply the principles and theories of Team Building in managing Technology oriented businesses. • To empower the learners to build robust teams for running and leading a business efficiently and effectively • To provide knowledge of leadership styles, effectiveness, and global leadership trends.					
Unit I	INTRODUCTION TO MANAGING TEAMS				9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.					
Unit II	MANAGING AND DEVELOPING EFFECTIVE TEAMS				9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.					
Unit III	INTRODUCTION TO LEADERSHIP				9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment .					
Unit IV	LEADERSHIP IN ORGANISATIONS				9
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.					
Unit V	LEADERSHIP EFFECTIVENESS				9
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.					
Total periods: 45					

Text Books:															
1. Daniel Levi, Group Dynamics for Teams ,4th Ed, (2014), Sage Publications.															
2. Dyer, W. G., Dyer, W. G., Jr., & Dyer, J. H..Team building: Proven strategies for improving team performance, 5thed, Jossey-Bass, (2013).															
References:															
1. Hughes, R.L., Ginnett, R.C., &Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. (2019).															
2. Katzenback, J.R., Smith, D.K., The Wisdom of Teams: Creating the High PerformanceOrganisations, Harvard Business Review Press, (2015).															
3. Haldar, U.K., Leadership and Team Building, Oxford University Press, (2010).															
4. Daft, R.L., The Leadership Experience, Cengage, (2015).															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of managing teams for business.													Remember (K1), Understand (K2)		
CO2: Understand developing effective teams for business management.													Understand (K2), Apply (K3)		
CO3: Understand the fundamentals of leadership for running a business.													Understand (K2)		
CO4: Learn about the importance of leadership for business development.													Apply (K3), Analyze (K4)		
CO5: Acquaint with emerging trends in leadership effectiveness for entrepreneurus.													Analyze (K4), Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1						2	2		1			
CO2	1	2	2	1					2	2		1			
CO3	2	2	1						2	3		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG009	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of entrepreneurship and business fundamentals. • Awareness of creative thinking and problem-solving skills. • Fundamental knowledge of innovation concepts. • Interest in developing new ideas, products, or business models. • Basic analytical and decision-making skills.					
Course Objectives: • To develop the creativity skills among the learners • To impart the knowledge of creative intelligence essential for entrepreneurs • To know the applications of innovation in entrepreneurship. • To develop innovative business models for business. • To develop innovative and sustainable business models for successful enterprises.					
Unit I	CREATIVITY				9
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity- Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.					
Unit II	CREATIVE INTELLIGENCE				9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.															
Unit III		INNOVATION												9	
Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system															
Unit IV		INNOVATION AND ENTREPRENEURSHIP												9	
Innovation and Entrepreneurship: Entrepreneurial Mindset , Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit															
Unit V		INNOVATIVE BUSINESS MODELS												9	
Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.															
Total periods: 45															
SUGGESTED READINGS:															
1. Creativity and Inovation in Entrepreneurship, Kankha, Sultan Chand															
2. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.															
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.															
4. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.															
5. Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.															
6. Dale Timpe, Creativity, Jaico Publishing House, 2003.															
7. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.															
8. Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.															
Course Outcomes:													Blooms Taxonomy		
CO1: Learn the basics of creativity for developing Entrepreneurship													Remember (K1), Understand (K2)		
CO2: Understand the importance of creative inteligence for business growth													Understand (K2), Apply (K3)		
CO3: Understand the advances through Innovation in Industries													Understand (K2), Analyze (K4)		
CO4: Learn about applications of innovation in building successful ventures													Apply (K3), Analyze (K4)		
CO5: Acquaint with developing innovative business models to run the business effecientlty and effectively													Analyze (K4), Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							2	2		1			
CO2	1	2	2						2	3		1			
CO3	1	2	2	1					2	3		1			
CO4		2	3	2	1				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG010	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	Category:PEC			
		L	T	P	C
		3	0	0	3
Prerequisites					

• Basic understanding of business operations and entrepreneurship. • Awareness of customer needs and buying behavior. • Fundamental knowledge of economics and business environment. • Interest in marketing strategies, branding, and product development. • Basic analytical and communication skills.		
Course Objectives: • To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs • To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners. • To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners. • To provide an understanding of marketing mix decisions, environmental analysis, and customer-focused strategies. • To enable learners to apply marketing concepts to develop solutions for contemporary marketing challenges.		
Unit I	INTRODUCTION TO MARKETING MANAGEMENT	9
Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.		
Unit II	MARKETING ENVIRONMENT	9
Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.		
Unit III	PRODUCT AND PRICING MANAGEMENT	9
Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.		
Unit IV	PROMOTION AND DISTRIBUTION MANAGEMENT	9
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.		
Unit V	CONTEMPORARY ISSUES IN MARKETING MANAGEMENT	9
Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.		
Total periods: 45		
Text Books:		
1. Philip Kotler, Gary Armstrong, Principles of Marketing, Pearson Education, 17th Edition, 2018.		
2. Ramaswamy V.S., Namakumari S., Marketing Management: Global Perspective – Indian Context, McGraw Hill Education, 5th Edition, 2018		
3. C.B. Gupta, Rajan Nair, Marketing Management: Text and Cases, Sultan Chand & Sons, 17th Edition, 2017.		
References:		
1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.		
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.		
3. Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.		
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy&S.Namakumari, Macmillan Publishers India,5th edition, 2015.		
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.		
6. Marketing Management- text and Cases, Dr. C.B.Gupta& Dr. N.Rajan Nair, 17th edition, 2016.		
Course Outcomes:		Blooms Taxonomy

CO1: Have the awareness of marketing management process													Remember (K1), Understand (K2)		
CO2: Understand the marketing environment													Understand (K2), Analyze (K4)		
CO3: Acquaint about product and pricing strategies													Understand (K2), Apply (K3)		
CO4: Knowledge of promotion and distribution in marketing management.													Apply (K3), Analyze (K4)		
CO5: Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.													Analyze (K4), Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1							2	2		1			
CO2	1	2	2	1					2	3		1			
CO3	1	2	2	2	1				3	3		1	1		
CO4		2	3	2	2				3	3	1	1	1		
CO5		1	2	2	2				3	3	1	2	1		
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG011	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of organizational structure and management principles. • Awareness of fundamental business operations and entrepreneurial functions.					
Course Objectives: • To introduce the basic concepts, structure and functions of human resource management for entrepreneurs. • To create an awareness of the roles, functions and functioning of human resource department. • To understand the methods and techniques followed by Human Resource Management practitioners. • To impart understanding of training methods, employee development and compensation systems. • To enable students to understand HR controlling techniques such as performance appraisal, discipline and grievance handling.					
Unit I	INTRODUCTION TO HRM				9
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.					
Unit II	HUMAN RESOURCE PLANNING				9
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends					
Unit III	RECRUITMENT AND SELECTION				9
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.					
Unit IV	TRAINING AND EMPLOYEE DEVELOPMENT				9
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices					
Unit V	CONTROLLING HUMAN RESOURCES				9
Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends					
Total periods: 45					

Text Books:															
1. K. Aswathappa, Sadhna Dash , Human Resource Management - Text and Cases , 9th Edition, McGraw Hill, 2021.															
2. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012															
References:															
1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e , Pearson, 2015.															
2. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.															
3. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014															
4. R. Wayne Mondy, Human Resource Management, Pearson , 2015.															
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012															
6. John M. Ivancevich, Human Resource Management,12e, McGraw Hill Irwin,2013.															
Course Outcomes:													Blooms Taxonomy		
CO1: To understand the Evolution of HRM and Challenges faced by HR Managers													Remember (K1), Understand (K2)		
CO2: To learn about the HR Planning Methods and practices.													Understand (K2), Apply (K3)		
CO3: To acquaint about the Recruitment and Selection Techniques followed in Industries.													Understand (K2), Apply (K3)		
CO4: To known about the methods of Training and Employee Development.													Apply (K3), Analyze (K4)		
CO5: To comprehend the techniques of controlling human resources in organisations.													Analyze (K4), Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	1	1	2	3	2	1	3	2	1
CO2	2	3	2	2	1	2	1	1	2	3	2	1	3	2	1
CO3	2	2	3	2	1	2	1	1	3	3	2	1	3	2	2
CO4	2	2	3	3	2	2	1	1	3	3	2	2	3	2	2
CO5	2	2	2	3	2	3	1	2	3	3	2	2	3	2	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG012	FINANCING NEW BUSINESS VENTURES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of accounting and financial statements • Understanding of fundamental business concepts • Awareness of entrepreneurship and new venture creation basics					
Course Objectives: • To develop the basics of business venture financing. • To impart the knowledge essential for entrepreneurs for financing new ventures. • To acquaint the learners with the sources of debt and equity financing. • To empower the learners towards fund raising for new ventures effectively. • To empower learners to apply effective fund-raising methods for new ventures					
Unit I	ESSENTIALS OF NEW BUSINESS VENTURE				9
Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.					
Unit II	INTRODUCTION TO VENTURE FINANCING				9

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.																
Unit III		SOURCES OF DEBT FINANCING												9		
Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.																
Unit IV		SOURCES OF EQUITY FINANCING												9		
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.																
Unit V		METHODS OF FUND RAISING FOR NEW VENTURES												9		
Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends																
Total periods: 45																
Text Books:																
1. Prasanna Chandra , <i>Financial Management: Theory and Practice</i> , McGraw Hill Education, Latest Edition.																
2. I.M. Pandey , <i>Financial Management</i> , Vikas Publishing House, Latest Edition.																
3. Bhabatosh Banerjee , <i>Fundamentals of Financial Management</i> , PHI Learning, Latest Edition.																
References:																
1. Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018																
2. Prasanna Chandra, Projects :Planning ,Analysis,Selection ,Financing,Implementation and Review, McGraw Hill Education India Pvt Ltd ,NewDelhi , 2019.																
3. Introduction to Project Finance. Andrew Fight,Butterworth-Heinemann, 2006.																
4. Metrick, Andrew; Yasuda, Ayako. Venture Capital And The Finance Of Innovation. Venture Capital And The Finance Of Innovation, 2nd Edition, Andrew Metrick And Ayako Yasuda, Eds., John Wiley And Sons, Inc, 2010.																
5. Feld, Brad; Mendelson, Jason. Venture Deals. Wiley, 2011.																
6. May, John; Simons, Cal. Every Business Needs An Angel: Getting The Money You Need To Make Your Business Grow. Crown Business, 2001.																
7. Gompers, Paul Alan; Lerner, Joshua. The Money Of Invention: How Venture Capital Creates New Wealth. Harvard Business Press, 2001.																
8. Camp, Justin J. Venture Capital Due Diligence: A Guide To Making Smart Investment Choices And Increasing Your Portfolio Returns. John Wiley & Sons, 2002.																
9. Byers, Thomas. Technology Ventures: From Idea To Enterprise. Mcgraw2014.																
10. Lerner, Josh; Leamon, Ann; Financing Of Entrepreneurship. 2012.																
Course Outcomes:														Blooms Taxonomy		
CO1: Learn the basics of starting a new business venture.														Remember (K1)		
CO2: Understand the basics of venture financing.														Understand (K2)		
CO3: Understand the sources of debt financing.														Apply (K3)		
CO4: Understand the sources of equity financing.														Analyze (K4)		
CO5: Acquaint with the methods of fund raising for new business ventures.														Evaluate (K5)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	3	2	1	1	1	2	1	1	2	3	2	1	3	2	1	
CO2	3	3	2	2	1	2	1	1	2	3	2	1	3	2	1	
CO3	2	3	3	2	1	2	1	1	3	3	2	1	3	2	2	
CO4	2	3	3	3	2	2	1	1	3	3	2	2	3	2	2	
CO5	2	3	3	3	2	3	1	2	3	3	2	2	3	2	2	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation																

VERTICAL III: PUBLIC ADMINISTRATION

23CMG013	PRINCIPLES OF PUBLIC ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of social sciences (recommended, not mandatory). • No formal prerequisites.					
Course Objectives: • To Introduce the meaning, nature, scope and significance of Public Administration. • To Explain the evolution and changing trends in Public Administration including NPA and NPM. • To Familiarize students with classical, scientific, bureaucratic, human relations and ecological approaches. • To Explore the interdisciplinary relationships between Public Administration, Political Science, History, and Sociology. • To Develop understanding of leadership, communication and decision-making processes within administrative systems.					
Unit I					9
1. Meaning, Nature and Scope of Public Administration 2. Importance of Public Administration 3. Evolution of Public Administration					
Unit II					9
1. New Public Administration 2. New Public Management 3. Public and Private Administration					
Unit III					9
1. Relationships with Political Science, History and Sociology 2. Classical Approach 3. Scientific Management Approach					
Unit IV					9
1. Bureaucratic Approach: Max Weber 2. Human Relations Approach : Elton Mayo 3. Ecological Approach : Riggs					
Unit V					9
1. Leadership: Leadership - Styles - Approaches 2. Communication: Communication Types - Process - Barriers 3. Decision Making: Decision Making - Types, Techniques and Processes.					
Total periods:45					
Text Books:					
1.Avasthi and Maheshwari, <i>Public Administration in India</i> , Lakshmi Narain Agarwal, Agra, 2013.					
2.Rumki Basu, <i>Public Administration: Concepts and Theories</i> , Sterling Publishers, New Delhi, 2013.					
References:					
1. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.					
2. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.					
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.					
4. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.					

5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.															
Course Outcomes:													Blooms Taxonomy		
CO1:Analyze the meaning, nature, scope and evolution of Public Administration.													Analyze(K4)		
CO2:Analyze New Public Administration, New Public Management and compare public–private administration.													Analyze(K4)		
CO3: Evaluate classical, scientific, bureaucratic, human relations and ecological approaches.													Evaluate(K5)		
CO4:Create administrative frameworks using classical and modern administrative theories.													Create(K6)		
CO5: Apply leadership, communication and decision-making techniques in administrative contexts.													Applying(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1					2	3			1		
CO2	2	1		2					2	3			1		
CO3	2	2	2	3					2	3			2		
CO4	1			2				1	3	3			1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG014	CONSTITUTION OF INDIA	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of Indian history and civics (recommended but not mandatory). • No formal prerequisites.					
Course Objectives: • To provide knowledge about the constitutional developments and the making of the Indian Constitution. • To enable students to understand Fundamental Rights, Duties, and Directive Principles of State Policy. • Familiarize students with the structure and functioning of the Union Government – President, Parliament, Supreme Court. • To explain the functioning of State Government institutions – Governor, State Legislature, High Courts. • To develop awareness on secularism, social justice, and minority rights in the Indian constitutional framework.					
Unit I					9
1. Constitutional Development Since 1909 to 1947 2. Making of the Constitution. 3. Constituent Assembly					
Unit II					9
1. Fundamental Rights 2. Fundamental Duties 3. Directive Principles of State Policy					
Unit III					9
1. President 2. Parliament 3. Supreme Court					
Unit IV					9

1. Governor 2. State Legislature 3. High Court																
Unit V																9
1. Secularism 2. Social Justice 3. Minority Safeguards																
Total periods:45																
Text Books:																
1.D.D. Basu – Introduction to the Constitution of India, LexisNexis / Prentice Hall of India.																
2.M. Laxmikanth – Indian Polity, McGraw Hill Education.																
References:																
1. Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi.																
2. Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.																
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi																
4. Agarwal R.C: Indian Political System; S.Chand& Co., New Delhi																
Course Outcomes:														Blooms Taxonomy		
CO1: Explain the historical evolution, constitutional development (1909–1947), and making of the Constitution.														Understand(K2)		
CO2:Describe and interpret the Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy, and their significance in the Indian constitutional framework.														Understand (K2)		
CO3:Analyze the structure, powers, and functions of the President, Parliament, and Supreme Court, and evaluate their roles in the Union Government.														Analyze (K4)		
CO4:Explain the functioning of State Government institutions—Governor, State Legislature, and High Courts—and compare their roles with corresponding Union institutions.														Analyze (K4)		
CO5: Examine the concepts of secularism, social justice, and constitutional safeguards for minorities, and assess their relevance in contemporary India.														Evaluate (K5)		
CO - PO & PSO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	1					1	2		1			1			
CO2	2	2		1			2	2		1			1			
CO3	2	2	1	2			2	2		1			2	1		
CO4	1	2	1	2			2	2		1			2	1		
CO5	1	1		1			3	3		1			2	1		
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation																

23CMG015	PUBLIC PERSONNEL ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • No formal prerequisites. • Basic understanding of public administration and governance (recommended).					
Course Objectives: • To understand the meaning, scope, and significance of personnel administration in public organizations. • To familiarize students with various personnel systems and administrative structures. • To explain recruitment, training, promotion, and their role in administrative efficiency. • To analyze the relationship between civil servants, political executives, and integrity systems. • To provide insights into employer–employee relations, wage systems, and employee benefits in					

CO4	1			2			1	3	3				1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High, ' ' No correlation															

23CMG016	ADMINISTRATIVE THEORIES	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of public administration and management concepts (recommended).					
Course Objectives: - To understand the meaning, scope, and significance of Public Administration. - To study the evolution of Public Administration as a discipline and its identity. - To learn classical, scientific, and human relations theories of organization. - To analyze organizational behavior, design, and group dynamics. - To examine motivation and leadership theories and the contributions of eminent administrative thinkers.					
Unit I					9
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration					
Unit II					9
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory					
Unit III					9
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.					
Unit IV					9
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making					
Unit V					9
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker					
Total periods:45					
Text Books:					
1.Shum Sun Nisa Alvi – <i>Eminent Administrative Thinkers</i>					
2.Keith Davis – <i>Organization Theory</i>					
References:					
1. CrozierM : The Bureaucratic phenomenon (Chand)					
2. Blau. P.M and Scott. W : Formal Organizations (RKP)					
3. Presthus. R : The Organizational Society (MAC)					
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.					
5. Keith Davis : Organization Theory (MAC)					
Course Outcomes:					Blooms Taxonomy
CO1:Explain the meaning, scope, significance, and evolution of Public Administration.					Understand(K2)
CO2:Analyze organizational theories: Scientific Management, Classical, and Human Relations approaches.					Analyze(K4)
CO3:Examine organizational behavior, group dynamics, and organizational design.					Analyze(K4)
CO4:Evaluate motivation and leadership theories and apply decision-making techniques.					Evaluate(K5)
CO5:Assess contributions of eminent administrative thinkers and their relevance to contemporary administration.					Evaluate(K5)
CO - PO & PSO Mapping					

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CO5:Apply knowledge of anti-corruption mechanisms like Ombudsman, Lok Pal & Lok Ayuktha.													Applying(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1				2	2				1		
CO2	2	2	1	2				2	3				1		
CO3	2	2	1	3				2	3				2	1	
CO4	1	1	1	3			2	3	3				2	1	
CO5	1			2				2	3				2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

23CMG018	PUBLIC POLICY ADMINISTRATION	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - No formal prerequisites. - Basic understanding of political science, public administration, and governance (recommended).					
Course Objectives: - To understand the meaning, nature, scope, and importance of public policy. - To examine the relationship of public policy with social sciences, political science, and public administration. - To explore approaches to policy analysis, including institutional, incremental, system, and Dror’s optimal model. - To analyze stages in the policy-making process: formulation, implementation, and evaluation. - To study the institutional framework of policy-making and the role of bureaucracy, interest groups, and political parties.					
Unit I					9
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.					
Unit II					9
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Mode					
Unit III					9
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation –Policy Evaluation.					
Unit IV					9
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.					
Unit V					9
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.					

Total periods:45															
Text Books:															
1.Rajesh Chakrabarti & Kaushik Sanyal – Public Policy in India, Oxford University Press, 2016															
References:															
1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.															
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.															
3. Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.															
4. Pradeep Saxena : Public Policy Administration and Development															
5. Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016															
Course Outcomes:													Blooms Taxonomy		
CO1:Explain the meaning, nature, scope, and significance of public policy.													Understand(K2)		
CO2:Analyze various approaches to policy analysis, including institutional, incremental, system, and Dror’s optimal mode.													Analyze(K4)		
CO3: Evaluate the policy formulation process and assess the factors influencing effective policy design.													Evaluate(K5)		
CO4: Examine the institutional framework of policy-making and the roles of bureaucracy, political parties, and interest groups.													Analyze(K4)		
CO5:Apply knowledge of public policies in India, including economic, population, agriculture, and IT policies.													Apply(K3)		
CO - PO & PSO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1				2	2				1		
CO2	2	2	1	2				2	3				1		
CO3	2	2	1	3				2	3				2	1	
CO4	1			2			1	3	3				1		
CO5								1	3	3			2	1	
1 - Low, 2 - Medium, 3 - High , ‘ ‘ No correlation															

VERTICALIV :BUSINESSDATAANALYTICS

23CMG019	STATISTICSFORMANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	1
Prerequisites • A strong foundational knowledge of high school level algebra and arithmetic operations is required. • Basic familiarity with using spreadsheet software applications like Microsoft Excel for data entry. • The ability to interpret and analyze basic statistical charts and graphical representations of data. • An introductory understanding of mathematical concepts such as set theory and logical reasoning. • Possession of basic analytical thinking skills to solve numerical problems effectively.					
Course Objectives: • To learn the various applications of statistical methods in modern business decision-making processes. • To understand the fundamental concepts of probability distributions and their real-world implications. • To apply different sampling techniques and estimation methods to calculate population parameters. • To perform parametric and non-parametric hypothesis testing to validate business assumptions. • To analyze the relationships between multiple business variables using correlation and regression techniques.					
Unit I	INTRODUCTION				9

Basic definitions and rules of probability – Bayes’ theorem – random variables – probability distributions: binomial, Poisson, uniform, and normal distributions.															
Unit II	SAMPLING DISTRIBUTION AND ESTIMATION													9	
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and interval estimates of population parameters.															
Unit III	TESTING OF HYPOTHESIS- PARAMETRIC TESTS													9	
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.															
Unit IV	NON-PARAMETRIC TESTS													9	
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.															
Unit V	CORRELATION AND REGRESSION													9	
Correlation–Rank Correlation–Regression–Estimation of Regression line–Method of Least Squares– Standard Error of estimate.															
Total periods: 45															
Text Books:															
1.Statistics for Management by Levin, Rubin, et al. (Pearson, 2017)															
2.Applied Business Statistics by Ken Black (Wiley, 2012)															
References:															
1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.															
2.Prem.S.Mann,Introductory Statistics,Wiley Publications,9th Edition,2015															
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.															
4.Ken Black,Applied Business Statistics,7th Edition,Wiley India Edition,2012.															
5.David R.Anderson,Dennis J.Sweeney,Thomas A.Williams,Jeffrey D.Camm,James															
6.Cochran,Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.															
7.N.D.Vohra,Business Statistics,Tata McGraw Hill,2017.															
Course Outcomes													Blooms Taxonomy		
CO1: To facilitate objective solutions in business decision making.													Apply (K3)		
CO2: To understand and solve business problems.													Understand (K2)		
CO3: To apply statistical techniques to data sets, and correctly interpret the results.													Analyze (K4)		
CO4: To develop skill-set that is in demand in both the research and business environments.													Evaluate (K5)		
CO5: To enable the students to apply the statistical techniques in a work setting.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	3													
CO3	3	3	2										3		
CO4	3	3	2	2										3	
CO5	3	3	3												3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG020	DATAMINING FOR BUSINESS INTELLIGENCE	Category: PEC			
		L	T	P	L
		3	0	0	3
Prerequisites • A solid foundational knowledge of basic statistical concepts and probability theory is essential. • Basic understanding of database management systems and how data is structured and stored. • Familiarity with fundamental programming logic or algorithm development for data processing. • Understanding of linear algebra concepts including matrix operations and vector spaces. • Basic knowledge of core business processes and how decision-making occurs in organizations.					
Course Objectives: • To know how to derive meaningful insights from huge volumes of complex data and information. • To understand how the knowledge discovery process is utilized in effective business decision-making. • To apply advanced prediction techniques including time series analysis and data visualization methods. • To implement classification and clustering algorithms to segment data for business analysis. • To understand the integration and application of machine learning and AI in data mining.					
Unit I	INTRODUCTION				9
Datamining,Textmining,Webmining,Datawarehouse.					
Unit II	DATAMININGPROCESS				9
Datamining process – KDD, CRISP-DM, SEMMA Prediction performance measures					
Unit III	PREDICTIONTECHNIQUES				9
Datavisualization,Timeseries–ARIMA,WinterHolts,					
Unit IV	CLASSIFICATIONANDCLUSTERINGTECHNIQUES				9
Classification,Association,Clustering.					
Unit V	MACHINELEARNINGANDAI				9
Geneticalgorithms,Neuralnetwork,Fuzzylogic,AntColonyoptimization,ParticleSwarmoptimization					
Total periods: 45					
Text Books:					
1.Data Mining Concepts and Techniques by Han & Kamber (2006)					
2.Business Intelligence by Turban et al. (2008)					
References:					
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006					
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.					
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.					

4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition, 2013.															
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011															
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011															
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011															
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009															
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011															
10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriack C, Adaptive Business Intelligence, Springer – Verlag, 2007															
11. Galit Shmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010.															
Course Outcomes												Blooms Taxonomy			
CO1: Learn to apply various data mining techniques into various areas of different domains.												Apply (K3)			
CO2: Be able to interact competently on the topic of data mining for business intelligence.												Understand (K2)			
CO3: Apply various prediction techniques.												Analyze (K4)			
CO4: Learn about supervised and unsupervised learning technique.												Evaluate (K5)			
CO5: To enable the students to apply the statistical techniques in a work setting.												Create (K6)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	2	2								2					
CO3	3	3	3											3	
CO4	3	3		2											
CO5	3		3												3
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CMG021	HUMAN RESOURCE ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of the core functions and responsibilities within human resource management. • Familiarity with key organizational behavior concepts and employee performance dynamics. • Fundamental skills in statistics and the ability to interpret data patterns correctly. • Proficiency in using spreadsheet tools for performing calculations and organizing workforce data. • Understanding of strategic management principles and overall organizational business goals.					
Course Objectives: • To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy. • To know the different types of HR metrics and understand their respective impact and application. • To understand the impact and use of HR metrics and their connection with HR analytics. • To understand common workforce issues and resolving them using people analytics. • To measure the return on investment (ROI) for various training and development initiatives.					
Unit I	INTRODUCTION TO HR ANALYTICS				9
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.					
Unit II	HR ANALYTICS I: RECRUITMENT				9
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.					

Unit III	HR ANALYTICS - TRAINING AND DEVELOPMENT												9		
Training & Development Metrics : Percentage of employees trained- Internally and externally trained -Training hours and cost per employee - ROI.															
Unit IV	HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION												9		
Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.															
Unit V	HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT												9		
Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix															
Total periods:45															
Text Books:															
1.The New HR Analytics by Jac Fitz-enz (2010)															
2.Predictive HR Analytics by Edwards & Edwards (2016)															
References:															
1. JacFitzenz , The New HR Analytics, AMACOM , 2010.															
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric.London: Kogan Page.2016.															
3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2003															
4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and Applications, SAGE Publications India ,2017.															
5. Sesil, J. C. , Applying advanced analytics to HR management decisions: Methods fo selection, developing incentives, and improving collaboration. Upper Saddle River,New Jersey: Pearson Education,2014.															
6. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley ,2014.															
7. Phillips, J., & Phillips, P.P, Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME. McGraw-Hill,2014.															
Course Outcomes												Blooms Taxonomy			
CO1: The learners will be conversant about HR metrics and ready to apply at work settings.												Understand (K2)			
CO2: The learners will be able to resolve HR issues using people analytics.												Apply (K3)			
CO3:Analyze workforce data to identify trends and patterns in employee behavior.												Analyze (K4)			
CO4: Evaluate the effectiveness of HR interventions and training programs using ROI.												Evaluate (K5)			
CO5: Create strategic HR plans based on predictive analytics models.												Create (K6)			
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2		2							
CO2	3	3											3		
CO3	3	3	2											2	
CO4	3	3		2											
CO5	3		3								2				3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG022	MARKETING AND SOCIAL MEDIA WEB ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Fundamental understanding of marketing management principles and consumer engagement strategies. • Basic knowledge of internet technologies, web architecture, and social networking platforms. • Understanding of consumer behavior models and current digital marketing trends.					

- Basic statistical analysis skills required for interpreting marketing performance data.
- Familiarity with various digital communication channels and online community dynamics

Course Objectives:

- To showcase the opportunities that exist today to leverage the power of the web and social media.
- To understand the methods for marketing budget allocation and performance measurement analysis.
- To analyze the strategies for community building and understanding the viral impact of social media.
- To implement effective web analytics strategies and define key performance indicators for success.
- To apply search engine optimization techniques and traffic analysis to improve online visibility

Unit I	MARKETING ANALYTICS												9		
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis															
Unit II	COMMUNITY BUILDING AND MANAGEMENT												9		
History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media.															
Unit III	SOCIAL MEDIA POLICIES AND MEASUREMENTS												9		
Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.															
Unit IV	WEB ANALYTICS												9		
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.															
Unit V	SEARCH ANALYTICS												9		
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.															
Total periods:45															
Text Books:															
1.Web Analytics: An Hour a Day by Avinash Kaushik (2007)															
2.Social Media in Business and Governance by K. M. Shrivastava (2013)															
References:															
1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013															
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014															
3. Bittu Kumar, Social Networking, V & S Publishers, 2013															
4. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007															
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004															
6. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016															
Course Outcomes													Blooms Taxonomy		
CO1: Understand the role of web and social media in modern marketing strategies.													Understand (K2)		
CO2: Apply marketing analytics tools to measure performance and budget allocation.													Apply (K3)		
CO3:Analyze social media audiences and influencers to optimize digital PR.													Analyze (K4)		
CO4: Evaluate web traffic data and key performance indicators (KPIs) for strategy.													Evaluate (K5)		
CO5: Create comprehensive reports and proposals based on web and social data.													Create (K6)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2				3										
CO2	3	2											3		
CO3	3	3	2											3	
CO4	3			3		2									
CO5	3		3												3
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG023	OPERATION AND SUPPLY CHAIN ANALYTICS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of operations management principles and supply chain logistics flows. • Familiarity with linear programming concepts and mathematical optimization problems. • Fundamental knowledge of calculus and algebra to solve operational equations. • Understanding of logistics, warehousing, and distribution concepts in a business context. • Basic probability skills to assess risks within supply chain networks					
Course Objectives: • To understand various location models and layout methods for optimizing facility placement. • To analyze warehousing decisions using heuristic approaches and dynamic location models. • To apply inventory management strategies and risk pooling techniques to optimize stock levels. • To optimize transportation network models using spanning tree and shortest path algorithms. • To apply multi-criteria decision-making models like AHP and TOPSIS to operational problems.					
Unit I	INTRODUCTION				9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.					
Unit II	WAREHOUSING DECISIONS				9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.					
Unit III	INVENTORY MANAGEMENT				9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.					
Unit IV	TRANSPORTATION NETWORK MODELS				9
Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.					
Unit V	MCDM MODELS				9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.					
Total periods: 45					
Text Books:					
1.Big Data Driven Supply Chain Management by Nada R. Sanders (2014)					
2.Supply Chain Network Design by Watson et al. (2013)					
References:					
1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.					
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.					
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time:					
Course Outcomes					Blooms Taxonomy
CO1: Apply optimization models to solve facility location and layout problems.					Apply (K3)
CO2:Analyze inventory systems and warehousing decisions using data.					Analyze (K4)
CO3: Evaluate transportation networks and risks using simulation and algorithms.					Evaluate (K5)
CO4: Create efficient supply chain strategies using multi-criteria decision models.					Create (K6)
CO5: Understand the fundamental concepts of supply chain analytics and logistics.					Understand (K2)
CO-PO Mapping					

Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											2		
CO2	3	3	3											3	
CO3	3	3		2											
CO4	3		3												3
CO5	2				2										
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CMG024	FINANCIAL ANALYTICS		Category: PEC			
			L	T	P	C
			3	0	0	3
Prerequisites • Understanding of fundamental financial accounting principles and financial reporting standards. • Knowledge of time value of money concepts and their application in finance. • Basic understanding of probability theory and statistical analysis for financial data. • Familiarity with the functioning of financial markets and various investment instruments. • Proficiency in using Excel for creating financial models and analyzing datasets.						
Course Objectives: • To apply corporate financial predictive modeling techniques for project and cash flow analysis. • To estimate and predict the risk and return associated with bond and stock investments. • To perform portfolio analysis using the capital asset pricing model and option pricing models. • To use technical analysis charts and market indicators for the prediction of share prices. • ☐ To evaluate credit risk models using techniques like logistic regression and decision trees.						
Unit I	CORPORATE FINANCE ANALYSIS					9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.						
Unit II	FINANCIAL MARKET ANALYSIS					9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.						
Unit III	PORTFOLIO ANALYSIS					9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.						
Unit IV	TECHNICAL ANALYSIS					9
Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.						
Unit V	CREDIT RISK ANALYSIS					9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.						
Total periods: 45						
Text Books:						
1. Financial Analytics with R by Bennett & Hugen						
2.Quantitative Financial Analytics by Williams &Dobelman						
References:						
1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press.						
2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov.						
3. Quantitative Financial Analytics: The Path To Investment Profits Paperback – Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.						
Course Outcomes					Blooms Taxonomy	
CO1: Apply financial predictive modeling techniques to project and cash flow analysis.					Apply (K3)	
CO2: Analyze financial market data to estimate risk, return, and volatility.					Analyze (K4)	

CO3: Evaluate portfolio performance using CAPM and option pricing models.													Evaluate (K5)		
CO4: Create trading strategies based on technical analysis and chart patterns.													Create (K6)		
CO5: Understand the principles of credit risk analysis and decision modeling.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3									3		3		
CO2	3	3	3											3	
CO3	3	3		3											
CO4	3		3												3
CO5	2										2				
1 - Low, 2 - Medium, 3 - High, '-' No correlation															

VERTICAL V : ENVIRONMENT AND SUSTAINABILITY

23CES001	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic knowledge of civil engineering fundamentals and construction materials • Awareness of environmental studies and basic sustainable development concepts					
Course Objectives: • To impart knowledge about sustainable Infrastructure development goals, practices • To understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects. • To familiarize sustainable construction techniques and material selection. • To assess environmental, economic and social impacts of infrastructure projects. • To introduce modern tools and technologies for sustainable infrastructure management.					
Unit I	SUSTAINABLE DEVELOPMENT GOALS				9
Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands– Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.					
Unit II	SUSTAINABLE INFRASTRUCTURE PLANNING				9
Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement & Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).					
Unit III	SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES				9
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.					
Unit IV	SUSTAINABLE CONSTRUCTION MATERIALS				9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies		
Unit V	SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS	9
Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .		
Total periods:45		
Text Books:		
1. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 4th Edition, Wiley Publishers, 2016.		
2. Steve Goodhew, Sustainable Construction Processes, Wiley-Blackwell, UK, 2016.		
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth-Heinemann, 2011.		
4. William P. Spence, Construction Materials, Methods and Techniques, Yesdee Publication Pvt. Ltd., 2016.		
References:		
1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.		
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.		
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.		
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.		
5. New Building Materials and Construction World magazine		
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher:Belhaven Press,ISBN:1852930039.		
7. Munier N, "Introduction to Sustainability", Springer2005		
8. Sharma, “Sustainable Smart Cities In India: Challenges And Future Perspectives”, SPRINGER, 2022.		
9. Ralph Horne, Tim Grant, KarliVerghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009		
10. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010		
11. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).		
12. GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.		
Course Outcomes:		Blooms Taxonomy
CO1: Understand the environment sustainability goals at global and Indian scenario.		Understand (K2)
CO2: Understand risks in development of projects and suggest mitigation measures.		Understand (K2)
CO3: Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.		Apply (K3)
CO4: Explain Life Cycle Analysis and life cycle cost of construction materials.		Explain (K2)

CO5: Explain the new technologies for maintenance of infrastructure projects.													Explain (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		2			2		1	2		
CO2	3	3	2		2		2			2		1	3	1	
CO3	3	3	3	2	2		2	1		3		1	3	2	1
CO4	2	3	2	2	2	1	2	2		3		2	3	2	1
CO5	2	2	2	2	3	1	3	2	1	3		2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CES002	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites: • Basic understanding of ecology and environmental science • Fundamental knowledge of agriculture and natural resource management					
Course Objectives: • To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world. • To develop understanding of soil, water, nutrient and pest management for sustainable farming. • To introduce sustainable strategies for energy use and waste management in agriculture. • To enable evaluation of agroecosystem sustainability using appropriate indicators. • To promote sustainable agricultural practices for long-term environmental balance and food security.					
Unit I	AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS				9
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems					
Unit II	SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT				9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control					
Unit III	WATER MANAGEMENT				9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use					
Unit IV	ENERGY AND WASTE MANAGEMENT				9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture					
Unit V	EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS				9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies					
Total periods:45					
Text Books:					
1. Lal, R., Sustainable Agriculture and the Environment, CRC Press, 2016.					
2. Pretty, J., Sustainable Agriculture and Food Systems, Earthscan Publications, 2008.					
3. Gliessman, S.R., Agroecology: The Ecology of Sustainable Food Systems, CRC Press, 2015.					

4. Altieri, M.A., Agroecology: The Science of Sustainable Agriculture, Westview Press, 2012.															
References:															
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020															
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020															
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016															
4. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016															
5. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021															
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014															
Course Outcomes:													Blooms Taxonomy		
CO1: Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture													Understand (K2)		
CO2: Discuss the sustainable ways in managing soil health, nutrients, pests and diseases													Analyze (K4)		
CO3: Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources													Apply (K3)		
CO4: Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas													Create (K6)		
CO5: Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		2			2		1	2		
CO2	3	3	2		2		2			2		1	3	1	
CO3	3	3	2	1	2		2	1		3		1	3	2	1
CO4	2	3	2	2	2	1	2	2		3		2	3	2	1
CO5	2	2	2	2	3	1	3	2	1	3		2	3	2	1
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES003	SUSTAINABLE BIO MATERIALS	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites: • Basic knowledge of materials science. • Introductory understanding of chemistry and biology.					
Course Objectives: • To Impart knowledge of biomaterials and their properties • To learn about Fundamentals aspects of Biopolymers and their applications • To learn about bioceramics and biopolymers • To introduce the students about metals as biomaterials and their usage as implants • To make the students understand the significance of bionanomaterials and its applications.					
Unit I	INTRODUCTION TO BIOMATERIALS				9
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials					
Unit II	BIO POLYMERS				9
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials -Polyethylene -Polymethylmethacrylate					

(PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) -Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives- Synthetic polymeric membranes and their biological applications																
Unit III		BIO CERAMICS AND BIOCOMPOSITES												9		
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Compsite(PMC)- Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds																
Unit IV		METALS AS BIOMATERIALS												9		
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals																
Unit V		NANOBIOMATERIALS												9		
Meatllicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor-Bioimaging/Molecular Imaging- challenges and future perspective.																
Total periods:45																
Text Books:																
1. Buddy D. Ratner et al., Biomaterials Science: An Introduction to Materials in Medicine, Elsevier, 2013.																
2. D. Williams, Essential Biomaterials Science, Cambridge University Press, 2014.																
3. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.																
4. Joon Park and R.S. Lakes, Biomaterials: An Introduction, Springer, 2007.																
References:																
1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.																
2. Donglushi “Introduction to Biomaterials” Tsinghua University press, 2006.																
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.																
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.																
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.																
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018																
7. Leopoido Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.																
8. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.																
9. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.																
Course Outcomes:														Blooms Taxonomy		
CO 1: Students will gain familiarity with Biomaterials and they will understand their importance.														Understand (K2)		
CO2: Students will get an overview of different biopolymers and their properties														Understand (K2)		
CO3: Students gain knowledge on some of the important Bioceramics and Biocomposite materials														Understand (K2)		
CO4: Students gain knowledge on metals as biomaterials														Understand (K2)		
CO5: Student gains knowledge on the importance of nanobiomaterials in biomedical applications.														Understand (K2)		
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	2				1	2	2					2	1		
CO2	2	2	2		2	1	2	2					2	2		
CO3	2	3	3	2	2	1	2	2					3	2	1	
CO4	2	3	3	2	2	1	2	2					3	3	1	
CO5	2	3	3	3	2	2	3	2					3	3	2	

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation

23CES004	MATERIALS FOR ENERGY SUSTAINABILITY	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of physics and chemistry. • Fundamental knowledge of energy systems and materials.					
Course Objectives: • To familiarize the students about the challenges and demands of energy sustainability • To provide fundamental knowledge about electrochemical devices and the materials used. • To introduce the students to various types of fuel cell • To enable students to appreciate novel materials and their usage in photovoltaic application • To introduce students to the basic principles of various types Supercapacitors and the materials used.					
Unit I	SUSTAINABLE ENERGY SOURCES				9
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy					
Unit II	ELECTROCHEMICAL DEVICES				9
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiased hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)					
Unit III	FUEL CELLS				9
Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).					
Unit IV	PHOTOVOLTAICS				9
Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)					
Unit V	SUPERCAPACITORS				9
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non -					

Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.															
Total periods:45															
Text Books:															
1. David S. Ginley and David Cahen, Fundamentals of Materials for Energy and Environmental Sustainability, Cambridge University Press, 2012.															
2. John A. Turner, Sustainable Hydrogen Production Processes, Wiley, 2014.															
3. Mark Z. Jacobson, Renewable Energy and the Environment, Academic Press, 2018.															
4. Vikas Mittal, Advanced Materials for Energy Conversion and Storage, Wiley, 2019.															
References:															
1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.															
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.															
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.															
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.															
5. Materials for Supercapacitor applications; B.Viswanathan. M.AuliceScibioh															
6. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.															
7. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.															
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.															
Course Outcomes:													Blooms Taxonomy		
CO1:Students will acquire knowledge about energy sustainability.													Understand (K2)		
CO2: Students understand the principles of different electrochemical devices.													Understand (K2)		
CO3: Students learn about the working of fuel cells and their application.													Apply (K3)		
CO4: Students will learn about various Photovoltaic applications and the materials used.													Apply (K3)		
CO5: The students gain knowledge on different types of supercapacitors and the performance of various materials													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2	3	2					2	1	
CO2	2	3	2		2	2	3	2					2	2	
CO3	2	3	3	2	2	2	3	2					3	2	1
CO4	2	2	3	2	2	2	3	2					3	2	2
CO5	2	3	3	3	2	2	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-’ No correlation															

23CES005	GREEN TECHNOLOGY												Category: PEC			
													L	T	P	C
													3	0	0	3
Prerequisites - Basic knowledge of chemistry and environmental science. - Awareness of pollution and sustainability concepts.																
Course Objectives: - To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability. - To provide green engineering solutions to energy demand, reduced energy footprint. - To encourage sustainable design of products and industrial processes. - To promote the application of green synthesis and green reagents. - To analyze the role of green nanotechnology in environmental protection.																
Unit I	PRINCIPLES OF GREEN CHEMISTRY												9			
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.																
Unit II	POLLUTION TYPES												9			
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.																
Unit III	GREEN REAGENTS AND GREEN SYNTHESIS												9			
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions																
Unit IV	DESIGNING GREEN PROCESSES												9			
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention																
Unit V	GREEN NANOTECHNOLOGY												9			
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology																
Total periods: 45																
Text Books:																
1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997																
2. Green Chemistry – An introductory text - M. Lancaster, RSC,2016.																
3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) , Wiley publications,2008																
References:																
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017																
Course Outcomes:													Blooms Taxonomy			
CO1: To understand the principles of green engineering and technology													Understand (K2)			
CO2: To learn about pollution using hazardous chemicals and solvents													Understand (K2)			
CO3: To modify processes and products to make them green and safe.													Apply (K3)			
CO4: To design processes and products using green technology													Create (K6)			
CO5: To understand advanced technology in green synthesis													Understand (K2)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	2				3	3	2					2	1		
CO2	2	3			2	3	3	2					2	2		

CO3	2	3	3	2	2	3	3	2					3	2	1
CO4	2	2	3	3	2	3	3	2					3	2	2
CO5	2	3	3	3	2	3	3	2					3	3	2

1 - Low, 2 - Medium, 3 - High, '-' No correlation

23CES006	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	Category: PEC			
		L	T	P	C
		3	0	0	3

Prerequisites

- Basic understanding of environmental science.
- Knowledge of basic analytical and scientific measurement methods.

Course Objectives:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.
- To introduce instrumental methods used in environmental quality assessment.
- To analyze environmental risk and monitoring programmes.
- To develop skills in interpreting environmental data for quality control.

Unit I	ENVIRONMENTAL MONITORING AND STANDARDS	9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

Unit II	MONITORING OF ENVIRONMENTAL PARAMETERS	9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

Unit III	ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING	9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

Unit IV	ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT	9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

Unit V	AUTOMATED DATA ACQUISITION AND PROCESSING	9

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks - Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

Total periods:45

Text Books:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

References:

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.															
3. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.															
Course Outcomes:													Blooms Taxonomy		
CO 1: Basic concepts of environmental standards and monitoring.													Understand (K2)		
CO2: The ambient air quality and water quality standards;													Understand (K2)		
CO3: The various instrumental methods and their principles for environmental monitoring													Analyze (K4)		
CO4:The significance of environmental standards in monitoring quality and sustainability of the environment.													Evaluate (K5)		
CO5: The various ways of raising environmental awareness among the people.													Understand (K2)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				3	3	2					2	1	
CO2	2	3		2	2	3	3	2					2	2	
CO3	2	3	3	2	2	3	3	2					3	2	1
CO4	2	2	3	3	2	3	3	2					3	2	2
CO5	2	2			2	3	3	2					2	1	
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES007	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites - Fundamental knowledge of energy resources and environmental studies. - Basic awareness of sustainable development concepts.					
Course Objectives: - To create awareness on the energy scenario of India with respect to world - To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation - Familiarisation on the concept of sustainable development and its benefits - Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development - Acquainting with energy policies and energy planning for sustainable development					
Unit I	ENERGY SCENARIO				9
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security					
Unit II	ENERGY AND ENVIRONMENT				9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls					
Unit III	SUSTAINABLE DEVELOPMENT				9
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.					
Unit IV	RENEWABLE ENERGY TECHNOLOGY				9
Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits					
Unit V	ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT				9
National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol					

blending, Energy Efficiency and Energy Mix															
Total periods:45															
Text Books:															
1. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, 2012.															
2. Virendra K. Vijay, Energy Planning and Policy for Sustainable Development, Springer, 2016.															
3.Vaclav Smil, Energy and Civilization: A History, MIT Press, 2017.															
4. R. K. Rajput, Energy Management and Conservation, Laxmi Publications, 2014.															
References:															
1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004															
2. Robert Ristirer and Jack P. Kraushaar, “Energy and the environment”, Willey, 2005.															
3. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012															
4. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.															
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.															
6. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016															
7. https://www.niti.gov.in/verticals/energy															
Course Outcomes:													Blooms Taxonomy		
CO 1:Understand the world and Indian energy scenario													Understand (K2)		
CO2:Analyse energy projects, its impact on environment and suggest control strategies													Analyze (K4)		
CO3: Recognise the need of Sustainable development and its impact on human resource development													Understand (K2)		
CO4:Apply renewable energy technologies for sustainable development													Apply (K3)		
CO5:Fathom Energy policies and planning for sustainable development.													Evaluate (K5)		
CO-PO Mapping															
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2	3	2					2	1	
CO2	2	3	2	2	2	2	3	2					2	2	
CO3	2	2	3	2	2	2	3	2					3	2	1
CO4	2	2	3	3	2	2	3	2					3	2	2
CO5	2	3	3	3	2	2	3	2					3	3	2
1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation															

23CES008	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	Category: PEC			
		L	T	P	C
		3	0	0	3
Prerequisites • Basic understanding of energy systems and environmental impact. • Introductory knowledge of sustainability principles					
Course Objectives: • To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation • To create awareness on energy audit and its impacts • To acquaint the techniques adopted for performance evaluation of thermal utilities • To familiarise on the procedures adopted for performance evaluation of electrical utilities					

To learn the concept of sustainable development and the implication of energy usage																
Unit I		ENERGY AND ENVIRONMENT												9		
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP																
Unit II		ENERGY AUDITING												9		
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments																
Unit III		ENERGY EFFICIENCY IN THERMAL UTILITIES												9		
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression																
Unit IV		ENERGY CONSERVATION IN ELECTRICAL UTILITIES												9		
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers																
Unit V		SUSTAINABLE DEVELOPMENT												9		
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,																
Total periods: 45																
Text Books:																
1. Eastop T.D. and Croft D.R., Energy Efficiency for Engineers and Technologists, Longman Scientific & Technical, 1990.																
2. W.R. Murphy and G. McKay, Energy Management, Butterworths, London, 1987.																
3. Pramod Verma, Energy Audit and Conservation, McGraw Hill, 2015.																
4. A. Thumann and Terry Niehus, Handbook of Energy Audits, Fairmont Press, 2010.																
References:																
1. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp , a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004																
2. Eastop.T.D& Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, ISBN-0-582-03184, 1990																
3. W.R. Murphy and G. McKay “Energy Management” Butterworths, London 1987																
4. Pratap Bhattacharyya, “Climate Change and Greenhouse Gas Emission”, New India Publishing Agency- Nipa,2020																
5. Matthew John Franchetti , Defne Apul “Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies” CRC Press,2012 6. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022																
7. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016																
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.																
Course Outcomes:													Blooms Taxonomy			
CO1: Understand the prevailing energy scenario													Understand (K2)			
CO2: Familiarise on energy audits and its relevance													Understand (K2)			
CO3: Apply the concept of energy audit on thermal utilities													Apply (K3)			
CO4: Employ relevant techniques for energy improvement in electrical utilities													Apply (K3)			
CO5: Understand Sustainable development and its impact on human resource development													Understand (K2)			
CO-PO Mapping																
Particular	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	2				2	3	2					2	1		

CO2	2	3		2	2	2	3	2					2	2	
CO3	2	3	3	2	2	2	3	2					3	2	1
CO4	2	2	3	3	2	2	3	2					3	2	2
CO5	2	2			2	2	3	2					2	1	

1 - Low, 2 - Medium, 3 - High , ‘-‘ No correlation