METHODIST COLLEGE OF ENGINEERING & TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Accredited by NBA & NAAC with A+ Grade

Approved by AICTE, New-Dehli. Affiliated to Osmania University, Hyderabad.
Abids, HYDERABAD-500001, Telangana.

M21 - SCHEME OF INSTRUCTIONS and SYLLABI of III - VIII Semesters for B.E. Four Year Degree Programme in Mechanical Engineering

(With Effect from the Academic Year 2022-23)
(As approved in Academic Council Meeting)

Empower Youth - Architects of Future World

B.E. (Mechanical Engineering)

SEMESTER - III

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6BS303HS	Numerical Methods and Partial Differential Equations	3	1	-	4	40	60	4
2	6HS303HS	Human Value and Professional Ethics	2	-	-	2	40	60	2
3	6ES301CS	Programming for Problem Solving	3	-	-	3	40	60	3
4	6PC301ME	Thermodynamics	3	-	-	3	40	60	3
5	6PC302ME	Strength of Materials	3	-	-	3	40	60	3
6	6PC303ME	Metallurgy & Material Science	3	-	-	3	40	60	3
Practical / Laboratory									
7	6ES351CS	Programming for Problem Solving Lab	-	-	2	2	40	60	1
8	6PC351ME	Metallurgy and Material Testing Lab	-	-	3	3	40	60	1.5
9	6PC352ME	Computer Aided Machine Drawing	-	-	3	3	40	60	1.5
10	6MC351ME	Solid Edge Certification Course	-	-	2	2	50	*S/U	-
Total			**17**	**1**	**10**	**28**	**410**	**540**	**22**

*S=Satisfactory, U= Unsatisfactory

B.E. (Mechanical Engineering)

SEMESTER - IV

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
1	6ES403CS	Python Programming	3	-	-	3	40	60	3
2	6PC404ME	Applied Thermodynamics	3	1	-	4	40	60	4
3	6PC405ME	Manufacturing Processes	3	-	-	3	40	60	3
4	6PC406ME	Fluid Mechanics & Hydraulic Machines	3	-	-	3	40	60	3
5	6PC407ME	Kinematics of Machines	3	1	-	4	40	60	4
6	6MC402HS	Essence of Indian Traditional Knowledge	2	-	-	2	40	60	-
7	6ES453CS	Python Programming Lab	-	-	2	2	40	60	1
8	6PC453ME	Applied Thermodynamics Lab	-	-	2	2	40	60	1
9	6PC454ME	Manufacturing Processes Lab	-	-	2	2	40	60	1
10	6PC455ME	Fluid Mechanics & Hydraulic Machines Lab	-	-	2	2	40	60	1
Total			**17**	**2**	**8**	**27**	**400**	**600**	**21**

*S=Satisfactory, U= Unsatisfactory

Note : The students have to undergo an Internship of two weeks' duration after IV semester and credits will be awarded in V semester after evaluation.

B.E. (Mechanical Engineering)

SEMESTER-V

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6HS502HS	Managerial Economics and Financial Accounting (MEFA)	3	-	-	3	40	60	3
2	6HS503HS	Effective Technical Communication	2	-	-	2	40	60	2
3	6PC508ME	Computer Aided Design & Manufacturing	3	-	-	3	40	60	3
4	6PC509ME	Design of Machine Elements I	3	1	-	4	40	60	4
5	6PC510ME	Metrology and Machine Tools	3	-	-	3	40	60	3
6	PE	Professional Elective I / MOOC's	3	-	-	3	40	60	3
7	OE	Open Elective I**	3	-	-	3	40	60	3
Practical / Laboratory									
8	6PC556ME	Metrology and Machine Tools Lab	-	-	2	2	40	60	1
9	6PC557ME	CAD/CAM Lab	-	-	2	2	40	60	1
10	6PW551ME	Internship -I	-	-	2	2	40	60	1
11	6MC552ME	Skill Development Lab-2 /Value Added Course	-	-	2	2	50	*S/U	-
Total			**20**	**1**	**8**	**29**	**450**	**600**	**24**

Professional Elective I :

1. 6PE501ME Automobile Engineering
2. 6PE502ME Experimental Stress Analysis
3. 6PE503ME Modern Machining & Forming Methods
4. 6PE504ME Advances in Welding and Joining **(MOOC's-2C)**

****O.E.I→1**. 6OE501ME Start-up Entrepreneurship.

** Subject is not offered to the students of Mech. Engg. Department.

B.E. (Mechanical Engineering)

SEMESTER-VI

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6PC611ME	Dynamics of Machines	3	1	-	4	40	60	4
2	6PC612ME	Heat Transfer	3	-	-	3	40	60	3
3	6PC613ME	Design of Machine Elements- II	3	1	-	4	40	60	4
4	OE	Open Elective II**	3	-	-	3	40	60	3
5	PE	Professional Elective II / MOOC's	3	-	-	3	40	60	3
6	PE	Professional Elective III / MOOC's	3	-	-	3	40	60	3
7	6MC603HS	Indian Constitution	2	-	-	2	40	60	-
Practical / Laboratory									
8	6HS653HS	Soft Skills Lab	-	-	2	2	40	60	1
9	6PC658ME	Theory of Machines Lab	-	-	2	2	40	60	1
10	6PC659ME	Heat Transfer Lab	-	-	2	2	40	60	1
Total			**20**	**2**	**6**	**28**	**400**	**600**	**23**

O.E.II→1. 6OE602ME 3D Printing Technologies

** Subject is not offered to the students of Mech. Engg. Department

P.E.II →

1. 6PE605ME Power Plant Engineering (MOOC's-2C)
2. 6PE606ME Industrial Tribology
3. 6PE607ME Introduction to Composites (MOOC's-3C)
4. 6PE608ME Entrepreneurship (MOOC's-3C)

P.E.III →

1. 6PE609ME Turbo Machinery
2. 6PE610ME Introduction to Mechanical Vibrations (MOOC's-2C)
3. 6PE611ME Fundamentals of Additive Manufacturing Technologies (MOOC's-3C)
4. 6PE612ME Industrial Engineering.

Note : Students have to undergo summer internship of 4 weeks at the end of semester VI and credits.

B.E. (Mechanical Engineering)

SEMESTER-VII

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6HS704HS	Operation Research	3	-	-	3	40	60	3
2	6PC714ME	Finite Element Analysis	3	-	-	3	40	60	3
3	PE	Professional Elective IV / MOOCs	3	-	-	3	40	60	3
4	OE	Open Elective III #	3	-	-	3	40	60	3
5	OE	Open Elective IV #	3	-	-	3	40	60	3
Practical / Laboratory									
6	6PC760ME	FEA Lab	-	-	2	2	40	60	1
7	6PC761ME	Automation & Robotics Lab	-	-	2	2	40	60	1
8	6PW752ME	Internship-II	-	-	4	4	40	60	2
Total			**15**	**-**	**8**	**23**	**320**	**480**	**19**

Professional Elective – 4

Course Code	Course Title
6PE713ME	Computational Fluid Dynamics (MOOC's-3C)
6PE714ME	Fundamentals of Robotics (MOOC's-3C)
6PE715ME	Mechatronics
6PE716ME	Product Design and Development (MOOC's-1C)

#Open Elective – 3

S. No.	Course Code	Course Title
1	6OE703ME	Introduction to Robotics

offered by Mechanical Engineering Department to other departments.

B.E. (Mechanical Engineering)

SEMESTER-VIII

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	PE	Professional Elective V / MOOCs	3	-	-	3	40	60	3
2	PE	Professional Elective VI / MOOCs	3	-	-	3	40	60	3
3	6PW853ME	Project Work	-	-	16	16	50	100	8
		Total	**6**	**-**	**16**	**22**	**130**	**220**	**14**

Professional Elective – 5

S. No.	PE Stream	Course Title
1	6PE817ME	Gas Dynamics and Jet Propulsion
2	6PE818ME	Automation in Production Systems
3	6PE819ME	Business Analytics
4	6PE820ME	Total Quality Management

Professional Elective – 6

S. No.	PE Stream	Course Title
1	6PE821ME	Heating Ventilation and Air Conditioning
2	6PE822ME	Operations and Supply Chain Management (MOOC's-3C)
3	6PE823ME	Electric Vehicle Technology
4	6PE824ME	Non Destructive Techniques

#Open Elective – 4

S. No.	Course Code	Course Title
1	6OE804ME	Industrial Engineering & Management

offered by Mechanical Engineering Department to other departments.

B.E. (Mechanical Engineering)

SEMESTER-III

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6BS303HS	Numerical Methods and Partial Differential Equations	3	1	-	4	40	60	4
2	6HS303HS	Human Value and Professional Ethics	2	-	-	2	40	60	2
3	6ES301CS	Programming for Problem Solving	3	-	-	3	40	60	3
4	6PC301ME	Thermodynamics	3	-	-	3	40	60	3
5	6PC302ME	Strength of Materials	3	-	-	3	40	60	3
6	6PC303ME	Metallurgy & Material Science	3	-	-	3	40	60	3
Practical / Laboratory									
7	6ES351CS	Programming for Problem Solving Lab	-	-	2	2	40	60	1
8	6PC351ME	Metallurgy and Material Testing Lab	-	-	3	3	40	60	1.5
9	6PC352ME	Computer Aided Machine Drawing	-	-	3	3	40	60	1.5
10	6MC351ME	Solid Edge Certification Course	-	-	2	2	50	*S/U	-
Total			**17**	**1**	**10**	**28**	**410**	**540**	**22**

*S=Satisfactory, U= Unsatisfactory

Course Code	Course Title						Core/Elective
3BS303HS	NUMERICAL METHODS & PARTIAL DIFFERENTIAL EQUATIONS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basic Differentiation, Integration and Trignometric results.	3	1	-	-	40	60	4

COURSE OBJECTIVES:

It is intended to make the students to learn :

- To learn an alternative methods and analytical methods in mathematical concepts.
- To apply numerical techniques in solving ordinary differential equations.
- To study Interpolation and numerical methods to fit a curve
- To formulate and solve partial differential equations.
- To study physical applications of partial differential equations

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Find the solution of algebraic and transcendental equations using numerical methods.

CO2: Apply numerical techniques to solve ordinary differential equations and definite integrals.

CO3: Apply numerical methods to interpolate values and fit different curves from given data.

CO4: Find solutions of first order linear and non linear partial differential equations.

CO5: Apply the solution of partial differential equations to physical problems.

UNIT-I

Numerical Solutions of Algebraic and Transcendental Equations: Introduction, Bisection Method, Regula-False method, Iteration method and Newton Raphson method. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidel method.

UNIT-II

Numerical integration: Trapezoidal Rule, Simpson's 1/3rd and 3/8th Rule. Numerical solutions of Ordinary Differential Equations: Solution of ordinary differential equations by Taylor's Series, Picard's method of Successive approximations, Euler's and Modified Euler's methods, Fourth Order Runge-Kutta Method.

UNIT-III

Interpolation: Newton's Forward and Backward difference interpolations, Lagrange's interpolation, Newton's divided difference interpolation. Curve Fitting: Fitting a linear, second degree, exponential curve by method of least squares for the discrete data.

UNIT-IV

Differential Equations: Formation of first and second order partial differential equations, solution of first order equations, Lagrange's equation, Nonlinear first order equations, Charpit's method, higher order linear equations with constant coefficients.

UNIT-V

Applications to Partial Differential Equations: Classification of linear second order partial differential equations, Separation of variables method , solution of one dimensional heat and wave equations, Two dimensional Laplace's equation.

TEXT BOOKS :

1. Dr.B.S.Grewal, Higher. Engineering Mathematics, Khanna Publicatins, 43rd Edition.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd.
3. B.V.Ramana, Higher Engineering Mathematics, 3rd Edition.

REFERENCE BOOKS :

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 9th Edition.
2. M.K.Jain, S.R.K.Iyengar and R.K. Jain, Numerical Methods for Science and Engineering Computation,6th Edition, New Age International Publishers.
3. Peter. V. O' Neil, Advance Engineering Mathematics, 7th Edition.

Course Code	Course Title						Core/Elective
6HS303HS	HUMAN VALUES AND PROFESSIONAL ETHICS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	2	0	0	0	40	60	2

COURSE OBJECTIVES:

The following are the Objectives of the Course:

1. To create an awareness on Human Values and Engineering Ethics.
2. To move from discrimination to commitment.
3. To understand social responsibility of an engineer.
4. To appreciate ethical dilemma while discharging duties in professional life.
5. To encourage students to discover what they consider valuable in life.

COURSE OUTCOMES:

After completing the course, student will be able to:

- Understand the significance of value inputs in a classroom and start applying them in their life and profession
- Assess their own ethical values and the social context of problems
- Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
- Understand the role of a human being in ensuring harmony in society and nature.
- Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

COURSE CONTENT :

UNIT-I : Introduction to Value Education

1. Value Education, Definition, Concept and Need for Value Education
2. The Content and Process of Value Education
3. Self-Exploration as a means of Value Education
4. Happiness -Sukh, Suvidha, Sanyam & Swasthya.

UNIT-II : Harmony in the Human Being

1. Human Being is more than just the Body
2. Harmony of the Self ('I') with the Body
3. Understanding Myself as Co-existence of the Self and the Body
4. Understanding Needs of the Self and the Needs of the Body

UNIT-III: Harmony in the Family and Society and Harmony in Nature

1. Family as a basic unit of Human Interaction and Values in Relationships
2. The Dynamics of Mutual respect in Today's World – Affection, Care, Guidance, Reverence, Gratitude and Love.
3. Comprehensive Human Goals: The Five dimensions of Human Endeavour – Justice, Trust, Competence, Right Attitude and Mutual Tolerance

UNIT-IV: Social Ethics

1. The Basics for Ethical Human conduct
2. Challenges to ethical conduct in existence
3. Holistic perception of Harmony in existence
4. Social Hierarchy - Ethical Conduct and Mutual Co-existence

UNIT-V: Professional Ethics

1. Sanctity of Human values
2. Definitiveness of Ethical Human Conduct
3. Basics for Humanistic Education

TEXT BOOKS :

1. A.N Tripathy, "Human Values", New Age International Publishers, 2003.
2. T2. Bajpai. B. L., Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics, Taylor and Francis, 2007

REFERENCE BOOKS :

1. Corliss Lamont, Philosophy of Humanism, Humanist Press
2. Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books.
3. Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books.
4. Mortimer. J. Adler, – Whatman has made of man, Hardcover.

Course Code	Course Title						Core/Elective
6ES301CS	PROGRAMMING FOR PROBLEM SOLVING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mathematical Knowledge, Logical and Analytical Thinking	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1. To introduce the basic concepts of Computing environment, algorithms and flowcharts
2. To acquire knowledge about the basic concept of writing a program
3. To understand modular and structured programming constructs in C
4. To learn the usage of structured data types, data handling and memory management using pointers

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Formulate algorithms and learn fundamental program methodologies of C programming.
2. Understand control statements and interpret derived data types with mathematical and engineering problems.
3. Develop modular programming techniques to solve searching, sorting and file system.
4. problems. Recognize pre-processor directives and user defined usage.

UNIT – I

Introduction to Computers: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Algorithm, Flowchart / Pseudo code with examples

Introduction to C Language: History of C, Features, Structure of C program, Character set, Tokens, Variables, Data types, I/O statements, Type conversion Syntax and Logical Errors in compilation, object and executable code.

UNIT – II

Operators and Control Structures: Operators, Operator precedence, Arithmetic expressions, Conditional Branching and Loops, Writing and valuation of conditionals and consequent branching Arrays: Arrays (1-D, 2-D), Strings and its library functions.

UNIT – III

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble and Selection).

Functions: Functions, storage classes, Parameter passing techniques passing arrays to functions, Recursion Concept, Command line arguments.

UNIT – IV

Pointers: Idea of pointers, Defining pointers, array of pointers, pointer arithmetic, dynamic memory allocation,

Structure: Structures, Defining structures and Array of Structures, self – referential structures, Unions concept, Functions and structures, Enum, Bit fields.

UNIT – V

Pre-processor Directives : File Inclusion, Macros Substitutions, Conditional **Compilation. File Handling :** Introduction to File Handling, Types of files, File operations, File input/output statements.

TEXT BOOKS:

1. Computer Science A structured programming approach using C, Behrouz A. Forouzan and Richard F. Gilberg , Cengage Learning .
2. Schaum's Outline of Programming with C, Byron Gottfried, McGraw-Hill.
3. Data Structures and Program Design in C, Robert Kruse, Bruce Leung, Tondo, Pearson.

REFERENCE BOOKS :

1. C Programming Language, Brian W Kenningham, Dennis M Ritchie, Pearson.
2. How to solve it by Computer, R G Dromey, Pearson Edition.

Course Code	Course Title						Core/Elective
6PC301ME	THERMODYANAMICS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basics of Physics, Chemistry and Engineering mathematics	3	-	-	0	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

1. To familiarize the students to understand the fundamentals of thermodynamics
2. To understand laws of thermodynamic.
3. To understand power cycles and derivation.
4. To perform thermal analysis on their behavior and performance.
5. To make use of standard and approved Steam Table, Mollier Chart, and Psychrometric Chart.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Apply concept of temperature andtemperature scale

CO2. Apply the first law of thermodynamicsfor simple open and closed systems under steady and unsteady conditions.

CO3. Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.

CO4. Apply Rankine cycle to steam power plant and compare few cycle improvement methods

CO5. Derive simple thermodynamic relationsof ideal and real gases

UNIT-I:

Introduction: Basic Concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work transfer and Heat transfer, Point and Path function. Thermodynamic Equillibrium. Zeroth Law of Thermodynamics– Concept of Temperature.

– Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

UNIT-II:

Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process and cycle – applied to a flow system – Steady Flow Energy Equation. PMM-I, throttling and free expansion processes – Equation of state for ideal gas, deviations from perfect gas model – Vanderwaals equation of state – compressibility charts –specific heats and gas constant.

UNIT-III:

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and itsspecialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility, PMM-III – Thermodynamic Potentials, [Gibbs and Helmholtz Functions, Introduction to Maxwell Relations] – Elementary Treatment of the Third Law of Thermodynamics.

UNIT-IV:

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Mixture of Gases: Mole fraction and mass fraction, Partial pressure and Dalton's Law, Amagat-Leduc Law of Partial volumes, Relation between partial pressure, mole fraction and volume fraction; Gas Constant, molecular mass and specific heats of the gas mixtures; relation between volumetric and gravimetric analysis

UNIT-V:

Power Cycles: Otto, Diesel, Dual Combustion cycles, Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Brayton and Rankine cycles- performance evaluation.

Refrigeration Cycles:– Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:

1. Nag.P.K "Engineering Thermodynamics" 5th Edition, Tata McGraw-Hill, N-Delhi.
2. R.K.Rajput, "A Text Book Of Engineering Thermodynamics
3. Yunus a. Cengel & michael a. Boles, "Thermodynamics".

REFERENCE BOOKS :

1. Fundamentals of Thermodynamics- Sonntag R.E., Borgnakke C. & Van Wylen C. J.
2. Fundamentals of Engineering Thermodynamics -Moran M. J. & Shapiro H. N.
3. Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner.
4. Applied Thermodynamics -- Eastop T.D. & Mc conkey A.
5. Engineering Thermodynamics -- Rogers G.F.C. & Mayhew Y.R.

Course Code	Course Title						Core/Elective
6PC302ME	STRENGTH OF MATERIALS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Engineering	L	T	D	P			
Mechanics	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To understand the basic concept of stress and strains for different materials
- To know the mechanism of the development of shear force and bending moment in beams and the stresses in thin cylinders.
- To know the theory of simple bending, direct & bending stress and distribution of shear stress.
- To analyse and understand shear stress, Torsional stress and spring applications
- To study the deflections and its applications

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Explain the theory of elasticity including strain displacement and Hooke's law relationships and analyzing Stress-Strain diagram.

CO2. Analyse the shear forces and bending moment diagrams with various types of loads CO3. Evaluate the bending and shear stresses in beams and Strain energy in bars due to various loads.

CO4. Evaluate the slope and deflections in beams subjected to transverse loads.

CO5. Analyze various situations of structural members subjected to combined stresses andsolve the torsion problems in bars and stiffness of springs.

UNIT – I

Simple stresses and strains: Types of Stresses and Strains. Hook's Law, Stress-Strain curve for Ductile materials, Modulus of Elasticity, Poisson's ratio, Volumetric strain, Relation between Elastic Constants, Bars of varying sections, Bars of Uniform Strength, Compound bars and Temperature stresses.

Compound Stresses: Stresses on oblique planes, principal stresses and principal planes. Mohr circle of stresses.

UNIT-II

Shear Force and Bending Moment: Relation between Intensity of loading, Shear force and Bending moment. Shear force and Bending moment diagrams for Cantilever and Simply supported and Overhanging beams with Point load, Uniformly distributed load and Uniformly varying loads.

Thin Cylinders: Derivation of formulae for longitudinal stress, Circumferential (hoop) stress, Volumetric strains, Changes in diameter and volume.

UNIT-III

Theory of simple bending: Introduction, Derivation of bending equation: M/I = F/y = E/R Modulus of Section, Moment of Resistance.

Direct and Bending Stresses: Basic concepts, Core of sections for Rectangular, Solid and Hollow Circular and I sections.

Distribution of Shear stress: Equation of Shear stress, Distribution across Rectangular sections.

UNIT-IV

Deflections: Deflections of Cantilever and Simply Supported Beams including Overhanging beams for Point loads and Uniformly Distributed Loads by double integration and Macaulay's methods.

Strain Energy: Strain Energy in bars due to Gradually Applied loads, Sudden Loads, Impact loads and Shock loads.

UNIT-V

Torsion-Theory of Pure Torsion- Derivation of basic equation T/J = q/R = G?/L and Hollow circular shafts, Transmission of power, Combined Bending and Torsion.

Springs: Close and open coiled Helical springs subjected to Axial loads and Axial couples, strain energy in springs.

TEXT BOOKS :

1. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons.
2. Dr. R K bansal, Strength of Materials- Laxmi Publications.

REFERENCE BOOKS :

1. R.K. Rajput, Strength of Materials, S. Chand & Co.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi.
3. Ferdinand P Beer et.al. Mechanics of Materials, Tata McGraw-Hill.
4. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan Indian Limited, Delhi.
5. S.S. Bhavikatti, Strength of Materials, Vikas Publications.
6. D.S. Prakash Rao, Strength of Materials – A practical Approach, Universities Press.

Course Code	Course Title						Core/Elective
6PC303ME	METALLURGY & MATERIAL SCIENCE						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Physics & Chemistry	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Enable to understand structure property relations, analyse the failures of metals and their prevention.
- To broad understanding of phase diagrams.
- Acquire basic knowledge in various heat treatment operations, their purpose and applications.
- Understand various modes of failure and suggest mechanisms for preventions of failures.
- Understand applications of conventional metals and alloys.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1: Explain the structure of materials at various levels and testing their mechanical properties CO 2: Describe fatigue, creep failure and experimentally determine fatigue, creep strength, also list different types of fracture.

CO 3: Explain phase diagrams and identify various phases, composition by analyzing the phase diagrams.

CO 4: Classify different types of plain carbon steels & cast irons, explain various heat treatment techniques applied to steels,

CO 5: Explain the properties of non-ferrous metals, ceramics, polymers, composites and choose a particular material for an application.

UNIT-I

Introduction to Materials engineering, Space lattice, unit cell, crystal structure, crystal directions and planes, crystal imperfections. Effect of slip and twinning on the plastic deformation, Hall-Petch equation, Orange peel effect, cold and hot working, strain hardening and Bauchinger effect. Recovery, Recrystallisation, Grain growth and its effect on mechanical properties of metals.

Mechanical properties of materials- Tensile properties, stress-strain diagrams, elasticity, plasticity, ductility, toughness, modulus of elasticity, resolved shear stress, tensile and compression test, hardness and its measurement, Charpy and Izod impact tests.

UNIT-II:

Fracture: Ductile and Brittle fracture, modes of fracture, ductile to brittle transition, crack initiation and propagation.

Fatigue: S-N curve, Structure of fatigue fracture specimen, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Experimental determination of fatigue strength (RR-Moore Test). Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep Test, Differences between creep curve and stress rupture curve.

UNIT-III

Structure of Alloys: Types of solid solution, Hume Rothary's rules for Substitutional solid solutions, Intermediate phases and phase rule Construction and interpretation of Binary equilibrium diagram, Isomorphous, Eutectic and Peritectic diagrams, Iron-Iron Carbide equilibrium diagram, construction and interpretation. Types of Plain Carbon Steels, CastIron and their properties and Characteristics.

UNIT-IV

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon Tungsten, Titanium. Study about Stainless steels, HSS, Maraging steels, their composition and Properties.

Heat Treatment: Annealing, Normalising, Hardening, Tempering, Construction and interpretation of T.T.T Curve. Austempering and Martempering. Case Hardening: Carburising, Nitriding, Carbo-nitriding, Flame Hardening, Induction Hardening. Brief introduction of Age Hardening.

UNIT-V

Non-ferrous metals and alloys: Properties and applications of Copper and its alloys, Aluminium and itsalloys, Age hardening, Ti and its alloys, Ni- based alloys, their composition and properties. Ceramics, Polymers and Composites: Ceramics, crystalline ceramics, glasses, properties and applications of ceramics, polymers-polymerization, thermoplastics and thermosetting plastics, properties and applications of polymers. Composites: concept of composites, matrix and reinforcement, rule of mixtures, classification of composites, applications of composites.

TEXT BOOKS :

1. V.D.Kodgiri, Material Science And Metallurgy For Engineers, Everest Publishing House
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill.
3. S.P. Nayak, Engineering Metallurgy and Material Science, Charotar Publishing House.

REFERENCE BOOKS :

1. E. Dieter, Mechanical Metallurgy, Metric Editions, Tata McGraw Hill.
2. Robert M Jones, Mechanics of Composite Materials, Taylor and Francis.
3. V.Raghavan, Material Science and Engineering, Prentice Hall of India Ltd.

Course Code	Course Title						Core/Elective
6ES351CS	PROGRAMMING FOR PROBLEM SOLVING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-	-	2	40	60	1

COURSE OBJECTIVES:

The objective of this course is to make the student

1. Understand the fundamentals of programming in C Language.
2. Write, compile and debug programs in C.
3. Formulate solution to problems and implement in C.
4. Effectively choose programming components to solve computing problems

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Choose appropriate data type for implementing programs in C language
2. Design and implement modular programs involving input output operations, decision making and looping constructs
3. Apply derived data types and implement programs to store data in structures and files
4. Develop confidence for self-education and ability towards lifelong learning need of computer languages.

LIST OF EXPERIMENTS

1. Finding maximum and minimum of given set of numbers, finding roots of quadratic equation.
2. Sin x and Cos x values using series expansion.
3. Generating Pascal triangle, pyramid of numbers.
4. Factorial, Fibonacci, GCD recursive and non-recursive procedures
5. Linear search and binary search using recursive and non-recursive procedures.
6. Bubble sort and selection sort.
7. Matrix addition and multiplication using arrays,
8. Programs on pointers: pointer to arrays, pointer to functions.
9. Programs on structures, union, enum and string manipulations.
10. File handling programs (Reading, Writing, Copying files) 11.Program illustrating using Command Line Arguments.

Course Code	Course Title						Core/Elective
6PC351ME	METALLURGY & MATERIAL TESTING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg. Chemistry	-	-	-	3	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to :

- Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
- Expose to Metallographic study and analysis of various metals.
- Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
- Understand differences between different heat treatment methods.
- Expose to T-T-T curve and its application in engineering metallurgy.
- Understand the relation between micro structure and properties.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Prepare specimen for metallographic observation

CO.2 Analyse and identify low, medium and high carbon steels, different types of cast irons,non-ferrous alloys, from the study of their microstructure

CO3. Underlines the importance of grain size in evaluating the desired mechanical properties.

CO4. Correlate the heat treatment methods and the mechanical properties obtained.

CO5. Analyse and identify microstructures after annealing, normalizing, hardening and tempering.

LIST OF EXPERIMENTS:

A: Metallurgy Experiments:

1. Study of: Metallurgical Microscope, Iron-Iron Carbide diagram, Procedure for specimen preparation.
2. Metallographic Study of Pure Iron& Low carbon steel.

3. Metallographic Study of Medium carbon steel, Eutectoid steel& Hyper Eutectoid steel.
4. Metallographic Study of, White cast-iron, Malleable cast iron, Nodular cast iron &Grey cast-iron.
5. Metallographic Study of Aluminium, Brass & Bronze.
6. Jominy Quench test or Study of microstructure after heat treatment.
7. Heat treatment of Metals, Annealing, Normalizing and Quenching.

B: Materials testing Lab

1. Uni-axial tension test, to draw stress- strain diagram, and estimate modulus of elasticity, % of elongation and toughness.
2. To determine the impact strength of specimen by conducting Charpy & Izod tests.
3. To find the Hardness number for the given metal specimen using Brinell and Rockwel hardness testers.
4. To determine the Rigidity Modulus of the given specimen by conducting Torsion Test.
5. To determine the Young's Modulus (E) of given material by conducting the deflection test on Cantilever beam, simply supported beam

   To determine the stiffness and rigidity modulus of the given spring by Conducting compression tension tests.

Note : At least ten experiments should be conducted in the Semester

Course Code	Course Title						Core/Elective
6PC352ME	COMPUTER AIDED MACHINE DRAWING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg Graphics	-	-	-	3	40	60	1.5

COURSE OBJECTIVES:

It is intended to make the students to :

1. Read & Interpret technical drawings correctly.
2. Learn the use of CAD software - non-parametric & parametric.
3. Learn drawings of orthographic views of simple machine components.
4. Learn part modelling of assemblies using parametric software
5. Learn Assembly & motion analysis using parametric software
6. Learn generation of orthographic views & BOM Tables using parametric software

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Create templates for reuse in AutoCAD with suitable conventions.

CO2. Apply AutoCAD commands to draft orthographic views of machine parts to contain all technical details.

CO3. Apply the knowledge of draft orthographic views of assemblies like Rivets, Fasteners, Joints & Couplings.

CO4. Use parametric software to model parts of machine assemblies in 3D.

CO5. Use parametric software to generate drawings of machine parts & assemblies with Bill of Materials & Ballooning.

LIST OF EXPERIMENTS

Part A - AutoCAD

1. Creating templates with drawing layouts, title blocks, linetypes, lineweights, colours & blocks.
2. Orthographic views of sectioned machine components.
3. Riveted & screwed joints.

4. Joints - Socket Spigot Joint & Knuckle Joint.
5. Couplings - Flanged Coupling & Universal Coupling.

Part B - Solidworks / Creo Elements Pro / Solid Edge / Fusion 360 / Inventor

6. Modelling & part drawings of all parts from Screw Jack assembly.
7. Assembly & its Drawings of screw jack assembly along with Bill of Materials & balloon labelling.
8. Modelling of all parts from Stuffing Box assembly.
9. Modelling of all parts of Plummer Block assembly.
10. Assembly & drawings of the Crosshead assembly.
11. Assembly & drawings of the Tail stock assembly.
12. Assembly & drawings of the Machine Vice Assembly.
13. Assembly & drawings of the Eccentric Assembly.

Course Code	Course Title						Core/Elective
6MC351ME	SOLID EDGE CERTIFICATON COURSE						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Auto CAD	-	-	2	-	50	*S/U	-

COURSE OBJECTIVES:

- To train students to use synchronous and ordered modelling techniques for modelling mechanical parts in solid edge.
- To train students in assembling, finding interferences & carrying out motion analysis of complex machinery using solid edge.
- To train students in modifying geometries imported in neutral formats like IGES, STEP & Para-solid as per requirements.
- To train students in using solid edge simulations to analyse & optimise parts & assemblies.
- To train the students in developing drawings & rendered images of products.

COURSE OUTCOMES

After going through this course, the students will be able to

1. Model 3D mechanical parts using synchronous and ordered modelling techniques in solid edge.
2. Assemble, find interference & analyse motion of complex machinery using solid edge.
3. Modify geometries imported in neutral formats like IGES, STEP & Para-solid as per requirements.
4. Carry out simulations to analyse & optimise parts & assemblies using solid edge.
5. Understand development of production drawings & tools to produce rendered images of products.

1. Introduction to Solid-edge, Registration for Educational Version & Installation, Solid Edge Help & Learning Tools, Environments, User Interface, Creating, Opening & Saving Solid Edge Files.
2. Sketch Plane Locking, Creation of sketches, Sketch regions, Sketch tools, Using Intellisketch, Manipulating tools, Relationships to sketches, Dimension types, Reference Planes, Reference Plane Creation, Creating base features

3. Modelling Exercises on sketches & using inspection tools to find areas, perimeters.
4. Modelling exercises on simple machine parts & using inspection tools to verify volume, mass, Moments of inertia.
5. Modifying exercises by Moving faces, Steering Wheel, Rotating faces, Selecting faces, Design Intent, Relate Faces
6. Exercises on constructing assembly & applying motion constraints on parts placed into the assembly.
7. Creating 2D drawings from a part or assembly, Placing multiple views of assemblies, Modifying drawing views, Creating additional drawing sheets
8. Open models from Draft to edit, Tracking changes in model dimensions within a drawing, Dimensioning of drawings, Annotation of drawings
9. Introduction to simulation using Solid-edge, List of studies that can be simulated, experiments using parameters.
10. Introduction to Key-Shot rendering. Rendering of Derby Car Exercise

B.E. (Mechanical Engineering)

SEMESTER - IV

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6ES403CS	Python Programming	3	-	-	3	40	60	3
2	6PC404ME	Applied Thermodynamics	3	1	-	4	40	60	4
3	6PC405ME	Manufacturing Processes	3	-	-	3	40	60	3
4	6PC406ME	Fluid Mechanics & Hydraulic Machines	3	-	-	3	40	60	3
5	6PC407ME	Kinematics of Machines	3	1	-	4	40	60	4
6	6MC402HS	Essence of Indian Traditional Knowledge	2	-	-	2	40	60	-
Practical / Laboratory									
7	6ES453CS	Python Programming Lab	-	-	2	2	40	60	1
8	6PC453ME	Applied Thermodynamics Lab	-	-	2	2	40	60	1
9	6PC454ME	Manufacturing Processes Lab	-	-	2	2	40	60	1
10	6PC455ME	Fluid Mechanics & Hydraulic Machines Lab	-	-	2	2	40	60	1
Total			**17**	**2**	**8**	**27**	**400**	**600**	**21**

*S=Satisfactory, U= Unsatisfactory

Note : The students have to undergo an Internship of two weeks' duration after IV semester and credits will be awarded in V semester after evaluation.

Course Code	Course Title						Core/Elective
6ES403CS	PYTHON PROGRAMMING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Experience with a high level language (C/C++, Java, MATLAB)is suggested.	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1. To be able to introduce core programming basics and program design with functions using Python programming language.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand the high-performance programs designed to strengthen the practical expertise

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Create, run and manipulate Python Programs using core data structures like Lists, Tuples and Dictionaries.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Create and animate a variety of shapes and develop an application with graphical user interface (GUI).
6. Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

UNIT-I

Introduction to Python: installing Python, basic syntax, interactive shell, editing, saving, and running a script. The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators and expressions, comments in the program, understanding error messages. Conditions, Boolean logic, logical operators, ranges, Control statements.

UNIT-II

Strings and Files: Strings and text files, manipulating files and directories, os and sys modules, text files: reading/writing text and numbers from/to a file, creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string, strings and number system: converting strings to numbers and vice versa.

Lists, Tuples, and Dictionaries:

Basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries

UNIT-III

Design with functions: Hiding redundancy, complexity, arguments and return values, formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

Classes and OOP: Classes, objects, attributes and methods, defining classes, design with classes, data modeling, persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc), abstract classes, exception handling, try block.

UNIT-IV

Simple Algorithms and Data structures: Search Algorithms, Sorting Algorithms, Hash Tables

Simple Graphics and Image Processing: "Turtle" module, simple 2d drawing - colors, shapes, digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc).

UNIT-V

Graphical user interfaces: Event-driven programming paradigm, tkinter, module, creating simple GUI, buttons, labels, entry fields, dialogs, widget attributes - sizes, fonts, colors layouts, nested frames.

Multithreading, Networks, and Client/Server Programming: Introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages, CGI programming, programming a simple CGI form

TEXT BOOKS

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2nd Edition, 2017, Cengage Learning.

2. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

REFERENCE BOOKS

1. Mark Summerfield. - Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,,,,, 2nd edition, Updated for Python 3, Shroff/O,,Reilly Publishers, 2016
3. NPTEL Course, Programming, Data Structures and Algorithms using Python, Link: https://nptel.ac.in/courses/106106145
4. NPTEL Course, The Joy of Computing using Python, Link: https://nptel.ac.in/courses/106106182
5. FOSSEE, Python, Link: https://python.fossee.in/

Course Code	Course Title						Core/Elective
6PC404ME	APPLIED THERMODYNAMICS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
THERMODYNAMICS	3	1	-	-	40	60	4

COURSE OBJECTIVES:

It is intended to make the students to :

- Describe the types and working principle of reciprocating air compressors.
- Explain the construction and working principles of internal combustion engines
- Discuss the combustion phenomenon in petrol and diesel engines.
- Classify and explain the working principles of steam boilers and condensers
- Analyze vapour power cycles and steam nozzles.

COURSE OUTCOMES :

After completing the course, the students will be able to

1. Analyze the behavior of reciprocating compressors.
2. Explain the thermal design and working principles of IC Engines and their supporting systems
3. Describe the working principle of IC Engines and combustion phenomenon of SI and CI engines and thermal design of Combustion chambers.
4. Explain the thermal design and working principles of Power plant devices like Boilers, Condensers and Nozzles.
5. Analyze the performance of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration.

UNIT-I:

Reciprocating Air Compressors: Applications of compressed air, Classification of compressors- single stage and multistage compressors, Derivation of work done with and without clearance volume, Work done of multistage compressors, effect of clearance volume on work done, Inter- cooling and After-cooling.

UNIT-II:

Internal Combustion Engines: Classification of IC engines, working principle of 2 stroke, 4 stroke SI and CI engines, Valve and Port-timing diagrams,

Engine systems: Battery and Magneto ignition systems, working principle of simple carburettor and its limitations, Multipoint fuel injection system, Lubrication systems, cooling systems.

Performance of I.C Engines: Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, and volumetric efficiency, specific fuel consumption based on brake power and indicated power. Heat balance sheet, Morse Test.

UNIT-III:

I.C. Engine Combustion phenomena: Stages of combustion in S.I. Engines- Ignition lag, Flame front propagation and after burning. Abnormal combustion- Pre-ignition and Knocking. Factors affecting Knocking. Stages of combustion in C.I. Engines, Delay period, Period of Uncontrolled Combustion, Period of Controlled Combustion and After Burning. Abnormal Combustion-Knocking. Factors affecting Knocking. Octane and Cetane rating of fuels. Types of combustion chambers of S.I. engines and C.I. engines.

UNIT-IV:

Steam power plant : Working of Carnot and Rankine cycles, cycle analysis, Modified Rankine cycle, Cycle efficiency improvement methods: Reheating and Regeneration.

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle. Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio. Diameters of nozzle throat and exit for maximum discharge.

UNIT-V:

Steam Boilers : Classification and Working Principles.

Water tube boilers - Babcok & Wilcox and Stirling boilers.

Fire tube boilers - Cornish, Cochran, Locomotive and Lancashire boilers.

High Pressure boilers / Supercritical boilers: La-mont, Benson boiler, Loeffler boiler and Velox boiler. Boiler Mountings and Accessories. Boiler Draught.

Steam Condensers: Jet and Surface condensers, Principle of Operation and Applications.

TEXT BOOKS :

1. Ganeshan.V, "Internal Combustion Engines", Tata McGraw- Hill Education Pvt. Ltd.
2. Rajput. R. K, "Thermal Engineering" Laxmi Publishers.

REFERENCE BOOKS :

1. Eastop. T.D.,Mc Conkey. A, " Applied Thermodynamics for Engineering Technologists", Pearson Education.
2. Heywood. J.B, "Internal Combustion Engine Fundamentals ", Tata McGraw Education Pvt. Ltd.
3. Ballaney. P.L, "Thermal Engineering", Khanna Publishers
4. Mahesh M Rathor, "Thermal Engineering" Tata McGraw Education Pvt. Ltd
5. ISI Steam Tables in SI units, Indian Standards Institution, New Delhi, SP: 26-1983.

Course Code	Course Title						Core/Elective
6PC405ME	MANUFACTURING PROCESSES						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To understand the basic principles of major manufacturing processes such as metal casting, welding and forming of engineering materials.
- To know the advantages and limitations of each process.
- To be able to select the optimal process to produce a product.
- To know the basic principle of advanced forming processes

COURSE OUTCOMES :

After completing the course, the students will be able to

CO 1. Describe the concepts of Foundry Technologies consisting of pattern making, mould making, gating design and solidification.

CO 2. Discuss the importance of special casting processes, categorize various casting defects and describe the processing of plastics and powder metallurgy concepts.

CO 3. Classify and differentiate various Arc welding, Gas welding and Advanced welding processes, discuss their advantages, applications and limitations.

CO 4. Differentiate various Solid State welding and Resistance welding processes, discuss their applications, and identify various welding defects.

CO 5. Describe various forming processes, sheet metal operations and discuss the importance of unconventional forming processes.

UNIT-I

Casting Process : Casting terms, pattern materials, types of patterns, pattern allowances, colour code for patterns, Moulding sands, core sands, properties of moulding sand and its ingredients, different types of moulding machines, Directional solidification, use of chaplets, chills, gating and risering systems. Melting of metals and alloys.

UNIT-II:

Special Casting Processes: Shell moulding, CO2 moulding, die casting, centrifugal casting, investment or lost wax process; Casting defects, causes and remedies, Inspection and testing of castings.

Processing of Plastics - Extrusion, Injection moulding, Blow moulding and Thermoforming. Introduction to Powder Metallurgy- Process, Production of powders, blending, mixing, compaction techniques and finishing operations employed in powder metallurgy processes

UNIT-III

Welding Processes: Introduction, Classification of welding processes, principle of gas welding, gas welding equipment and techniques, types of flames and applications, advantages, limitations and applications of gas welding. Arc welding equipment electrode materials and specifications, polarity, types of arc welding.- SMAW, SAW, GMAW, GTAW, PAW, EBW, LBW, Atomic hydrogen welding, principle of Electro slag welding,

Thermit welding. Gas cutting, Brazing and Soldering.

UNIT-IV

Solid State Welding Process : Forge Welding, Friction Welding, Friction Stir Welding, Explosive Welding and Ultrasonic welding.

Resistance welding processes - Spot welding, Seam welding, Projection welding, Butt Welding.

Weldability and Welding defects.

UNIT-V

Forming Processes: Cold & Hot working, Process description of Forging, Rolling, Extrusion and Drawing operations.

Sheet Metal Operations: Blanking, Piercing, Bending, Deep drawing, Stretch forming, Spinning.

Advance Forming Processes- High energy rate forming processes such as Explosive forming, Electro- magnetic forming and Electro-hydraulic forming; Rubber pad forming.

TEXT BOOKS :

1. P.N. Rao, ?Manufacturing Technology,? Vol. 1, Tata McGraw Hill Publ.
2. J.P.Kaushish, "Manufacturing Processes", PHI Learning Pvt. Ltd.

REFERENCE BOOKS :

1. Amitabh Ghosh & Mallick, ?Manufacturing Science?, Assoc. East west Press Pvt. Ltd.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", Pearson Education.
3. Serope Kalpakjian, ?Manufacturing Engineering and Technology?, Pearson Education.
4. George. E. Dieter, "Mechanical Metallurgy", SI Metric Edition McGraw-Hill BookCompany.

Course Code	Course Title						Core/Elective
6PC406ME	FLUID MECHANICS & HYDRAULIC MACHINERY						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mathematics & Mechanics	3	-	-	-	40	60	3

COURSE OBJECTIVES

It is intended to make the students to :

1. Know various fluid properties, concepts and methods of fluid measurement.
2. Understand the basic concepts and principle of fluid flow.
3. Study different equations of fluid motion and fluid dynamics.
4. Analyze different flow characteristics of laminar flows.
5. Understand the working principle of hydraulic turbines and pumps and their performance.

COURSE OUTCOMES(CO):

After completing the course, student will be able to:

1. Understand the properties of Fluids and measurement of pressure by various devices.
2. Explain different types of flows and flow measuring devices and apply the energy equations.
3. Analyze the flow between Series and Parallel plates and examine the energy losses in pipes.
4. Understand the working principles of various Pumps and Turbines.
5. Design Impulse and Reaction turbines and evaluate the performance of various turbines.

UNIT – I

Basic Concepts and Properties of Fluid : Definition of Fluid, distinction between solid and fluid, Properties of fluids, density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary, surface tension, units and dimensions.

Fluid statics : Concept of fluid static pressure, Pascal's Law, absolute, gauge and Vacuum pressures, pressure measurements by piezometer, manometers and pressure gauges.

UNIT-II

Fluid Kinematics : Description of fluid flow, types of flow, Lagrangian and Eulerian approach, velocity field and acceleration, Continuity equation 1D and 3D differential forms, streamline, streak line, path line, time line, stream tube, stream function, velocity potential function, vorticity, circulation, rotation, flow net.

Fluid Dynamics : Equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications.

Venturi meter, Orifice meter, Pitot tube, Impulse-Momentum Equation, buoyancy, submerged bodies.

UNIT-III

Incompressible Fluid Flow : Viscous flow, Shear stress-pressure gradient relationship, laminar flow between parallel plates, Laminar flow through circular tubes (Hagen poiseulle's), Hydraulic and energy gradient lines, total energy line.

Flow through pipes : Darcy- Weisbach's equation, pipe roughness, friction factor, minor losses, flow through pipes in series and parallel, Boundary layer flows, boundary layer thickness, boundary layer separation, drag and lift coefficients.

UNIT-IV

Hydraulic Turbines : Definition and classifications, Pelton turbine, Francis turbine, propeller turbine, Kaplan turbine, working principles, velocity triangles, work done, specific speed, Efficiencies, Unit quantities, performance curves.

UNIT-V

Hydraulic Pumps : Definition and classifications. Centrifugal pump: classification, working principles, velocity triangles, specific speed, efficiency, priming, surging, cavitation in pumps and performance curves.

Reciprocating pump: Classification, working principle, indicator diagram, Air vessels, Separation of pumps

Rotary pumps: working principles of gear and vane pumps.

TEXT BOOKS :

1. Modi & Seth "Hydraulics and Fluid Mechanics" – standard book house.
2. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd. Delhi.

REFERENCE BOOKS :

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill.
2. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi.
3. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", TataMcGraw- Hill, 2nd edition.
4. Kumar D. S., "Fluid Mechanics and Fluid Power Engineering", S. K. Kataria & Sons.

Course Code	Course Title						Core/Elective
6PC407ME	KINEMATICS OF MACHINES						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg Mechanics	3	1	-	-	30	70	4

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the basic terminology & principles of kinematics related to machines.
- Study functioning of quadric chains & their inversions.
- Study useful mechanisms & understand their functioning.
- Study analysis of position, velocity & acceleration of parts in a machine.
- Study conversion of uniform rotary motion to specified linear & oscillating motion.
- Study gears for positive motion transmission.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Identify links & joints, determine mobility & explain motion of a connected system of links

CO 2. Analyse motion of planar mechanisms & their equivalent chains.

CO 3. Identify & explain the applications of commonly used mechanisms.

CO 4. Solve problems involving velocity & acceleration of planar mechanisms with given dimensions at specified positions.

CO 5. design gear trains for specified speed ratios and cams & followers for specified motion profiles

UNIT-I: Kinematic principles & inversions

Terminology: Link, Joint, Kinematic Pair, Kinematic Chain, Mechanism & Machine, Inversions of Quadric, Single Slider Crank & Double Slider Crank Chains. Analysis: Kutzbach & Grubler criterion, Grashof's Law, Coupler Curves, Robert's Law Synthesis: Type, Number & Dimensional Synthesis of Quadric Planar Mechanisms

UNIT-II: Application of Mechanisms

Straight Line Mechanisms: Watt, Tchebicheff, Robert, Scott Russel, Grasshopper, Paucellier, Hart, Parallel Linkages: Parallel Ruler, Lazy Tongs, Universal Drafting Machine Pantograph, Geneva Mechanism, Hooke's joints, Belt Drives vs Chain Drives Condition for Correct Steering: Applications in Davis & Ackerman Steering Gear Mechanisms.

UNIT-III : Analysis of Planar mechanisms

Velocity Analysis by Relative Velocity & Instantaneous Centre Methods, Angular Velocity theorem. Acceleration Analysis by Graphical Method - Centripetal, Tangential & Coriolis Components, Body & Space Centrodes, Axodes.

UNIT-IV: Cams

Types of Cams & Followers, Pressure Angle, Displacement, Velocity, Acceleration, Jerk & Snap (SVAJ) Diagrams for Follower Motion, Analysis of Uniform Motion, Parabolic Motion, Simple Harmonic Motion & Cycloidal Motion Profiles. Graphical Synthesis of Planar Cams with Knife Edge, Roller & Flat Faced Followers. Eccentric Circle-cam with a Translating Roller Follower.

UNIT-V: Gears

Classification & Terminology, Law of Gearing, Comparison of Involute & Cycloidal Profiles, Interference of Involute Gears, Minimum Number of Teeth to Avoid Interference, Contact Ratio, Pressure Angle, Sliding Velocity

Gear Trains: Simple, Compound, Reverted, & Epicyclic Gear Trains. Applications in Clock, Gearbox & Differential.

TEXT BOOKS :

1. "Theory of Machines" by S. S. Rattan - McGraw-Hill Publication
2. "Kinematics of Machines" by V P Singh - Dhanpath Rai & Co

REFERENCE BOOKS :

1. "Theory of Machines" by V P Singh - Dhanpath Rai & Co
2. "Kinematics and Dynamics of Machinery" by Norton RL - McGraw-Hill Publication
3. "Theory of Machines and Mechanisms" by J. E. Shigley - McGraw-Hill Publications
4. "Theory of Machines" by Thomas Bevan - Pearson Education
5. "Theory of Mechanisms and Machines" by Amitabha Ghosh & Ashok Kumar Mallik - EastWest Press Pvt. Ltd
6. "Kinematics with Microstation" - ICT Tools - https://www.youtube.com/UjjwalRane

Course Code	Course Title	Core/Elective					
6MC402HS	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	Mandatory Course					
		L	T	P/D	Credits	CIE	SEE
		2	0	0	0	40	60

OBJECTIVES:

1. To reinforce the students understanding with the pan-Indian heritage in terms of culture, traditions and knowledge.
2. To impart understanding of the importance of the roots of the traditional knowledge and types.
3. To impart basic knowledge on the evolution of the multiple languages that highlight India's diversity.
4. To know Indian Languages, Philosophies, Religion, Literature, Fine arts and Technology.
5. To explore the Ancient Science & Scientists, in Medieval and Modern India; the education system.

OUTCOMES :

Student will be able to-

1. Understand the concepts of Indian culture and Traditions and their importance.
2. Distinguish the Indian languages and literature
3. Learn the philosophy of Ancient, Medieval and Modern India.
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras, interpret the concepts and the importance to protect Intellectual property of the nation.

UNIT-I

- Introduction to Culture: Civilization, Culture and Heritage.
- General characteristics of culture, importance of culture in human literature.
- Indian Culture, Ancient India, Medieval India, Modern India.

UNIT-II

Indian Languages, Culture and Literature.

Indian Languages and Literature-I: -the evolution and role of Sanskrit, Prakrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India (Tamil).

Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III

Religion and Philosophy: Religion and Philosophy in Ancient India (Buddhism, Jainism and Shatdarshanas), Religion and Philosophy in Medieval India, Religious reform movements in Modern India (Brahma Samaj & Arya Samaj)

UNIT-IV

Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts Music: Divisions of Indian classical music, modern Indian music Dance and Drama.

Indian Architecture - Ancient (Harrappa and Mohenjodaro, Buddhist sculpture, Ashokan rock cut pillars, Iron Pillar of Mehrauli); Medieval- Bruhadeshwara temple, Ramappa Temple, Vijayanagara, Hampi) and Modern Architecture Science and Technology in India:

Development of science in Ancient, Medieval and Modern India. Their relation in terms of modern scientific perspective. Science and Scientists of Ancient, Medieval and Modern India Protection of traditional knowledge, significance, value to economy: Role of government in protection of indigenous knowledge and technology; protection of traditional knowledge bill, 2016.

UNIT - V

Education System in India:

Education in Ancient, Medieval and Modern India

Aims of education - Universities in Ancient India, Women Education in Ancient, Medieval and Modern India, National Education Policy-2020.

TEXT BOOKS:

1. Indian Knowledge Systems (2 Vols-Set),Kapil Kapoor and Avadhesh Kumar Singh, ISBN 10: 8124603367
2. Basanta Kumar Mohanta and Vipin K. Singh, Traditional Knowledge System and Technology in India, Book Originally published: 2012 Publication. ISBN 10: 8177023101
3. Nitin Singhania, Indian Art and Culture, 4th Edition, ISBN: 9354601804.
4. S. Narain, Education and Examination Systems in Ancient India, written/ authored/edited by S. Narain', published 2017, English-Hardcover, ISBN 9789351282518 publisher: Kalpaz Publications.

REFERENCES:

1. Science in Samskrit, Samskrita Bharati, Published by Samskrita Bharati, New Delhi, India, 2007; ISBN 10: 8187276339 / ISBN 13: 9788187276333.
2. Founders of Sciences in Ancient India,Satya Prakash, Vijay Kumar Publisher, New Delhi.
3. Essentials of Indian Philosophy,M. Hiriyanna, Motilal Banarsidass Publishers, New Delhi.
4. NCET Books from VI to XII standards
5. The social and economic conditions of Medieval India. Chopra, Puri & Das.

Course Code	Course Title						Core/Elective
6ES453CS	PYTHON PROGRAMMING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-	-	2	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1. To learn how to design and program using lists, tuples, and dictionaries.
2. To learn how to use indexing and slicing to access data in Python programs.
3. To learn structure and components of a Python and to read and write files.
4. To learn how to design object-oriented programs with Python classes and Exception handling techniques.
5. To learn how to design and build the GUI applications using python

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Develop solutions to simple computational problems using Python programs.
2. Solve problems using conditionals and loops in Python.
3. Develop Python programs by defining functions and calling them.
4. Use Python lists, tuples and dictionaries for representing compound data.
5. Develop Python programs for GUI applications

LIST OF EXPERIMENTS:

1. Develop program to demonstrate different number datatypes in python.
2. Develop program to understand the control structures of python.
3. Develop program on String manipulation.
4. Develop program to perform various operations on files.
5. Develop programs to learn different types of structures (list, dictionary, tuples) in python.
6. Develop programs to learn concept of functions scoping, recursion and list mutability.
7. Develop program to demonstrate classes and OOP principles.
8. Develop programs for data structure algorithms using python – searching, sorting and hash tables
9. Develop programs to understand working of exception handling and assertions
10. Draw graphics using Turtle.
11. Develop event driven GUI programs.
12. Develop Program for demonstration client server communication.

Course Code	Course Title						Core/Elective
6PC453ME	APPLIED THERMODYNAMICS LAB						Core
Prerequisites	L	T	D	P	CIE	SEE	Credits
-	-	-	-	3	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to :

- To understand applications of thermal engineering concepts through experimentation.
- To provide knowledge in testing of properties of fuels and lubricating oils
- To demonstrate and conduct experiments, Interpret and analyse data and report results of IC engine testing

COURSE OUTCOMES:

After completing the course, student will be able to:

1. Perform experiments to find the efficiency of Petrol and Diesel engines.
2. Find the properties of unknown fuels/lubricants.
3. Perform experiments on CI and SI engines.
4. Perform experiments on Reciprocating Air Compressor

LIST OF EXPERIMENTS :

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve timing diagram of a Petrol/Diesel engine.
3. To determine port timing diagram of a Petrol/Diesel engine.
4. To conduct performance test on single cylinder Diesel engine.
5. To conduct heat balance test on a Diesel engine.
6. To conduct Morse test on multi cylinder Petrol engine.
7. To conduct performance test on multi cylinder Petrol engine.
8. To conduct performance test on a two-stroke Petrol engine.
9. To conduct performance test on multi cylinder Diesel engine.
10. To study the performance of a Petrol engine under different compression ratios.
11. Determination of viscosity of lubricating oil.
12. Determination of flash and fire points of a fuel.
13. Study of Boiler Models.

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title						Core/Elective
6PC454ME	MANUFACTURING PROCESS LAB						Core
Prerequisites	L	T	D	P	CIE	SEE	Credits
Engg. Workshop	-	-	-	3	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to :

1. To gain knowledge and skill in various manufacturing processes such as casting, welding& forming.
2. To understand and perform operations like pattern making, sand testing and casting.
3. To join metal pieces by various welding techniques and gain hands on experience.
4. To understand the working principle and produce some components by various metal forming techniques

Course Outcomes:

After completing the course, student will be able to:

1. Conduct experiments and gain hands-on experience on various processes in foundry, welding, forging, forming and plastic manufacturing technologies.
2. Demonstrate the understanding of the theoretical concepts of above technologies while working in small groups.
3. Demonstrate writing skills through clear laboratory reports
4. Identity the defects / imperfections and discuss their causes and suggest remedies to eliminate them.
5. Transfer group experience to individual performance of exercises and demonstrate effective oral communication skills.

LIST OF EXPERIMENTS:

Foundry

1. Producing different types of patterns considering draft, shrinkage and machining allowances.
2. Green sand mould making processes with complete gating and risering systems.

3. Testing of moulding sand properties
4. Melting and pouring of aluminium to produce casting.

Welding

I. Evaluation of strength and hardness of

1. Butt Joint prepared by gas welding using different types of flames
2. Lap joint by resistance welding process
3. V-Joint by Arc welding process

II. Exercises using TIG and MIG welding processes.

III. Performing Brazing and Soldering operations.

Forming:

1. Evaluation of formability using Erichsen cupping test.
2. Performing drawing operation on different materials (ex. MS, Cu, Al, etc)
3. Performing blanking and piercing operations using hydraulic/fly presses.
4. Manufacturing of a simple component using Plastic Injection moulding machine Manufacturing of a simple component using Plastic Blow moulding machine.

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title						Core/Elective
6PC455ME	FLUID MECHANICS AND HYDRAULIC MACHINERY LAB						Core
Prerequisites	L	T	D	P	CIE	SEE	Credits
-	-	-	-	3	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to understand :

- The working of pumps of different kinds and their behaviour.
- The working of turbines of different kinds and their behaviour.
- The theory of working of various flow measuring devices and their utility in industry

COURSE OUTCOMES:

After completing the course, student will be able to:

1. Practice and experiment on different types of turbines and analyse their performance at rated and off design conditions.
2. Investigate through experimentation different types of pump models and estimate their performance.
3. Apply the principle of different flow measuring instruments and their adoptability to the industry.
4. Develop the hydraulic circuits to cater the needs of the industry.

LIST OF EXPERIMENTS:

1. To conduct performance test and draw the characteristic curves of Self Priming pump
2. To conduct performance test and draw the characteristic curves of Centrifugal pump
3. To conduct performance test and draw the characteristic curves of Reciprocating pump
4. To conduct performance test and draw the characteristic curves of Gear pump
5. Study of Impact of Jets on Vanes
6. To conduct performance test and draw the characteristic curves of Pelton Wheel
7. To conduct performance test and draw the characteristic curves of Francis Turbine
8. To conduct performance test and draw the characteristic curves of Kaplan Turbine
9. To determine coefficient of discharge of Venturi meter
10. To determine coefficient of discharge of orifice meter
11. To Study Hydraulic Circuits
12. To Study pneumatic Circuits

Note: At least ten experiments should be conducted in the Semester

Semester – V

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
		Theory Courses							
1	6HS502HS	Managerial Economics and Financial Accounting (MEFA)	3	-	-	3	40	60	3
2	6HS503HS	Effective Technical Communication	2	-	-	2	40	60	2
3	6PC508ME	Computer Aided Design & Manufacturing	3	-	-	3	40	60	3
4	6PC509ME	Design of Machine Elements I	3	1	-	4	40	60	4
5	6PC510ME	Metrology and Machine Tools	3	-	-	3	40	60	3
6	PE	Professional Elective I / MOOC's	3	-	-	3	40	60	3
7	OE	Open Elective I**	3	-	-	3	40	60	3
		Practical / Laboratory							
8	6PC556ME	Metrology and Machine Tools Lab	-	-	2	2	40	60	1
9	6PC557ME	CAD/CAM Lab	-	-	2	2	40	60	1
10	6PW551ME	Internship -I	-	-	2	2	40	60	1
11	6MC552ME	Skill Development Lab-2 /Value Added Course	-	-	2	2	50	*S/U	-
		Total	**20**	**1**	**8**	**29**	**450**	**600**	**24**

Professional Elective I :

1. 6PE501ME Automobile Engineering.
2. 6PE502ME Experimental Stress Analysis.
3. 6PE503ME Modern Machining & Forming Methods.
4. 6PE504ME Advances in Welding and Joining (MOOC's-2C).

****O.E.I→1**. 6OE501ME Start-up Entrepreneurship.

** Subject is not offered to the students of Mech. Engg. Department

O.E.II→1. 6OE602ME 3D Printing Technologies.

Course Code	Course Title						Core/Elective
6HS502HS	MANAGERIAL ECONOMICS & FINANCIAL ACCOUNTING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand responsibilities of a manager of a business undertaking.
2. To analyze various determinants influencing demand and price.
3. To understand the principles of accounting and prepare Journal, Ledger, Trial Balance & Final accounts.
4. To understand Financial statement Analysis.
5. To evaluate & analyze the long term investments.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Determine the responsibilities & decision making in the Organization.
2. Understand the various factors influencing demand & market structure.
3. Understand the principles of Accounting & solve the problems.
4. Analyze the Financial performance.
5. Understand the capital structure & to take decision on selection of projects.

UNIT-I

Introduction to Managerial Economics, its Scope, Importance and relation to other sciences, its usefulness to Engineers-Basic concepts of Managerial Economics.

UNIT-II

Demand Analysis: Introduction to demand, determinants, law of demand, its assumptions, Elasticity of demand-price, income and cross elasticity, demand forecasting, Market competitive structure price & output determination under perfect competition and Monopoly.

UNIT-III

Basics of Accounting: Financial Accounting–Definition- Accounting Cycle-Journal - Ledger - Cash book - Trial Balance.

UNIT-IV

Financial statement Analysis: - Preparation of Final accounts with simple adjustments (including Problems). Ratio Analysis – Importance – Liquidity and profitability ratios.

UNIT-V

Capital management: Significance determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, Time Value of money - Methods: Non-Discounted cash flow methods (pay back, ARR), Discounted (NPV, PI, IRR) with problems.

TEXT BOOKS :

1. Mehta P.L., Managerial Economics, Sultan Chand & Sons Publishers.
2. Managerial Economics - A Problem Solving Approach, by Luke M Froeb.
3. I.M.Panday Financial Management, Vikas Publishing House.
4. Maheswari S.N. Introduction to Accountancy. Vikas Publishing House.

REFERENCE BOOKS :

1. R.L.Varshney, K.L.Maheshwari, Managerial Economics, Sultan Publishers.
2. D.M.Mithani, Managerial Economics, Himalaya Publishing House.
3. Mukherjee, Hanif, Financial Accounting, Tata McGraw Hill.
4. Ramachandran, Kakani, Financial Accounting for Management, Tata McGraw Hill.

Course Code	Course Title						Core/Elective
6HS503HS	EFFECTIVE TECHNICAL COMMUNICATION						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	2	-	-	-	40	60	2

COURSE OBJECTIVES:

1. To understand the process, features and barriers of Communication.
2. To learn the aspects of communication and Presentation.
3. To comprehend the types of official and business correspondence.
4. To analyze the techniques of Report Writing
5. Aspects of data transfer and presentation.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Handle Technical Communication effectively by overcoming barriers of communication.
2. Use different types of Professional correspondence to communicate effectively.
3. Use different types of Business and Inter Office Correspondence.
4. Acquire adequate skills to draft reports efficiently.
5. Enhance their skills of information transfer.

UNIT-I

Introduction to Communication

Definition, process and Channels of Communication. ABC of Technical communication. Barriers to communication. Differences between general and Technical writing.

UNIT-II

Aspects of Communication

Importance of listening and types of Listening. Types of Technical communication (Oral and Written). Features of technical communication (Precision, relevance, format, style & Use of visual aids). Persuasive Techniques.

UNIT-III

Emails, IOM, Business Letters - enquiry and response; compliant and Adjustment; placement of order; Cover letters/Job Application & Resume Writing. Business proposals.

UNIT-IV

Technical Writing –II

Types of technical reports (Informative, analytical, periodic, Special, formal and Informal) Formal Elements of a Report. Feasibility, Project, Progress and Evaluation reports.

UNIT-V

Information Transfer and Presentations

Non-verbal to verbal. Verbal to non – verbal. Important aspects of oral and Visual Presentations.

TEXT BOOKS :

1. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd ed.). New Delhi.OUP.
2. Rizvi, Ashraf, M. Effective Technical Communication (2 nd ed.) New Delhi, Tata McGraw Hill Education.

REFERENCE BOOKS :

1. Tyagi, Kavita & Misra, Padma. Advanced Technical Communication.New Delhi, PHI Learning.
2. Jungk, Dale. Applied Writing for technicians. Newyork, McGraw Hill Higher Education.
3. Sharma, R. C,& Mohan , Krishna. Business Correspondence and Report Writing: A Practical approach to business & technical communication (4 th ed.) New Delhi, Tata McGraw Hill Education.

Course Code	Course Title						Core/Elective
6PC508ME	COMPUTER AIDED DESIGN AND MANUFACTURING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To introduce the concepts of CAD and advanced modelling techniques.
2. To understand the functioning of computer numerical control machine tools and also in writing programs for operating these machines.
3. To understand the advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning; Computer aided quality control, Artificial Intelligence etc.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the fundamental concepts and principles of CAD and evaluate geometric transformations in both 2D and 3D design space.
2. Apply the concepts and principles of wireframe modelling to create accurate representation of objects.
3. Create the realistic and functional designs by combining surface, solid and assembly modelling techniques effectively.
4. Create the Numerical Control (NC) programs using different methods of part programming both manual and computer assisted programming tools.
5. Understand the basic concepts and components of Flexible Manufacturing Systems (FMS), and Automated Material Handling Systems.

UNIT-I

Introduction to CAD, Product cycle, Design process, Design criteria, Benefits of CAD/ CAM – Design workstation, CAD/ CAM database and structure. Data Exchange Formats (IGES, STEP).

Geometric 2D & 3D Transformations: Introduction, Translation, Rotation, Scaling, Reflection Transformations, Homogenous Representation, Concatenated Transformation.

UNIT-II

Wire frame Modelling: Wireframe entities and their definition, interpolation and approximation curves. Parametric and non-parametric representation- line, circle and helix curves, properties of splines, synthetic curves: parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

UNIT-III

Surface Modelling: Surface representation, Analytic surfaces: definition of Plane surface, Ruled surface, Surface of revolution, Tabulated cylinder, Synthetic surfaces-Hermite cubic and Bezier surfaces.

Solid Modelling: Solid entities, Boolean operations, B – rep and CSG approaches, feature based modelling, Assembly modelling.

UNIT-IV

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming.

Group Technology: Part families, layout, part classification and coding system. MICLASSCODE system.

UNIT-V

Flexible Manufacturing System: Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS layout and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles.

TEXT BOOKS:

1. CAD CAM Theory and Practice: Ibrahim Zeid, McGraw Hill.
2. CAD/CAM: Computer Aided Design and Manufacturing, by Groover, Pearson India.

REFERENCE BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P Groover, Pearson Education
2. P. Radhakrishnan, "Computer Numerical Control ", New Central Book Agency.
3. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.

Course Code	Course Title						Core/Elective
6PC509ME	DESIGN OF MACHINE ELEMENTS-I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering mechanics & mechanics of solids.	3	1	-	-	40	60	4

COURSE OBJECTIVES:

1. To understand the general design procedures and principles in the design of machine elements.
2. To study different materials of construction and their properties and factors determining the selection of material for various applications.
3. To determine stresses under different loading conditions.
4. To learn the design procedure of different fasteners, joints, shafts and couplings.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the standards, codes, Theories of failure, various design considerations for joints, Power screws, stress, strains and Mechanical elements like shafts, keys, couplings, Joints.
2. Select the suitable shafts, Keys, couplings, Permanent and temporary Joints for a given application.
3. Demonstrate the ability to apply the fundamentals of stress analysis, theories of failure and material science in the design of Mechanical components of shafts, keys, couplings, Joints and power screws.
4. Analyze and evaluate shafts, keys couplings, Joints and power screws subjected to static and dynamic loads.
5. Design of Keys, couplings, curved beams, Permanent and temporary joints for a given application using various empirical relations.

UNIT-I:

Introduction: Materials used in machine design and their specifications to Indian standards, codes and standards used in design.

Reliability, principles of Ergonomics and Manufacturing considerations, preferred numbers. Analysis of stress and strain: Types of loading and stresses.

Theories of failure under static loading, stress concentration factor, factor of safety, Design of components for static loads and Fatigue loads

UNIT-II

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor–Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve–Goodman's diagram– Soderberg's diagram for fatigue design.

UNIT-III

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code.

Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Keys: Types and design of keys-stresses in keys.

UNIT-IV:

Design of Permanent Joints: Types of Riveted joints, efficiency of the joint. Design of riveted joints subjected to direct and eccentric loads.

Types and design of welded joints subjected to direct and eccentric loading.

UNIT-V:

Design of Bolted Joints & Power Screws: Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.

Cotter and knuckle joints: Introduction, Type of Cotter joints, Design of Socket and Spigot Cotter joints, Sleeve Cotter joints and Knuckle joints

Introduction to design optimization: General Characteristics of mechanical elements, adequate and optimum design, principles of optimization, design constraints, classification of optimization problems. Single and multivariable optimization techniques.

TEXT BOOKS :

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill.
2. Machine design/RS Khurmi.

REFERENCE BOOKS:

1. Machine Design / Jindal / Pearson.
2. Design of Machine Elements / V. M. Faires / Macmillan.
3. Design of Machine Elements-I / Kannaiah, M.H / New Age.

Course Code	Course Title						Core/Elective
6PC510ME	METROLOGY AND MACHINE TOOLS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

Students will be able to

1. To have knowledge of various precision linear and angular measuring instruments.
2. To familiarize with Limits & fits, I.S.O. system and the instruments used to measure these limits.
3. To learn the principle and working of various machine tools like lathe, shaper, planer, milling, drilling and grinding machines etc.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the concept of metrology and its significance in ensuring accurate measurements.
2. Apply the principles of inter-changeability, selective assembly, and determine tolerance grades, fits, and types of fits.
3. Understand the principles and operation of various comparators, tool maker's microscopes, surface roughness measurement instruments, and thread metrology methods.
4. Understand the constructional features and specifications of machine tools, including lathes, drilling, boring, milling and grinding machines.
5. To determine the cutting forces and machining time in lathe, milling, drilling and boring operations.

UNIT-I

Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of Standards, Line and End Standards.

Liner measurement and angular measurements: Different types of Micrometers, Height gauges. Slip gauges-Indian standards on slip gauges, Wringing of slip gauges, Measurement of angle-Sine bar, Autocollimator-Applications for measuring straightness.

System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Interchangeability & Selective assembly. Tolerance grades, Fits, Types of fits, Problems on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design.

UNIT-II

Comparators: Mechanism of Dial indicator, Mechanical comparators. Free flow and Back pressure type Pneumatic comparator. Electrical and Optical comparator. Tool maker's Microscope applications, Measurement of straightness, flatness and roundness with bench centre and talyrond.

Surface Roughness Measurements- Profilometer, Taylor Hobson Talysurf. Application of Thread metrology - 2 wire and 3 wire methods. Gear tooth thickness, General geometric tests for machine tools – Lathe, Drill and Mill.

UNIT-III

Metal cutting: Introduction, elements of cutting process – Geometry of single point cutting tools. Chip formation and types of chips.

Engine lathe – Principle of working, types of lathe, specifications. Taper turning, – Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts

UNIT-IV:

Drilling and Boring Machines – Principles of working, specifications, types, and operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines –Principles of working – machining time calculations.

UNIT-V

Milling machines – Principle of working – Types of milling machines – Geometry of milling cutters, methods of indexing, machining time calculations.

Grinding – Theory of grinding, classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel, Lapping, honing and broaching machines, comparison and constructional features.

TEXT BOOKS:

1. M.Mahajan-" Metrology", Dhanpat Rai & Co.(P)Ltd, New Delhi.
2. P.N. Rao, "Manufacturing Technology - Metal Culling & Machine Tools", Vol. 2. Tata McGraw Hill Education Pvt. Ltd.

REFERENCE BOOKS:

1. K.L.Narayana-"Engineering metrology" ,third edition, Scitech Publications Pvt. Ltd.
2. I.C. Gupta – "Engineering metrology", Dhanpat Rai Publications, New Delhi.
3. RK Jain, "Engineering Metrology", Khanna Publications, 1996.

Course Code	Course Title						Core/Elective
6PE501ME	AUTOMOBILE ENGINEERING						PE-1
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student to

1. Learn the anatomy of the automobile, basic structure and super structure.
2. Understand the location and importance of each engine components.
3. Learn the functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
4. Study the Suspension, springs and other connections of systems.
5. Understand Emissions, pollution regulations, EURO and BHARATH stages and servicing of automobile.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the different parts and constructional details of the automobile engines.
2. Understand the working of various systems like engine lubricating system and cooling system, types of ignition system and different batteries used in automobile.
3. Explain the constructional and working principle of steering, suspension systems, braking system and steering systems.
4. Select suitable braking system, steering mechanism, suspension system and cooling system for different automobile vehicles.
5. Explain the effect of automobile pollution on environment and necessity of pollution norms along with trouble shooting.

UNIT-I

Types of automobiles: Conventional, Electrical and Hybrid Vehicles: Series and parallel systems, Hydrogen Fuel cell vehicle. Engine location, Chassis layout and Engine components-cylinder block, cylinder head, crankcase, inlet and exhaust manifolds, gaskets, cylinder liners, constructional features of piston, piston slap,

methods to overcome piston slap. Piston rings, compression rings, oil control rings, crank shaft. Valve Operating Mechanisms, inlet and exhaust manifolds.

Fuel supply systems: Fuel supply system for petrol and diesel engines, single point and multipoint injection (MPFI), mechanical and electronic injection system, CRDI system and its present scenario.

UNIT–II

Lubricating Systems: Mist (Petroil) System, Wet sump and Dry Sump.

Cooling systems: Air Cooling, Water cooling: Thermo siphon, pump circulation system, components of cooling system- Radiator, Thermostat Control and Anti Freezing agents.

Ignition Systems: Types of Ignition Systems, Modern Ignition systems.

Batteries: Types of Batteries and charging systems- Batteries used in Electric and Hybrid Vehicles, starting motors.

Electrical Systems: Main electrical circuits, generating & starting circuit, lighting system, indicating devices, warning lights, speedometer, automobile air-conditioning.

UNIT-III

Steering Systems: Linkage arrangements and its components, steering gear box types, recent trends, Davis Steering, Modified Ackerman linkage.

Steering geometry: wheel alignment, caster, camber, King Pin Inclination, Toe in, Toe out.

Wheel and Tyres: Tyre construction, specification. Tyre wear and causes.

Suspension systems: Types of Suspension systems, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

UNIT-IV

Power Train: Single & Multi Plate Clutch, Cone clutch. Manual Gear Box: Constant Mesh, Sliding Mesh, Synchromesh. Automatic Gear Box, Torque Converter, Propeller Shaft, Universal Coupling, Differential, four wheel drive system.

Brakes Systems: Disc and drum types, leading and trailing shoe layout, Description and operation of hydraulic brake, hand brake linkage, Pneumatic, air and vacuum brakes, ABSand SRS Airbag system.

UNIT–V

Automobile Emissions and control: Emissions from automobiles and its control techniques used for petrol and diesel engines, PCVS, EGR, SCRT, Thermal Reactors, Catalytic converters; Euro norms and Bharat Norms.

Maintenance: Trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment.

TEXT BOOKS:

1. Kirpal Singh., - Automobile Engineering, Vol. I & II Standard Publishers, Delhi.
2. Er. S.K. Gupta- Automobile Engineering, S.Chand Publications, New Delhi.

REFERENCE BOOKS:

1. Crouse & Anglin, -Automotive Mechanics, 10/e, TMH. Publishing Co. Ltd., New Delhi.
2. Joseph Heitner, -Automotive Mechanics, 2/e, Affiliated East West Pvt. Ltd.
3. R.K. Rajput, -A Textbook of Automobile Engineering, Laxmi Publications, New Delhi.
4. D S Kumar, -Automobile engineering, S K Kataria Publications, New Delhi.

Course Code	Course Title						Core/Elective
6PE502ME	EXPERIMENTAL STRESS ANALYSIS						PE-1
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg. Physics	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Demonstrates principles of experimental approach
2. Teaches regarding the working principles of various strain gauges.
3. Throws knowledge on strain rosettes and principles of non destructive testing of concrete.
4. Gives an insight into the principles of photo elasticity.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the different methods of experimental stress analysis and use of strain gauges for measurement of strain
2. Explain the measurement of strain under static and dynamic loads
3. Summarize the principles of experimental approach
4. Analyze theory of photo elasticity and its applications in analysis of structures.
5. Evaluate experimental method of finding the response of the structure to different types of load.

UNIT -I

PRINCIPLES OF EXPERIMENTAL APPROACH: Merits of Experimental Analysis Introduction, uses of experimental stress analysis, advantages of experimental stress analysis, different methods –simplification of problems.

UNIT-II

STRAIN MEASUREMENT USING STRAIN GAUGES: Definition of strain and its relation of experimental determinations, properties of Strain gauge Systems-types of strain gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges -Inductance strain gauges –LVDT –Resistance strain gauges –various types –Gauge factor –Materials of adhesion base.

UNIT-III

STRAIN ROSSETTES AND NON–DESTRUCTIVE TESTING OF CONCRETE:

Introduction –the three elements Rectangular Rosette –The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity method – Application to Concrete. Hammer Test.

UNIT -IV

THEORY OF PHOTOELASTICITY: Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polariscope for various arrangements – Fringe Sharpening. Brewster?s Stress Optic law.

UNIT -V

TWO DIMENSIONAL PHOTO ELASTICITY: Introduction –Iso-chromatic Fringe patterns-Isoclinic Fringe patterns, passage of light through plane Polariscope and Circular polariscope, Isoclinic Fringe patterns –Compensation techniques – Calibration methods – Separation methods –Scaling Model to prototype Stresses – Materials for photo elasticity and properties of Photo elastic materials.

TEXT BOOKS:

1. Dr.Sadhu Singh, "Experimental stress analysis", khanna Publishers.
2. U.C.Jindal, "Experimental Stress analysis", Pearson Publications.

REFERENCE BOOKS:

1. J.W.Dally and W.F.Riley, "Experimental stress analysis College House Enterprises"
2. L.S.Srinath, "Experimental Stress Analysis", MC.Graw Hill Company Publishers.

Course Code	Course Title						Core/Elective
6PE503ME	MODERN MACHINING & FORMING METHODS						PE-I
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mfg. Processes	-	3	-	-	40	60	3

COURSE OBJECTIVES:

1. To know the importance of unconventional machining and forming processes.
2. To learn the working principle of various modern machining and forming processes.
3. To understand the advantages, limitations and applications of various modern machining and forming processes.
4. To understand the relationship between process parameters and performance of various processes.
5. To know the suitability of processes for various engineering materials and applications.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the classification and need of non traditional machining technology in modern manufacturing.
2. Understand the principle and operation of USM, AJM, AWJM, WJM, EDM, EDG, ECM, CHM, LBM, EBM and PAM processes.
3. To determine the effect of process parameters on the performance and material removal rate in USM, AJM, WJM, AWJM, EDM, EDG, ECM, CHM .
4. Understand the principle, description & applications of stretch forming, tube spinning, hydrostatic forming and water hammer forming techniques.
5. To find the suitability of various types of modern machining and high energy rate forming methods in industrial applications.

UNIT-I

Introduction: Need for non-traditional machining processes, selection, classification & comparative study of different processes; **Ultrasonic Machining (USM):** Introduction, process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry, Types of Transducers, effect

of process parameters, applications and limitations; **Abrasive Jet Machining (AJM):** Principle of operation, process details, process variables and their effect on MRR and accuracy. Equation for MRR Advantages, disadvantages and applications; **Water Jet Machining (WJM):** Schematic diagram, equipment used, advantages and applications; **Abrasive Water Jet Machining (AWJM):** Schematic diagram, equipment used, advantages and applications.

UNIT – II

Electro-Chemical Machining (ECM): Schematic diagram of process parameters, function and characteristics of electrolyte, chemistry of the process, Equation for specific MRR and electrode feed rate, advantages, limitations and applications; **Electro Chemical Grinding:**

Process description and applications.

Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper? Flushing, Mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications. **Wire EDM:** Process description and applications; Electro Discharge Grinding: Process description and applications;

UNIT – III

LASER Beam Machining (LBM): Principle of LASER Beam production, materials used, thermal analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications; **Plasma Arc Machining (PAM):** Introduction equipment used, process description and parameters, types of plasma arc - Transferred arc and non transferred arc; advantages, disadvantages and applications; **Electron Beam Machining (EBM):** Schematic diagram og process, process parameters, principle of production of Electron beam, equipment used, Advantages, disadvantages and applications; **Ion Etching:** Process description and applications.

UNIT – IV

High Energy Rate Forming (HERF): Introduction, comparison of conventional & high energy rate forming methods. Types of high energy rate forming methods; **Explosive Forming:** principle, Explosive materials, types of explosive forming - standoff operation and contact operation, advantages, disadvantages and applications; **Electro-Hydraulic forming (EHF):** Schematic of the process description and its applications; **Electro-Magnetic Forming (EMF):** Schematic diagram of the

process description and its applications; **Rubber Pad Forming:** Principle, process details and its types; Guerin, wheel on, Marforming and Hydro forming processes and applications.

UNIT – V

Stretch Forming: Introduction, types of stretch forming - stretch draw forming, rotary stretch forming or stretch wrapping, compression forming and radial draw forming, Stretch forming equipment and accessories, accuracy and surface finish, process variables, limitations and applications; **Tube spinning:** Introduction, methods of tube spinning - backward spinning, Forward spinning; machines and tools used, machine variables - speeds and feeds; effect of tube spinning on work metal properties and applications; **Hydrostatic Forming:** Process principle, description and applications; **Water Hammer Forming (WHF):** Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

TEXT BOOKS:

1. P.K.Mishra "Non Traditional Machining processes" Narosa Publications, New Delhi.
2. V.K Jain "Advanced Machining Processes" Allied Publishers, Hyderabad.

REFERENCE BOOKS:

1. HMT Production Technology, Tata McGraw Hill Publications.
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill
3. Manufacturing Technolgy, Kalpakzian, Pearson.
4. New Technology, Bhattacharya A, the Institution of Engineers, India.

Course Code	Course Title						Core/Elective
6PE504ME	ADVANCES IN WELDING AND JOINING						PE-1
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Understand the various types of solid state welding and advanced welding processes available.
2. Gain knowledge of the weldability concepts and operating procedures of ferrous metal and non ferrous metals.
3. To gain the knowledge of defects, remedial procedure and testing methods in welded joints.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Explain the concept and applications of solid state welding
2. Apply the knowledge of advanced welding techniques in manufacturing industries
3. Select the welding procedure for joining ferrous materials
4. Apply the knowledge of welding and joining of non ferrous metals in industrial application
5. Explain the welding defects, remedial measures and testing procedure in ferrous and non ferrous joints.

UNIT I:

SOLID STATE WELDING PROCESS:

Solid state welding process - Cold welding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, MIAB welding and hot pressure welding processes - advantages, limitations and applications.

UNIT II :

ADVANCED WELDING PROCESS:

Atomic hydrogen welding, Electron Beam welding, Laser Beam welding, Friction Stir welding, Cold Metal Transfer welding, Under Water welding- advantages, limitations and applications.

UNIT -III:

WELDING AND JOINING OF FERROUS METALS:

Weldability of cast irons: Gray cast iron, White cast iron and Malleable cast iron. Weldability of Carbon steel- low carbon steel, medium carbon steels and high carbon steels. Weldability of Stainless steels - austenitic, ferritic, martensitic stainless steels.

UNIT- IV:

WELDING AND JOINING OF NON- FERROUS METALS:

Weldablity of copper and its alloys, Weldablity factors, welding of copper and its alloys, brazing and soldering of copper and its alloys. Weldablity of aluminium alloys, problems associated with welding of aluminium; Welding of Ti and Ni alloys

UNIT - V:

WELD DEFECTS AND TESTING OF WELDS

Welding defects, their causes and remedial measures; Hot cracking and cold cracking; distortion in welding; Weldability tests- Destructive and non-destructive testing of weldments- liquid penetrant, magnetic particle, ultrasonic and radiographic testing.

TEXT BOOKS:

1. Parmer R. S., 'Welding Engineering and Technology', Khanna Publishers.
2. Cary, Howard, "Modern Welding Technology", prentice Hall.

REFERENCE BOOKS:

1. Linnert G. E.,'Welding Metallurgy', Volume I and II, 4th Edition, AWS.
2. Granjon H., 'Fundamentals of Welding Metallurgy', Jaico Publishing House.
3. Kenneth Easterling, 'Introduction to Physical Metallurgy of Welding', 2nd Edition, Butterworth Heinmann.

Course Code	Course Title						Core/Elective
6PC556ME	METROLOGY AND MACHINE TOOLS LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To have knowledge of various precision measuring instruments.
2. To familiarize various machining and metal cutting operations

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Apply the principles and techniques of measurement using inside, outside, and depth micrometers, Vernier callipers, and height gauges.
2. Apply the principles and techniques of measuring roundness errors and ovality using V-blocks and dial bore gauge.
3. Determine the angles with precision using Sine bar and Bevel protractor. Accurately measure linear and angular dimensions using a Tool Maker's Microscope
4. Apply the lathe machine operations, thread cutting, drilling, gear cutting, and shaping techniques on work pieces accurately and effectively.
5. Analyze the cutting force during machining operations using a lathe tool dynamometer.

LIST OF EXPERIMENTS:

A) Metrology

1. Measurement with inside, outside and depth micrometers, Vernier callipers and Height gauges
2. Measurement of roundness errors with V-block and dial gauge
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope
4. Measurement of angles with Sine bar, Bevel protractor
5. Measurement with Dial Indicator/Dial Bore Gauge.

B) Machine tools

1. Facing, plain turning, step turning and taper turning on the lathe machine.
2. Thread cutting and knurling on the lathe machine.
3. Drilling, boring and tapping.
4. Gear Cutting on milling machine.
5. Perform shaping operation.
6. Measurement of Cutting forces with Lathe tool dynamometer. Note: At least ten experiments should be conducted in the Semester.

Course Code	Course Title						Core/Elective
6PC557ME	CAD/CAM LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	40	60	1

COURSE OBJECTIVES:

- To learn design criteria of machine components, selection of materials and manufacturing Process.
- To familiarize with NC features, part programming using G and M codes, APT, CNC, DNC and FMS etc.

COURSE OUTCOMES:

- Create the models of the components.
- Demonstrate the documentation and presentation skills
- Prepare the production drawings of the parts from the given assembly drawing
- Generate the bill of materials and indicate details pertaining to manufacturing requirements.
- To recognize the importance of Computer Aided Manufacturing and prepare a simple part program to perform machining on a CNC machine and to produce various machine components by performing different machining operations.

LIST OF EXPERIMENTS:

Introduction to CAD

1. Part modelling-I from given assembly drawings using any solid modelling package.
2. Part modelling-II from given assembly drawings using any solid modelling package.
3. Geometrical dimensioning and tolerance representation on part drawings.
4. Conventional practices indicating Dimensional, Form & Position tolerances.
5. Calculation of limits, suggestion of suitable fits for mating parts with Interference detection.
6. Surface finish, surface treatments- specification and indication methods on the drawings.

7. Generation of production drawings in 2D from part models representing Limits, fits, tolerances, surface finish, geometrical and form tolerance etc.
8. Preparation of Process sheet incorporating Tool work orientation diagrams.

Introduction to CAM

9. To perform simple turning, step turning, chamfering & fillet operations on a given shaft using CNC lathe.
10. To perform the facing operation on a given shaft using CNC lathe.
11. To perform external threading and grooving operations on a given shaft using CNC lathe.
12. To perform drilling operation on a given shaft using CNC lathe.

LIST OF ADDITIONAL EXPERIMENTS:

13. To perform boring operation on a given shaft using CNC lathe.
14. To perform internal threading operation on a given shaft using CNC lathe.

Course Code	Course Title						Core/Elective
6PW551ME	INTERNSHIP-1						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	40	60	1

COURSE OBJECTIVES:

1. Produce an accurate record of work performed during the Internship.
2. Apply engineering knowledge to a problem in industry.
3. Produce a technical report.
4. Discuss work in a team environment, if relevant to the project.
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. To develop and enhance technical skills.
2. To apply the theoretical knowledge they have acquired in their academic courses.
3. To develop practical skills that are relevant to their academic courses
4. To gain industry-specific knowledge that aligns with their academic courses
5. To engage in professional communication and collaborate with colleagues, supervisors and industry persons.

Internship is introduced as part of the curriculum of encouraging students to work on problems of interest to industries. A batch of two to three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 2 weeks. This will be during the summer vacation following the completion of the IV Semester Course work.

One faculty coordinator will also be attached to each group (of 2 or 3 students) to monitor the progress and to interact with the industry co-ordinate (person from industry). The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship.

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the internship and
2. Present the work through a seminar talk (to be organized by the Department)

Award of Sessional marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (40 Marks) followed by presentation before the committee constituted by the department (60 Marks).

One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 2 weeks at the end of semester IV and credits will be awarded after evaluation in V semester.

Course Code	Course Title						Core/Elective
6MC552ME	SKILL DEVELOPMENT LAB-2 / VALUE ADDED COURSE						MC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	50	*S/U	-

COURSE OBJECTIVES:

The course objectives are : To

1. Complement the core curriculum and provide additional knowledge, skills, and experiences.
2. Provide students with in-depth knowledge and expertise in a particular field of interest.
3. Foster critical thinking skills and develop the ability to approach engineering challenges from multiple perspectives.
4. Equip students with the skills and knowledge needed to excel in their careers and adapt to the evolving demands of the industry.
5. Bridge the gap between academic knowledge and practical application, preparing students for real-world challenges.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Gain insights into the professional aspects of mechanical engineering.
2. Hands-on experience with tools, equipment, and software used in the industry.
3. Collaborate, communicate ideas, and work effectively as part of a team.
4. Improve the critical thinking abilities and adapt to the evolving demands of the industry.
5. Solve complex problems, and make informed decisions.

Value-added courses in mechanical engineering are designed to supplement the core curriculum and provide students with additional skills and knowledge that can enhance their career prospects. These courses go beyond the fundamental concepts taught in traditional mechanical engineering programs and focus on specialized areas or emerging technologies. Value-added courses in mechanical engineering under “Skill Development Lab-2” may be considered in the following areas of specialization.

Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM): These courses provide training in using software tools like Solid-Works, CATIA, or Pro/ ENGINEER for designing and modelling mechanical components. Students learn to create 2D and 3D models, perform simulations, and generate manufacturing instructions.

NDT: NDT stands for Non-Destructive Testing, which is a set of techniques used to evaluate the integrity, quality, and reliability of materials, components, and structures without causing any damage to them. NDT plays a critical role in ensuring the quality, safety, and reliability of various industries by enabling the detection of defects and flaws that may compromise the integrity of materials and structures.

Students should undergo training in any of the above mentioned courses with minimum of 30 hours duration and should submit a course completion certificate from the respected authorities.

Course Code	Course Title						Core/Elective
6OE501ME	START- UP ENTREPRENEURSHIP						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

Students should be able to understand

1. To motivate students to take up entrepreneurship in future.
2. To learn nuances of starting an enterprise & project management.
3. To understand project formulation and choice Technology in Enterprise.
4. To understand Intellectual properties, patents, Start-ups.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Understand the concept of Intellectual Property Rights and Patents
5. Comprehend the aspects of Start-Ups.

UNIT -1

Entrepreneurship: Definition, functions of Entrepreneurship, Characteristics and qualities of entrepreneurs, Entrepreneur vs. intrapreneur, need of innovation, Economic growth. Small Scale Industry in India, Linkage among small, medium and heavy industries.

UNIT – II

Indian Industrial Environment: Competence, Opportunities and Challenges, Emergence of First generation entrepreneurs, women entrepreneurs. Conception and evaluation of ideas and their sources. Types of enterprises. Collaborative interaction for Technology development. Corporate Social Responsibility

UNIT – III

Project formulation: Introduction, Elements of Business Plan and its salient features, Analysis of market demand, Financial and profitability analysis and Technical analysis.

UNIT-IV

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

UNIT-V

Aspects of Start-Up: What is Start-Up, Start-up Policy, start-up strategy, Progress of startups in India, Principles of future organizations, start-up sectors and action plan for start-ups by Govt. of India.

TEXT BOOKS:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House,
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd.
3. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, MacmillanIndia Ltd.

REFERENCE BOOKS:

1. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication.
2. G.S. Sudha, "Organizational Behaviour".
3. Robert D.Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed.
4. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. Gogia Law Agency.

Course Code	Course Title						Core/Elective
1OE501AD	ARTIFICIAL INTELLIGENCE						Open Elective-1
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to:

1. To introduce the AI techniques to solve problems and search strategies to find optimal solution paths from start to goal state.
2. To introduces different knowledge representation methods in AI Programs.
3. To introduce different design techniques for Game Playing Programs.
4. To introduce the AI Agents their design, planning and learning techniques.

To introduce the natural language processing and expert systems

COURSE OUTCOMES :

After completing the course, student will be able to:

CO 1. Understand fundamental AI concepts and identify arrange of symbolic and non symbolic AI techniques.

CO 2. Demonstrate an understanding of various searching algorithms such as adversarial search and game-playing commonly used in artificial intelligence software.

CO 3. Use different knowledge representation techniques used in AI Applications.

CO 4. Demonstrate an understanding of agent based AI architectures, Planning and logic based agents.

CO 5. Exploring Expert systems.

UNIT-I

Introduction: Artificial Intelligence and its applications, Artificial Intelligence Techniques Problem solving techniques: States pace search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A*search, AO*search, Constraint satisfaction problem, Agenda Driven Search, Mean-end analysis, Min- Max Search, Alpha-Beta Pruning, Iterative Deepening.

UNIT-II

Knowledge representation: Mapping between facts and representations, Approaches to knowledge representation, procedural vs declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Weak and Strong filler structures.

UNIT-III

Non Monotonic and Statistical Reasoning: on monotonic Logic, Default Logic, Circumscription, Bayes Theorem, Bayesian Network, Dempster Shafer Theory, Fuzzy sets, Fuzzy Logic, Defuzzification.

UNIT-IV

Planning and Learning Agents: Intelligent Agents, Nature and structure of Agents, Learning Agents, Introduction to different Forms of Learning, The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

UNIT-V

Introduction to Learning and Expert system: Expert systems, Expert system examples, Expert System Architectures, Rule base Expert systems, Non Monotonic Expert Systems, Decision tree base Expert Systems.

TEXTBOOKS :

1. AI: A Modern Approach StuartJ. Russel, Peter Norvig Pearson Education Latest Edition, 2012
2. Artificial Intelligence Elaine Rich, Knight McGraw Hill Third Edition 2010.
3. Artificial Intelligence, Saroj Kaushik Cengage Learning, First Edition 2011.

REFERENCE BOOKS :

1. Artificial Intelligence, Partick Henry Winston Addison Wesley Latest Edition 2012.
2. Artificial Intelligence George Luger Pears on Education Latest Edition 2010.

Course Code	Course Title						Core/Elective
OE501CE	DISASTER MITIGATION						Open
Prerequisite	Contact Hours per Week				CIE	SEE	Elective-1
Environmental	L	T	D	P			Credits
Sciences	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to:

- Define disaster and explain the different types of disasters.
- Describe the disaster management cycle and the role of NDMA in disaster management.
- Analyze the legal aspects of disaster management.
- Develop disaster mitigation plans.
- Participate in disaster response and recovery activities.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Demonstrate the concepts of disaster management

CO 2. Identify different types of disasters

CO 3. Explain the disaster management cycle

CO 4. Illustrate the role of NDMA in disaster management

CO 5. Explain the development of disaster mitigation plan

UNIT-I:

Introduction to Disaster Management: Definition of disaster, Types of disasters, History of disaster management in India, National Disaster Management Authority (NDMA) and its role in disaster management, Disaster management cycle. Case studies of disasters in India and the world

UNIT II:

Disaster Mitigation: Mitigation measures for different types of disasters, Use of technology in disaster mitigation, Disaster risk assessment, Disaster preparedness, Exercises and simulations on disaster mitigation.

UNIT III:

Disaster Response: Search and rescue operations, Medical relief, Food and shelter, Restoration of essential services, Rehabilitation and reconstruction,

UNIT IV:

Disaster Law and Policy: Disaster management acts of India, Disaster management policies of India, Legal aspects of disaster management

UNIT V:

Disaster Communication and Public Awareness: Importance of communication in disaster management, Methods of disaster communication, Public awareness programs, Case studies of disaster communication and public awareness in India and the world.

TEXT BOOKS:

1. R.Subramanian, Disaster Management, Vikas Publishing House, 2018.
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016.

REFERENCE BOOKS:

1. S. C. Sharma, Disaster Management: Concepts, Approaches and Techniques, Khanna Book Publishing House, 2017.
2. G. K. Ghosh, Disaster Management: Theory and Practice, APH Publishing Corporation, 2018.

Course Code	Course Title						Core/Elective
3OE501CS	OOPs USING JAVA						Open
Prerequisite	Contact Hours per Week				CIE	SEE	Elective-1
	L	T	D	P			Credits
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student to

1. The Java programming language: its syntax, idioms, patterns and styles.
2. Object oriented concepts in Java and apply for solving the problems.
3. How exception handling and multithreading makes Java robust.
4. Explore java Standard API library such as io, util, applet,awt.
5. Building of applications using Applets and Swings..

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the concept of OOP and analyze relationships among classes, objects.
2. Develop programs using concepts like inheritance, packages, interfaces, Java I/O streams and strings
3. Utilize exception handling and Multithreading concepts to develop Java programs
4. Interpret the Java Collection API, Java utility classes, concept of files and serialization
5. Design GUI applications using concepts like AWT controls and Swings and client server programs using networking concepts

UNIT-I

Object Oriented Programming: Principles, Benefits of Object Oriented Programming. Introduction to Java : Javabuzzwords, bytecode. Java Programming Fundamentals: Applet and Application program using simple java program, data types, variables, arrays, operators, expressions, control statements, type conversion and casting, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, introducing access control, static, final, nested and inner classes, exploring string class, using command-linear arguments.

Inheritance: Inheritance concept, types of inheritance, Member access rules, use of super and final.

Polymorphism-dynamic binding, method over riding, abstract classes and methods.

UNIT-II

Interfaces: Defining an interface, implementing interfaces, extending interface.

Packages: Defining, Creating and Accessing a Package, importing packages

Exception handling: Benefits of exception handling, classification, checked exceptions and unchecked exceptions, usage of try, catch, throw, throw sand finally, re throwing exceptions, built in exceptions, creating own exception sub classes

Multithreading: Java Thread Model, The Main Thread, creating a Thread, creating multiple threads, using is Alive and join, thread priorities, synchronization, inter thread communication, deadlock

UNIT-III

Collections: Overview of Java Collection frame work, commonly used Collection classes – Array List, Linked List, Hash Set, Tree Set, Collection Interfaces – Collection, List, Set. Accessing Collection via iterator, working with Map. Legacy classes and interfaces –Vector, Hash table, Stack, Dictionary, Enumeration interface.

Other Utility classes: String Tokenizer, Date, Calendar, Gregorian Calendar, Scanner Java Input/Output: exploring java.io, Java I/O classes and interfaces, File, Stream classes, byte stream, character stream, serialization.

UNIT-IV

GUI Programming with java : The AWT class hierarchy, MVC architecture.

Applet Revisited: Basics, architecture and skeleton, simple applet program.

Event Handling: Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces. Handling mouse and keyboard events, Adapter classes.

Database Programming using JDBC : Introduction to JDBC, JDBC Drivers & Architecture, CURD operation Using JDBC, Connecting to non-conventional Databases.

UNIT-V

Exploring Swing: JLabel, ImageIcon, JTextField, theSwingbuttons, JTabbedpane, J Scroll Pane, J List, J Combo Box.

Servlet: Life cycle, using tomcat, simple servlet, servlet API, javax.servlet package, reading servlet parameters, javax.servlet. http package, handling HTTP requests and responses.

TEXTBOOKS:

1. Java: The Complete Reference, X Edition, Herbert Schildt, Mcgraw Hill.
2. JavaFundamentals:A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. Java for Programming, P.J. Dietel X Edition, Pearson Education.

REFERENCEBOOKS:

1. The Java Programming Language, Ken Arnold, David Holmes, James Gosling, Prakash Goteti, III Edition, Pearson 2008.
2. An Introduction to OOP, T. Budd, III Edition, Pearson Education.
3. Introduction to Java Programming, Y.Daniel Liang, X Edition, Pearson Education.

Course Code	Course Title						Core/Elective
5OE501EC	Basics of Electronic Communication						Open
Prerequisite	Contact Hours per Week				CIE	SEE	Elective-1
	L	T	D	P			Credits
BEE	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To provide an introduction to fundamental concepts in the understanding of communications systems.
2. To describe the network model and some of the network layers including physicallayer, data link layer, network layer and transport layer.
3. To discuss the evolution of wireless systems and current wireless technologies.

COURSE OUTCOMES :

At the end of the course, the students will be able to

1. Understand the working of analog and digital communication systems.
2. Explain the OSI network model and the working of data transmission.
3. Describe the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
4. Differentiate between analog and digital modulation techniques
5. Understand the optical fibre communication link, structure, propagation and transmission properties.

UNIT– I

Introduction to Communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.

Signal Transmission Concepts: Baseband transmission and Broadband transmission, **Communication Parameters:** Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT– II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT– III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/ IPv6), Transport Layer – TCP,UDP.

UNIT-IV

Telecommunication Systems: Telephones, Telephone system, **Optical Communications:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT-V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. **Current Wireless Technologies:** Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

TEXTBOOKS:

1. Louis E. Frenzel, "Principles of ElectronicCommunicationSystems",3rd edition, McGraw Hill, 2008.
2. George Kennedy, Bernard Davis, "Electronic Communication systems", 4th edition, McGraw Hill, 1999.

REFERENCEBOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking",5th edition, TMH, 2012.
2. Rappaport T.S. ,"Wireless communications",2nd edition, Pearson Education, 2010.
3. Wayne Tomasi, "Advanced Electronic Communications Systems",6th edition, Pearson Education.

Course Code	Course Title	Core/Elective					
4OE501EE	RENEWABLE ENERGY SYSTEMS	Open Elective - 1					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To understand the concepts and Importance of renewable energy sources such as solar, wind, biomass, tidal power.
2. To make the students understand the advantages and disadvantages of different renewable energy sources

COURSE OUTCOMES :

At the end of the course students will be able to

1. Explain the advantages, disadvantages and applications of different conventional and non-conventional sources.
2. Acquire the knowledge of various components, principle of operation and present scenario of different conventional and non- conventional sources.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells – Principle of operation with specialreferencetoH2 °2Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells — Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy, V-I and P-V curves and the concept of MPPT.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS - Classification of WECS - Site selection considerations - Advantages and disadvantages of WECS - Wind energy

collectors - Wind electric generating and control systems - Applications of Wind energy - Environmental aspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation - Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

TEXTBOOKS:

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, NewDelhi,2011.
2. David M Buchla and Thomas E Kissell, Renewable Energy Systems,1st Edition by, Pearson India.

REFERENCE BOOKS :

1. M.M. El- Wakil, Power Plant Technology, McGraw Hill,1984.
2. John T widell, Tony Weir, Renewable Energy R73esources,3rdEdition,Taylor and Francis.

Semester – VI

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6PC611ME	Dynamics of Machines	3	1	-	4	40	60	4
2	6PC612ME	Heat Transfer	3	-	-	3	40	60	3
3	6PC613ME	Design of Machine Elements- II	3	1	-	4	40	60	4
4	OE	Open Elective II**	3	-	-	3	40	60	3
5	PE	Professional Elective II / MOOC's	3	-	-	3	40	60	3
6	PE	Professional Elective III / MOOC's	3	-	-	3	40	60	3
7	6MC603HS	Indian Constitution	2	-	-	2	40	60	-
Practical / Laboratory									
8	6HS653HS	Soft Skills Lab	-	-	2	2	40	60	1
9	6PC658ME	Theory of Machines Lab	-	-	2	2	40	60	1
10	6PC659ME	Heat Transfer Lab	-	-	2	2	40	60	1
Total			**20**	**2**	**6**	**28**	**400**	**600**	**23**

O.E.II→1. 6OE602ME 3D Printing Technologies

** Subject is not offered to the students of Mech. Engg. Department

P.E.II →

1. 6PE605ME Power Plant Engineering (MOOC's-2C)
2. 6PE606ME Industrial Tribology
3. 6PE607ME Introduction to Composites (MOOC's-3C)
4. 6PE608ME Entrepreneurship (MOOC's-3C)

P.E.III →

1. 1.6PE609ME Turbo Machinery
2. 6PE610ME Introduction to Mechanical Vibrations (MOOC's-2C)
3. 6PE611ME Fundamentals of Additive Manufacturing Technologies (MOOC's-3C)
4. 6PE612ME Industrial Engineering

Note : Students have to undergo summer internship of 4 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

Course Code	Course Title						Core/Elective
6PC611ME	DYNAMICS OF MACHINES						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Mechanics, Strength of Materials & Kinematics of Machinery	3	1	-	-	40	60	4

COURSE OBJECTIVES:

1. To understand the forces, torques and energy involved in different machine members.
2. To understand theory involved in the analysis of clutches, brakes, dynamometers and flywheels.
3. Aware of situations like speed fluctuations, rotor imbalance and machine vibration which appears in industry.
4. To understand the modes of vibrations, two degree of Freedom and Torsional Vibrations.
5. To determine natural frequencies of undamped, damped and forced vibrating systems of single degree freedom systems.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Recall the gyroscopic effects in ships, aero planes and road vehicles, function of governors, flywheels and basic concepts on vibrations, brakes, rotating and reciprocating machinery.
2. Demonstrate the ability to apply the fundamentals of gyroscopic couple, Governors, Brakes, Balancing of rotating, reciprocating masses and Vibrations.
3. Analyze gyroscopic couple, Height of Governor, Angular velocity of Flywheels, Balancing of forces in Reciprocating machinery, Rotating machinery, fundamental frequencies of free, forced and Torsional Vibrations.
4. Evaluate gyroscopic couple, Height of Governor, Angular velocity of Flywheels, Balancing of forces in Reciprocating machinery, Rotating machinery, Fundamental frequencies of free, forced and Torsional Vibrations.
5. Formulate Gyroscopic couple, Height of Governor, Angular velocity of Flywheels, Balancing of forces in Reciprocating machinery Rotating machinery, fundamental frequencies of free, forced and Torsional Vibrations.

UNIT-I:

Force analysis: Dynamic force analysis of single slider crank mechanism and four bar mechanism concept of dynamically equivalent link. Static force analysis of single slider crank mechanism and four bar mechanism.

Gyroscope: Principle of gyroscope, rolls, yaw and pitch motions, gyroscopic effect in a two- wheeler, car, ship and aeroplane, practical problems.

UNIT-II:

Governors: Necessity of governor, different types of governors, working principle of centrifugal governors, characteristics of Watt governor, Porter governor, Proell governor, Hartnell governor & Hartung governor. Hunting of governors, concept of control force, control force diagram, definition of stability of governor, condition for stability, concept of isochronisms, sensitivity of governor, energy of governor.

Brakes: Simple block brakes, internal expanding brake, band brake of vehicle, Dynamic force analysis on braking system.

UNIT-III:

Flywheels & Turning moment diagrams: Working principle of flywheel, turning moment on the crank shaft, turning moment diagrams, maximum fluctuation of energy and its determination, coefficient of fluctuation of speed, design of flywheels, rim type flywheel versus solid type flywheel. Flywheel analysis for I.C. Engines and shearing/punching/riveting machines.

UNIT – IV:

Balancing of Rotating masses: Balancing and its types, rotor balancing, single plane and two plane balancing, unbalanced forces and couples, static and dynamic balancing, balancing of rotors by analytical and graphical methods.

Balancing of reciprocating machines: Primary and secondary unbalanced forces, balancing of in line and radial engines.

UNIT – V:

Vibrations: Free Vibrations of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

TEXT BOOKS:

1. S.S. Rattan, -Theory of Machines Fourth edition, Tata-Mc Graw Hill.

REFERENCE BOOKS:

1. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, ?Theory of Machines & Mechanisms, Oxford University press.
2. William T.Thomson -Theory of Vibration with Application, 5th edition, Pearson education.
3. Ghosh and Mallick, -Theory of mechanisms and machines, Affiliated to E-W Press.
4. J.S. Rao and Gupta, -Theory and Practice of Mechanical Vibrations, PHI.

Course Code	Course Title						Core/Elective
6PC612ME	HEAT TRANSFER						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
TD	-	3	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand the basic concepts of heat transfer.
2. To study the concepts of conduction, convection and radiation.
3. To study and solve problems on different modes of heat transfer.
4. To study the basic concepts of Boiling and condensation.
5. To understand the basic concepts of Heat Exchangers and applications.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the basic modes of heat transfer.
2. Compute temperature distribution in steady-state and unsteady-state heat conduction.
3. Interpret forced and free convection heat transfer.
4. Understand the principles of boiling, condensation and radiation heat transfer.
5. Design of heat exchangers using LMTD and NTU methods.

UNIT-I

Conduction: Modes of Heat Transfer, Laws of Heat Transfer - Fourier, Newton, Stefan- Boltzmann General conduction equation in Cartesian, cylindrical and spherical coordinates, One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation, Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plate, cylinders and spheres, Steady state heat transfer through composite slabs, cylinders and spheres, Critical radius of insulation.

UNIT - II

Fins: Heat transfer analysis of tips with heat dissipation environment - rectangular straight pin fins, Application of fin to temperature measurement, unsteady state conduction, Lumped parameter analysis of a body with negligible internal temperature gradients, Transient heat transfer analysis of finite slab with specified temperature

and convective boundary conditions, Use of Grober and Heisler charts for solving problems of infinite slabs, cylinders and spheres.

UNIT – III

Free and forced convection: Dimensional analysis and its use in free and forced convection, Buckingham theorem, Physical significance of different dimensionless numbers, Application of Von-Karman integral equation for the analysis of thermal boundary layer in forced convection of flat plate, Reynold's analogy for flow over plane surfaces, calculation of heat transfer for flow over plates, cylinders, spheres and flow through tubes in free and forced convection using empirical formulae.

UNIT – IV

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's black body spectral distribution, Wien's and Stefan Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric cylinders, Enclosures with black and grey surfaces, Radiation shields and re-radiation surfaces.

UNIT – V

Heat Exchangers: Classification and applications of heat exchangers in industry, Analysis and design of counter flow and parallel flow heat exchanger, Fouling factors, problems on multi pass heat exchanger using non dimensional parameter plots.

Change of Phase: Boiling-pool boiling regimes nucleate pool boiling, effect of surface wettability on bubble contact angle, Critical heat flux, boiling in forced convection, **Condensation:** Film condensation, Drop wise condensation, Condensation film thickness, Heat transfer coefficient in film condensation.

TEXT BOOKS:

1. Rajput R.K. -Heat and Mass Transfer, S. Chand & Company Ltd, New Delhi.
2. Sachdeva R.C. -Fundamentals of Engineering Heat and Mass Transfer ? New Age International (P) Ltd Publishers, New Delhi.

REFERENCE BOOKS:

1. Holman J.P. -Heat Transfer McGraw Hill Publication, New Delhi.
2. Yadav R, Sanjay. and Rajay. -Heat and Mass Transfer, Central Publishing House, Allahabad.
3. Arora S.C. and Domkandwar ?A course in Heat and Mass Transfer - Dhanpat Rai & Sons, New Delhi.

Course Code	Course Title						Core/Elective
6PC613ME	DESIGN OF MACHINE ELEMENTS - II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Strength of Materials & Design of Machine Elements- I	3	1	-	-	40	60	4

COURSE OBJECTIVES:

1. To acquire knowledge how to analyse, design, and choose commonly used machine components using the principles of stress analysis, failure theories and material science.
2. To acquire knowledge about the numerous mechanical components that are available and to utilise mechanical engineering design theory to identify and quantify machine parts in the design of regularly used mechanical systems.
3. To gain knowledge about designing the essential mechanical gears and its design principles.
4. To gain knowledge about design principles of IC engine piston, connecting rod, crank shaft, C- clamp and crane hooks.
5. To acquire knowledge about using the data available in design data books to design the various engine components.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. State the function of springs, gears, Bearings, IC Engine parts and bending theory of members with initial curvature.
2. Summarize the Materials for springs, Gears, Bearings, IC Engine components and curved beams.
3. Select various types of Springs, Bearing, Gear drives and curved beams for specific application.
4. Analyze the design of Helical coil springs, leaf springs Gear drives, IC Engine components and curved beams for mechanical systems.
5. Design various types Springs, Gear drives, Bearings, IC Engine components and curved beams.

Note: Design Data Book is permitted.

UNIT-I

Mechanical Springs: Introduction, types of springs, Materials used for springs. Helical Springs: Wahl's factor, calculation of stresses, deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs: Stresses and deflection, nipping of Leaf springs. Design for static loads.

UNIT-II

Bearings: Introduction, classification of bearings, materials used for bearings, properties and types of lubricants. Design of Sliding Contact Bearings: Hydrodynamic bearings.

Selection of Rolling Contact Bearings: Types of rolling elements and their constructional details, Static and dynamic load carrying capacity, Load-life relationship, selection of bearing for cyclic loads and speeds.

UNIT-III

Gears: - Force Analysis, Spur, Helical Gears, Bevel and Worm Gears, Selection of Gears– Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear. Types of gear tooth failure and preventive measures

Design of Belts & Pulleys: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts – Flat and V types – Ropes – pulleys for belt and rope.

UNIT-IV

I.C. Engine Parts: Introduction, Materials used, Design of piston, connecting rod and overhang crank shaft.

UNIT-V

Design of Curved Beams: Introduction, stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular and trapezoidal sections, Design of C-clamp and crane hook.

Design for manufacturing: Design considerations for Welding, Forging & Casting. Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts. Material selection in machine design.

TEXT BOOKS:

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill.
2. Machine design/RS Khurmi.

REFERENCE BOOKS:

1. Machine Design / Jindal / Pearson.
2. Design of Machine Elements / V. M. Faires / Macmillan.
3. Design of Machine Elements-I / Kannaiah, M.H / New Age.

Course Code	Course Title						Core/Elective
6PE605ME	POWER PLANT ENGINEERING						PE-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand operation of steam turbine power plant.
2. To understand about gas turbine power plants.
3. To understand hydraulic power plant and various types of nuclear power plants.
4. To understand working knowledge of basic design principles of Solar, wind, geothermal and alternative power plants.
5. To understand the power plant economics, environmental and safety aspects of power plant operation.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. List out the various components in power plant.
2. Illustrate the working principle of gas turbine power plant.
3. Demonstrate the hydro power plant dams and spillways.
4. Explain the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized- water, boiling-water and heavy-water reactors.
5. Explain economic feasibility and the control methods of major pollutants emitted from fossil-fuel power plants.

UNIT-I

Introduction to Sources of Energy- Resources and Development of Power in India.

Steam Power Plant: Plant layout, working of different circuits, Fuel handling equipment, coal handling and choice of handling equipment, coal storage and ash handling systems.

UNIT-II

Combustion Process: Types of coal. Properties of coal- overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone

furnace, design and construction, Dust collectors, cooling towers and heat rejection, corrosion and feed water treatment.

UNIT-III

Gas Turbine Power Plant: Introduction -Classification-Layout with Auxiliaries-Principles of working of closed and open cycle gas turbines.

Hydro Electric Power Plant: Water Power, Classification of dams and spill ways, Hydrological cycle, flow measurement- drainage area Characteristics-Hydrographs-storage and pondage.

UNIT-IV

Nuclear Power Plant: Nuclear fuel-breeding and fertile materials -Nuclear reactor-reactor Operation- Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas-cooled reactor. Radiation hazards and shielding - Radioactive waste disposal.

UNIT-V

Power Plant Economics: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, average load and load factor, delivery factor-related exercises.

Environmental Considerations: Effluents from power plants and impact on environment - Pollutants and Pollution Standards -Methods of pollution control.

TEXT BOOKS:

1. Power Plant Engineering, P. K. Nag, McGraw Hill Publications, Fourth edition
2. Power Plant Engineering, R. K. Rajput, Laxmi Publications, Fourth edition

REFERENCE BOOKS:

1. Power Plant Engineering, RK Hegde, Pearson India publications, First edition
2. Power Plant Technology, M.M.El-Wakil, McGraw Hill, Indian
3. Power Plant Engineering, Arora & Domkundwar, Dhanpathi Rai & Sons, Tenth edition.

Course Code	Course Title						Core/Elective
6PE606ME	INDUSTRIAL TRIBOLOGY						PE-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Applied Mechanics, Material Science	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand the application of Tribology in modern machinery for designing, manufacturing and exploration for new and better products.
2. To understand the principles of theories of lubrication, lubricants and their chemistry.
3. To understand the principles of theories of wear and friction.
4. To familiarize various types of bearings for different applications.
5. The most important types of coatings and surface modifications for protection of surfaces.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the fundamentals of Tribology and associated parameters.
2. Apply the concepts of Tribology for the performance analysis and design of components experiencing relative motion and apply the principles of surface engineering for different applications of Tribology.
3. Select proper bearing materials and lubricants for a given tribological application.
4. Analyze the requirements and design hydrodynamic journal and plane slider bearings for a given application.
5. Design hydrodynamic journal and plane slider bearings for wear and Corrosion resistance.

UNIT-I

Introduction to Tribology: Historical background, practical importance, and subsequent use in the field.

Lubricants: Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.

UNIT-II

Friction: Origin, friction theories, measurement methods, friction of metals and non-metals.

Wear: Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies.

UNIT-III

Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reinhold's equation in 2D. Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Somerfield's number and its significance; partial bearings, end leakages in journal bearing, numerical examples.

UNIT-IV

Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing, centre of pressure, numerical examples.

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples. Introduction to Hydrostatic journal bearings.

UNIT-V

Bearing Materials: Commonly used bearings materials and properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Introduction to Surface engineering: Concept and scope of surface engineering.

Surface modification : Transformation hardening, surface melting, thermo chemical processes.

Surface Coating : Plating, fusion processes, vapour phase processes. Selection of coating for wear and corrosion resistance.

TEXT BOOKS:

1. Introduction to Tribology B. Bhushan John Wiley & Sons, Inc., New York.
2. Engineering Tribology Prasanta Sahoo PHI Learning Private Ltd, New Delhi.

REFERENCE BOOKS:

1. Engineering Tribology J. A. Williams Oxford Univ. Press.
2. Introduction to Tribology in bearings B. C. Majumdar Wheeler Publishing.
3. Engineering Tribology G. W. Stachowiak and A. W. Batchelor Butterworth-Heinemann.

Course Code	Course Title						Core/Elective
6PE607ME	INTRODUCTION TO COMPOSITES						PE-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To learn the concept of composite materials
2. To learn the polymer matrix composite.
3. To gain the knowledge of metal matrix composite and laminate composite
4. To understand the manufacturing methods of various composite materials.
5. To interpret the mechanical behaviour of composite materials

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Explain the advantages and applications of various types composite materials.
2. Describe the properties of polymer metal matrix of composite materials.
3. Summarize the metal matrix composite materials and importance.
4. Describe the manufacture of metal matrix and polymer matrix composites.
5. Formulate the mechanical behaviour of composite materials and theories of laminated composite materials.

UNIT-I

COMPOSITE MATERIALS

Fundamentals of composites – need for composites – classification of composites – Matrix- Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

UNIT-II

POLYMER MATRIX COMPOSITES

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand lay up processes – spray up processes – compression moulding.

UNIT-III

METAL MATRIX COMPOSITES

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, spray process.

UNIT-IV

LAMINATED COMPOSITES

Laminates Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Types of Laminates, Symmetric Laminates, Anti symmetric Laminate, Balanced Laminate, Quasi- isotropic Laminates.

UNIT-V

MECHANICAL BEHAVIOR OF COMPOSITES

Mechanical Properties: Material axes in unidirectional composites, composite density. Thermal properties. predictive models – strength, stiffness and Elastic constants.

TEXT BOOKS:

1. Chawla K. K., "Composite materials", Second Edition, Springer – Verlag.
2. M.Balasubramanian, Composite materials processing, 1st edition, CRC press.

REFERENCE BOOKS:

1. Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England.
2. Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint.
3. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press.
4. Mechanics of Composite Materials, Jones, R. M., Mc-Graw Hill.

Course Code	Course Title						Core/Elective
6PE608ME	ENTREPRENEURSHIP						PE-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To motivate students to take up entrepreneurship in future
2. To learn nuances of starting an enterprise & project management
3. To understand project formulation and choice technology in enterprise
4. To understand the behavioural aspects of entrepreneurs and time management

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-1

Entrepreneurship: Definition, functions of entrepreneurship, Characteristics and qualities of entrepreneurs, Entrepreneur vs. intrapreneur, need of innovation, Economic growth. Small Scale Industry in India, Linkage among small, medium and heavy industries.

UNIT – II

Indian Industrial Environment: Competence, Opportunities and Challenges, Emergence of First generation entrepreneurs, women entrepreneurs. Conception

and evaluation of ideas and their sources. Types of enterprises. Collaborative interaction for Technology development. Corporate Social Responsibility

UNIT – III

Project formulation: Introduction, Elements of Business Plan and its salient features, Analysis of market demand, Financial and profitability analysis and Technical analysis.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - Determinants, Attributes and Models. Leadership concepts and Models. Values and Attitudes.

Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

TEXT BOOKS:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", House, Tata McGraw-Hill Publishing Company Ltd.

REFERENCE BOOKS:

1. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication,
2. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd.,
3. G.S. Sudha, "Organizational Behaviour".

Course Code	Course Title						Core/Elective
6PE609ME	TURBO MACHINERY						PE-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Understand isentropic flow for variable areas and relations
2. Understand and apply fanno flow, Rayleigh flow and shock flow.
3. Understand centrifugal and axial flow compressor with velocity triangles
4. Understand and analyze impulse and reaction steam turbines with velocity triangles
5. Understand and analyze gas turbines and rocket propulsion

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Analyze situations of Thermal gradients in Turbo machines and apply the situation of fluid flow analysis with energy conversion principles for work transfer.
2. Develop knowledge about working principles of work absorption and work producing situations
3. Understand applications of Thermodynamics with fluid flow behavior and compressibility effects
4. Attain knowledge of Power production using external combustion engines, with methods of improving efficiencies
5. Establish and compute one dimensional thermodynamic analysis of Compressors, Turbines (both for air & vapour working fluids) and analyzing using velocity triangles for single and multi stages.

UNIT-I

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow. Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers. Flow in constant area ducts with friction-

Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction.

UNIT-II

Flow in constant area duct with Heat Transfer, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer. Flow with Shock Waves- Development of Normal Shock waves, governing equations, Prandtl -Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

UNIT-III

Blade nomenclature of an aerofoil, Rotodynamic compressors: Introduction and general classification, comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities, Thermodynamic cycles and work done, calculation of various efficiencies. Velocity diagrams and pre-whirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV

Steam Turbines: Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure- velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stage efficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust.

UNIT-V

Gas Turbines: Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines, Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications

TEXT BOOKS:

1. Yahya S M, Fundamentals of Compressible Flow, New Age International Publishers, Third Edition Mathur ML, & Mehta F S, Thermal Engineering, Jain Brothers, New Delhi.
2. Ganeshan V, Gas Turbines, Tata Me Graw Hills, New Delhi.

REFERENCE BOOKS:

1. Dennis G Shepherd, Aerospace Propulsion, Elsevier Publishing Company, New York.
2. Power Plant Technology, M.M.El-Wakil, Mc Graw Hill, Indian
3. CohenH Rogers G F C, Saravana Mutto H I H, Gas Turbine Theory, Longman 5th Edition, New York.

Course Code	Course Title				CIE	SEE	Core/Elective
6PE610ME	INTRODUCTION TO MECHANICAL VIBRATIONS						PE-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Kinematics of Machines & Dynamics of Machines	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Explain the concept of vibrations, with single degree of freedom systems.
2. Discuss the numerical methods involved in vibrations.
3. Demonstrate the concept of Transient vibrations.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the concepts related to vibrations and its motion in one, two and multi degree of freedom systems.
2. Demonstrate the ability to apply the fundamentals of Undamped, damped free & forced vibrations.
3. Analyze the vibration respond from Undamped and damped in free, forced excitation with various excitation and Vibration Measuring instruments for engineering applications
4. Evaluate Free, Forced, Damped, and Undamped, one, two and multi degrees of Freedom.
5. Formulate the solution of engineering problem in mechanical system by considering economy, safety & environment energy conservation.

UNIT-I

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems

UNIT-II

Damped free vibrations (Single Degree of Freedom): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

UNIT-III

Forced Vibrations (Single Degree of Freedom): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

UNIT-IV

Vibrations (Two degrees of Freedom Systems):

Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems, undamped dynamic vibration absorber and Problems.

UNIT-V

Numerical Methods for multi degree freedom of systems:

Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration and Problems.

Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.

TEXT BOOKS:

1. Rao, Singiresu S., "Mechanical Vibrations", 5th Edition, Prentice Hall.
2. Inman, D. J. "Engineering Vibration", 3rd Edition, Pearson Prentice Hall.

REFERENCE BOOKS:

1. Kelly, S. Graham, "Mechanical Vibrations: Theory and Applications", SI Edition, Cengage Learning.
2. Timoshenko, S. "Vibration Problems in Engineering", Fifth Edition, John Wiley & Sons, Inc.
3. Leonard Meirovitch, "Elements of Vibration Analysis", International Edition, McGrawHill.

Course Code	Course Title				Core/Elective		
6PE611ME	FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES						PE-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To introduce and make students understand the basics of additive manufacturing/rapid prototyping, its advantages & limitations.
2. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
3. To know the features of various software used in additive manufacturing.
4. To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based Technologies.
5. To know diversified applications of additive manufacturing Technologies and to explore the potential of AMT in different industrial sectors.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Interpret and describe the fundamentals and features of additive manufacturing.
2. Select suitable CAD data formats and software for different additive manufacturing technologies.
3. Describe the operating principles and capabilities of liquid, solid & powder based additive manufacturing systems.
4. Understand the advantages and limitations of liquid, solid & powder based additive manufacturing systems.
5. Explore the applications of AMT in different industrial sectors.

UNIT-I

Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of Rapid Prototyping, rapid prototyping process chain, Advantages Limitations of rapid prototyping, rapid prototyping wheel, Commonly used Terms, Classification of processes.

UNIT-II

Liquid-based Systems: Stereo Lithography Apparatus (SLA): Models and Specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser, laser scanning, Applications, Advantages and Disadvantages, Case studies. Poly jet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case Studies. Fused

Deposition Modelling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Wire Arc Additive Manufacturing (WAAM& WLAM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-III

Powder Based Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM).

Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

Rapid Tooling: Introduction to Rapid Tooling (RT),Conventional Tooling v/s RT, Need for RT. Rapid Tooling Classification; Direct & Indirect tooling methods.

UNIT-IV

Data Formats &Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL files Repairs, Newly Proposed Formats.

Software's Features: Magics, Mimics, Solid View, View Expert, 3D Rhino, 3D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, Mesh Lab, Ansys for Additive Manufacturing.

UNIT-V

Applications of Additive Manufacturing: Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, construction

field, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customised Implants Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization Bio molecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

TEXT BOOKS :

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific..
2. 3DPrinting, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition.

REFERENCE BOOKS :

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies:
2. Frank W. Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor &Francis Group.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley& Sons.

Course Code	Course Title						Core/Elective
6PE612ME	INDUSTRIAL ENGINEERING						PE-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To learn the concept of Management.
2. To understand the role of Production Planning and Control in Industry.
3. To learn various material procurement policies.
4. To understand importance of quality control and various methods.
5. To interpret the role of Decision theory in Industry.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Explain various approaches for industrial management. Able to infer concept of management in human resource domain.
2. Apply the Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time.
3. Determine the optimum requirement of inventory by developing the various quantitative models.
4. Develop the various models or methods for ensuring the required quality of the products or process.
5. Elaborate the role of Decision theory and apply various approaches under Uncertainty and Risk conditions.

UNIT-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO and Decision Making Process.

Personnel Management- Functions of personnel management, types of training, Job evaluation and Merit rating, Collective bargaining and labour participation in management.

UNIT-II

Production Planning & Control: Definition, Objectives, Importance and Functions of Production Planning & Control. Planning, Routing, Scheduling, Dispatching, Follow-up and progress Report. Introduction to Forecasting.

UNIT-III

Inventory Control: Importance of inventory control, types of inventory models, Inventory costs deterministic inventory models, Basic EOQ models, ABC analysis, production model without shortages, Purchase model with instantaneous replenishment and with shortages, production model without shortages. Inventory model with price breaks, Fixed order quality system, periodic review system, Inventory model with probabilistic demand model.

UNIT-IV

Quality Control: Concept of quality, evaluation of quality control, assignable and chance causes of variation, Variable Control charts (X and R charts), Attributes control charts: P chart and C chart

Acceptance Sampling–Single Sampling, Double Sampling and Multi sampling plans–OC curves of single sampling plans

UNIT-V

Decision Making:

Decision Theory, Types of Decision making Environment. Decision making under Uncertainty- Criterion of Optimism or Maxi max, Criterion of Pessimism or Maxi min, Mini max decision criteria, Decision making under Risk –Expected Monetary Value (EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information (EVPI) Criterion, Decision Trees.

TEXT BOOKS:

1. M.Mahajan, Industrial Engineering and Production Management", Dhanpatrai &sons, New Delhi
2. S.K. Sharma and Savita sarma, "Industrial Engineering and Organization Management ",SK Kataria & Sons, New Delhi.

REFERENCE BOOKS:

1. S.D.Sharma, "Operations Research", Kedarnnath, Ramnath & Co., Meerut.
2. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd.
3. V.K.Kapoor,"Operations Research", S.Chand, NewDelhi.
4. S K Sharma & Savita Sharma,"Acourse in Industrial Engineering & Operations Management ", S K Kataria & Sons.

Course Code	Course Title						Core/Elective
6MC603HS	INDIAN CONSTITUTION						MC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Elementary Civics-School level	2	-	-	-	40	60	-

COURSE OBJECTIVES:

The objective of this course is:-

1. To create awareness and relevance of the Indian Constitution, its directive principles.
2. To impart understanding of the role, powers and functions of administration at the Central, State and local levels.
3. To create awareness and understanding of Fundamental Rights, State Policy and Duties of Ideal citizen
4. To expose students to the relations between Central/Federal, State and Provincial units, divisions of executive, legislative and judiciary in them.
5. To impart knowledge about the statutory institutions and their role.

COURSE OUTCOMES:

After completion of the course, the student will be able to:-

1. Have a general knowledge and back ground about the Constitution of India and its importance.
2. Will distinguish and understand the working of the Central, state and provincial levels of administration.
3. Will be conscious about the fundamental duties, responsibilities and rights as an ideal citizen of India
4. Will be able to perceive and interpret the functioning and distribution of resources between centre and state.
5. Have an awareness and relate to the existing hierarchy of the social structure, election process and Grievance redressal in a democracy

UNIT-I

Introduction to Constitution- Meaning, reasons for having a constitution.

Evolution of the Indian Constitution: History, 1909 Act,1919 Act and 1935 Act and Premeable

Constituent Assembly: Composition and Functions.

UNIT-II

Government vs. Governance:

Union Government: Political Executive-President, Prime Minister, Council of Ministers, Bureaucratic Executive.

State Government: Executive: Governor, Chief Minister, Council of Ministers

Local Government: Panchayat Raj Institutions, Rural and Urban local bodies-composition

UNIT-III

Rights and Duties: Fundamental Rights, Directive principles of State Policy, Fundamental Duties of a good citizen Public Interest Litigation.

UNIT-IV

Relation between Federal and Provincial units:

Union-State relations: Administrative, Legislative and Financial, Inter-State council, NITI Ayog, Finance Commission of India.

UNIT-V

Constitutional and Statutory Bodies:

Election Commission and Electoral Reforms, National Human Rights Commission, National Commission for Women, National Commission for Minorities, National Commission for Protection of Child Rights.

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India", English-Hardcover –Lexis Nexis, New Delhi.
2. Dr. B.L. Fadia, Dr. Kuldeep Fadia , "Indian Government and Politics", Sahithya Bhavan Publications, Agra.
3. M . Lakshmikanth, "Indian polity', Tata McGraw Hill.

REFERENCE BOOKS:

1. M.V. Pylee, " Indian Constitution".
2. Khattar, "Indian Political System".
3. Constitution of India, Telugu Academy.

Course Code	Course Title						Core/Elective
6HS653HS	SOFT SKILLS LAB						HS
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To enable the students to listen to different speakers in different contexts for various purposes and learn target language expressions.
2. To enable the students to develop confidence and interactive skills to speak professionally in different situations.
3. To enable students to learn and develop various reading skills and strategies.
4. To enable the students to develop written expression of thought and provide opportunities to explore ideas by utilizing various techniques.
5. To equip the students to develop needed confidence and interactive skills to speak professionally and acquire skills to face any Interview.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Listen to a variety of speakers and texts and will be able to comprehend and perform the required tasks.
2. Interact in a group professionally and communicate confidently in terms of both the spoken and written communication.
3. Develop the skills and strategies of reading and writing.
4. Face any Interview confidently by managing time, making decisions by speaking appropriately according to the context.
5. Demonstrate right attitude and right skills to cope with team and communicate professionally.

LIST OF EXPERIMENTS

I. Listening Skills

- Listening to different situations by Native Speakers.
- Listening to Conversations.
- Listening to Motivational Speeches.

II. Speaking Skills

- Describing a person or a place or a thing using relevant adjectives.
- Picture Perception
- Oral Presentations.
- Etiquette in different situations.

III. Reading Skills

IV. Writing Skills

V. Interview Skills

- Reading different Texts
- Reading Comprehension Passages.
- Skimming and Scanning
- Paraphrasing.
- Writing Slogans related to the image.
- Communicating on Social Media.
- Skills required to attend an Interview
- Soft Skills to be demonstrated in a Job Interview.
- Debates and Group discussions.

TEXT BOOKS:

1. Andrea J. Rutherford.Basic Communication Skills for Technology. Pearson Education. Inc. New Delhi.
2. Antony Jay and Ros Jay. Effective Presentation. How to be a Top Class Presenter. Universities Press. (India) Limited.

REFERENCE BOOKS:

1. Robert M Sherfield and etal. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education.
2. M.Ashraf Rizvi Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited. New Delhi.

Course Code	Course Title						Core/Elective
6PC658ME	THEORY OF MACHINES LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Theory of Machines lab	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To impart practical knowledge on design and analysis of mechanisms in the automobiles.
2. To understand the kinematics and dynamics of mechanical elements such as linkages, cams, Governors and learn to design such elements to accomplish desired motions or tasks.
3. To acquire the knowledge in evaluating the stability of vehicles.
4. To demonstrate the importance of static and dynamic balancing.
5. Frequency response of spring mass system with damping and without damping - Undamped torsional vibrations of single and double rotor systems.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Understand the function of Governors, Gyroscope, Various types of vibrations and kinematic mechanisms
2. Summarize various types of governors, vibrations and kinematic mechanisms
3. Select Various types of governors, kinematic mechanisms and vibrations based on industrial applications
4. Analyze forces acting on governors, vibrations and kinematic mechanisms
5. Evaluate the balancing of forces in rotating masses, gyroscopic couple due to centrifugal force, Height of governor with respect to speed, Natural frequencies of free and forced vibrations

LIST OF EXPERIMENTS

1. To study various types of cam and cam follower arrangements.
2. To study various types of kinematics links, pairs, chains & mechanisms
3. To study inversions of 4 bar Mechanisms and slider crank mechanisms
4. Centrifugal Governors: Experiment on Performance Characteristic Curves.

5. Estimation of Gyroscopic Couple & Understanding of Gyroscopic Effects on a rotating disc.
6. Static and Dynamic Balancing of Rotating Masses.
7. Damped and Undamped Torsional Vibrations of Single and Double Rotor System.
8. Single DOF (Degrees of Freedom) of Spring Mass Damper System. (Damped and Undamped Systems).
9. Free and Forced Vibration of Simply Supported Cantilever Beam.
10. Dunkerley Method to Find Fundamental Frequencies.
11. Critical Speed of Shaft.
12. To find the coefficient of friction between belt and pulley

Note : Minimum ten experiments should be conducted in the semester.

Course Code	Course Title						Core/Elective
6PC659ME	HEAT TRANSFER LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications.
2. To demonstrate knowledge in evaluating thermal conductivity and heat transfer coefficient under natural convection phenomena and forced convection phenomena.
3. To understand the basic concepts of radiation heat transfer.
4. To understand the basic working principle of Heat Exchangers.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Analyze the effective thermal resistance in composite slabs and thermal conductivity of metal bar.
2. Evaluate the heat transfer coefficient in free and forced convection.
3 Evaluate the overall heat transfer coefficient of Parallel and counter flow heat exchanger.
4 Evaluate emissivity of test plate and Stefan Boltzman constant.
5 Analyze overall efficiency of Axial flow fan and Centrifugal blower.

LIST OF EXPERIMENTS

1. Determination of overall and individual plate thermal conductivity for a composite wall.
2. Determination of thermal conductivity of metal Rod.
3. Determine heat transfer in pin-fin and its efficiency.
4. Determination of radiation emissivity of a test plate
5. Determination of Stefan-Boltzmann constant for radiation.
6. Determine overall heat transfer coefficient of Parallel and counter flow heat exchanger
7. Heat transfer in Natural convection
8. Heat transfer in Forced convection
9. Determination of overall efficiency of centrifugal blower
10. Determination of overall efficiency of axial flow fan
11. Determination of COP of Refrigeration system using capillary tube and thermostatic expansion valve
12. Measurement of Lift and Drag force models in Wind tunnel section

Note: At least ten experiments should be conducted in the Semester

Course Code	Course Title						Core/Elective
6OE602ME	3D PRINTING TECHNOLOGIES						Open
Prerequisite	Contact Hours per Week						Elective-II
	L	T	D	P	CIE	SEE	Credits
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand the fundamental concepts of 3D Printing, its advantages & limitations.
2. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
3. To know the working principle, advantages, disadvantages & applications of liquid, solid and powder based 3D Printing technologies.
4. To know the diversified applications of 3D Printing technologies and explore them in different industrial sectors.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Describe the fundamentals of 3D printing, classify and explain advantages and disadvantages of 3D Printing technologies.
2. Select thesuitable CAD data formats and software used in 3D Printing technology.
3. Describe the operating principles, capabilities and limitations of liquid, solid & powder based 3D Printing Technologies.
4. Compare different 3D printing technologies based on their process capabilities and applications.
5. Apply the capabilities and knowledge of 3D printing in different industrial sectors.

UNIT-I

Prototyping Fundamentals: Historical Development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used terms, 3D Printing Process Chain, 3D Modelling, Data conversion and transmission, Checking & Preparing, Building, Post processing, Classification of 3D Printing processes, Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Data Formats & Software: Data formats; conversion and transmission, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats. Software's Features: Magics, Mimics, Solid View, Cura, ITK Snap.

UNIT-II

Liquid based Systems: Stereo Lithography Apparatus (SLA): Models and Specifications, Process, working principle, photopolymers, photo polymerization, Layering Technology, laser and laser scanning, Applications, Advantages and Disadvantages. Poly jet: Models and

Specifications, Process, working principle, Applications, Advantages and Disadvantages. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-III

Solid-based Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Fused Deposition Modelling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Multi Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages.

UNIT-IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Three Dimensional Printing (3DP): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Construction field, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production Medical Devices, Forensic Science and Anthropology and Web Based Rapid Prototyping Systems.

TEXT BOOKS:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition.

REFERENCE BOOKS:

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies:
2. Frank W. Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor & Francis Group.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons.

Course Code	Course Title						Core/Elective
1OE602AD	DEEP LEARNING						Open Elective-II
Prerequisite	Contact Hours per Week						
	L	T	D	P	CIE	SEE	Credits
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To Develop and Train Deep Neural Networks.
2. To Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition.
3. To Build and train RNNs, work with NLP and Word Embeddings.
4. To The internal structure of LSTM and GRU and the differences between them.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Feature Extraction from Image and Video Data.
2. Implement Image Segmentation and Instance Segmentation in Images.
3. Implement image recognition and image classification using a pre trained network (Transfer Learning).
4. Traffic Information analysis using Twitter Data.
5. Auto encoder for Classification & Feature Extraction.

UNIT-I

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT-II

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Over fitting and Under fitting. Hyper parameters.

UNIT-III

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers.

Dense Layers. Back propagation Through the Convolutional Layer. Filters and Feature Maps. Back propagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R- CNN, Mask-RCNN, YOLO

UNIT-IV

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Back propagation Through Time. Bidirectional RNNs (BRNN). Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to- Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT-V

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational

TEXT BOOKS :

1. Deep Learning a Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017.
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018.
3. Deep Learning Projects Using Tensor Flow 2, Vinita Silaparasetty, A press, 2020.

REFERENCE BOOKS :

1. Deep Learning with Python, François Chollet, Manning, Shelter Island, 2017
2. Pro Deep Learning with Tensor Flow, Santanu Pattanayak, Apress, 2017

Course Code	Course Title						Core/Elective
OE602CE	GREEN BUILDING TECHNOLOGIES						Open Elective-II
Prerequisite	Contact Hours per Week				CIE	SEE	
Environmental Sciences	L	T	D	P			Credits
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to:

- To impart knowledge of the principles behind the green building technologies
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings
- To bring awareness of the basic criteria in the green building rating systems
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Define a green building, along with its features, benefits and rating systems

CO 2. Describe the criteria used for site selection and water efficiency methods

CO 3. Explain the energy efficiency terms and methods used in green building practices

CO 4. Select materials for sustainable built environment & adopt waste management methods

CO 5. Describe the methods used to maintain indoor environmental quality

UNIT-I:

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT-II:

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III:

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV:

Building materials: Methods to reduce embodied energy in building materials: (a)Use of local building materials (b)Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c)use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V:

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

TEXT BOOKS:

1. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

REFERENCE BOOKS:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. 'Alternative building materials and technologies' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao

Course Code	Course Title						Core/Elective
3OE602CS	SOFTWARE ENGINEERING						Open Elective-II
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. Describe and compare various software development methods and understand the context in which each approach might be applicable
2. To impart knowledge on various phases, methodologies and practices of software development
3. To apply the project management and analysis principles to software project development
4. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metric
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting
4. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associated with the development of a significant software system
5. Apply the software engineering principles in real time project development

UNIT-I

Introduction to Software: What is software? Types of software, Characteristics of Software Attributes of good software.

Software Engineering: What is software engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering& software Engineering, SDLC.

Software Development Process Models: prescriptive Models,Water fall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT-II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification: System and software requirements, Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirements specification, Feasibility

UNIT-III

Building the Analysis Model: Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling.

Design Engineering: Design Process and Quality, Design Concepts, the Design Model,

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding: Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards

UNIT-V

Software Testing and Quality Assurance: Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing, Regression testing Design of test cases, Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management

Debugging: Debugging Techniques, The Art of Debugging.

Current trends in Software Engineering: Software Engineering for projects and products.

TEXTBOOKS:

1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, VII Edition, McGraw Hill, 2009
2. Software Engineering. Ian Sommerville, VII edition, Addison-Wesley, 2004.
3. Fundamentals of Software Engineering Rajib Mall, V Edition, PHI, 2009.

REFERENCE BOOKS:

1. Software Engineering Fundamentals, Ali Behforooz and Frederick J. Hudson, Oxford University Press, 1996
2. An Integrated Approach to Software Engineering, Pankaj Jalote, III Edition, Narosa Publishing House, 2000
3. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, VIII Edition, John Wiley.

Course Code	Course Title						Core/Elective
5OE602EC	FUNDAMENTALS OF IOT						Open
Prerequisite	Contact Hours per Week				CIE	SIE	Elective-II
Controllers, Communication protocols, web services	L	T	D	P			Credits
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To introduce the fundamentals, applications and requisite infrastructure of IOT.
2. To describe Internet principles and communication technologies relevant to IoT.
3. To discuss hardware and software aspects of designing an IoT system.
4. To explain the concepts of cloud computing and data analytics.
5. To illustrate the business models and manufacturing strategies of IoT products.

COURSE OUTCOMES:

1. UnderstandthevariousapplicationsofIoTandotherenablingtechnologies.
2. Comprehend various protocols and communication technologies used in IoT.
3. Construct simple IoT systems with requisite hardware and python programming.
4. Understand the relevance of cloud computing and data analytics to IoT.
5. Apply the business model of IoT from developing prototype to launching a product.

UNIT - I

Introduction to Internet of Things: Introduction to Internet of Things: Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and logistics, Smart Agriculture and Industry, Smart Industry and smart Health.

UNIT-II

Internet Principles and communication technology: Internet Communications: An Overview –IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS,

UNIT-III

Prototyping and Programming: Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling

Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT-IV

Cloud computing and Data analytics: Introduction to Cloud storage models-SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow.

UNIT-V

IoT Case Studies: Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation, Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

TEXT BOOKS:

1. Internet of Things- Converging Technologies for smart environments and integrated ecosystems, River Publishers.
2. Adrian Mc Ewen (Author), Hakim Cassimally, “Designing the Internet of Things”, Wiley India Publishers.

REFERENCE BOOKS:

1. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning.
2. Internet of Things (A Hands-on-Approach), Vijay Madisetti, Arshdeep Bahga, VPT Publisher, 1st Ed., 2014.

Course Code	Course Title	Core/Elective					
4OE602EE	ELECTRIC	Open Elective-II					
	VEHICLES	L	T	P/D	CIE	SEE	Credits
	TECHNOLOGY	3	0	0	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1 Know the history of electric hybrid electric vehicles (EV& HEV) and emphasize the need and importance of EV-HEV for sustainable future.

2 Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies

3 Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources.

COURSE OUTCOMES:

At the end of the course students will be able to

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control.
4. To compare and evaluatevarious energy sources and energy storage components for EV and HEV applications.

UNIT-I

Introduction: History of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/ HEV applications, vehicle power source characterization, and transmission characteristics. Vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion.

UNIT-II

Drive-Train Topologies: Series, Parallel, Series -Parallel and Complex configurations of HEV, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT-III

Electrical Machines and Power Converters for Hybrid and Electric Vehicles: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT-IV

Energy Sources for EV/HEV: Requirements of energy supplies and storage in EV/ HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT-V

Electric Vehicles Charging Station: Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging- Stationary Inductive charging, resonant and compensation circuit topologies.

TEXTBOOKS :

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiely, USA, 2012.
2. Iqbal Hussain, Electric & Hybrid Vehicles–Design Fundamentals, 2nd Edition, CRC Press,2011.

REFERENCE BOOKS :

1. Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspective, Wiely, 2011
2. Simora Onori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

B.E. (Mechanical Engineering)

SEMESTER-VII

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	6HS704HS	Operation Research	3	-	-	3	40	60	3
2	6PC714ME	Finite Element Analysis	3	-	-	3	40	60	3
3	PE	Professional Elective IV / MOOCs	3	-	-	3	40	60	3
4	OE	Open Elective III #	3	-	-	3	40	60	3
5	OE	Open Elective IV #	3	-	-	3	40	60	3
Practical / Laboratory									
6	6PC760ME	FEA Lab	-	-	2	2	40	60	1
7	6PC761ME	Automation & Robotics Lab	-	-	2	2	40	60	1
8	6PW752ME	Internship-II	-	-	4	4	40	60	2
Total			**15**	**-**	**8**	**23**	**320**	**480**	**19**

Professional Elective – 4

S. No.	Course Code	Course Title
1	6PE713ME	Computational Fluid Dynamics (MOOC's-3C)
2	6PE714ME	Fundamentals of Robotics (MOOC's-3C)
3	6PE715ME	Mechatronics
4	6PE716ME	Product Design and Development (MOOC's-1C)

#Open Elective – 3

S. No.	Course Code	Course Title
1	6OE703ME	Introduction to Robotics

offered by Mechanical Engineering Department to other departments.

Course Code	Course Title						Core/Elective
6HS704HS	OPERATION RESEARCH						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basic Mathematics	3	-	-	0	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Formulate the variables into linear programming models/techniques.
- Understand the concept of post optimality and the techniques of CPM and PERT.
- Learn the mathematical tools needed to optimize the transportation and assignment problems.
- Understand the replacement model in money value and game theory in market strategies.
- Know the sequencing in job operation and queuing in different private and public sector organizations.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Formulate the linear programming models in operation research at different applications.

CO2. Convert the primal programming problem to dual programming problems and know the techniques of CPM and PERT.

CO3. Analyze the transportation and assignment models in various research activities.

CO4. Analyze the replacement model in real time scenario and game theory in decision making conflict.

CO5. Apply the sequencing in job scheduling and queuing model in waiting line cases.

UNIT-I

Introduction: Definition and Scope of Operation Research: Linear programming, Formulation of linear programming problems, Graphical method of solving LP problem, Simplex method, maximization and minimization. Degeneracy in LPP, Unbounded and, Infeasible solutions.

UNIT-II

Duality: Definition, Relationship between primal & dual solutions, Economic Interpretation, Post optimality sensitive analysis, Dual Simplex Method.

Project Management: Introduction to CPM and PERT, Critical path calculation, float calculation and its importance, Cost reduction by Crashing of activity.

UNIT-III

Transportation Models: Finding an initial feasible solution - North West comer method, least cost method, Vogel's Approximation method, finding the optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem.

Assignment Problems: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

UNIT-IV

Replacement Models: Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time, replacement of items that fail suddenly, Individual replacement policy, Group replacement policy.

Game Theory: Introduction, 2 person zero sum games, Maximin Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing n jobs through 2 machines, processing n jobs through m machines, Processing 2 jobs through m machines

Queuing Theory: Introduction, single channel - Poisson arrivals - exponential service times with infinite population & finite population, Multi channel - poison arrivals - Exponential service times with infinite population.

TEXT BOOKS :

1. S.D. Sharma, - Operations Research, Kedarnath, Ramnath & Co., Meerut.
2. Hamdy, A. Taha, -Operations Research-An Introduction, Sixth Edition, Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS :

1. Hrvey M. Wagner, -Principles of Operations Resear, Second Edition, Prentice Hall of India Ltd.
2. V.K. Kapoor, -Operations Research, S. Chand Publishers, New Delhi.
3. R. Paneer Selvam, -Operations Research, Second Edition, PHI Learning Pvt. Ltd., New Delhi.
4. Data Reconciliation by Prof. Shanker Narasimha.

Course Code	Course Title						Core/Elective
6PC714ME	FINITE ELEMENT ANALYSIS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Strength of Material & Heat Transfer	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the theory and application of the finite element method for analyzing structural systems.
- Learn Approximation theory for structural problems as the basis for finite element methods.
- Learn formulations for a variety of elements in one, two, and three dimensions.
- Understand modeling and analysis of structures using solid, and plate elements.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Illustrate the concept of Finite Element Method and realize its limitations.

CO2. Construct shape functions for 1D, 2D and 3D linear and higher order elements.

CO3. Applying 1D, 2D and 3D elements to solve different static structural problems.

CO4. Solve 1D and 2D steady state heat transfer, and 1D Eigen value and Eigen-vector problems.

CO5. Analyze time dependent heat transfer problems.

UNIT-I

Introduction: Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Boundary conditions, Strain, Displacement, Stress-Strain relations. One dimensional problems: Finite element modelling coordinates and shapes functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT-II

Analysis of trusses, Beams: Hermite function, Element stiffness matrix for a truss member, Analysis of plane truss with two DoF at each node. Analysis of Beams: Element stiffness matrix for two nodes.

UNIT-III

Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modelling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

UNIT-IV

Two dimensional four noded iso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a slab and fin and two dimensional analysis of thin plate.

UNIT-V

Dynamic Analysis: Formulation of finite element model, element matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam, Time dependent field problems, Application to one dimensional heat flow in a rod. Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements.

TEXT BOOKS:

1. Tirupathi R. Chandraputla and Ashok, D. Belgundu" Introduction to Finite Elements in Engineering", PHI or Pearson Education.
2. Rao S.S., "The Finite Element Methods in Engineering", Pergamon Press.

REFERENCE BOOKS:

1. Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication.
2. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill Company.

Course Code	Course Title						Core/Elective
6PE713ME	COMPUTATIONAL FLUID DYNAMICS						PE-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the equations of fluid flow.
- Learn Finite difference method with heat transfer equations and grid generation.
- Understand forward, backward and central difference techniques.
- Learn Finite volume method and staggered grid.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Formulate the governing equations for different types of fluid flow systems.

CO2. Illustrate method of averaging of turbulent flow properties and classify second order partial differential equations.

CO3. List finite differential equations based on accuracy, type of differences and analyse their stability.

CO4. Solve equations using FDM and numerical methods on discretised domain.

CO5. Apply Finite volume method for basic equations of heat transfer and fluid flow problems.

UNIT-I

Review of basic equations of fluid dynamics: Continuity, Momentum and Energy equations- Navier Stokes equations, Reynolds and Favre averaged N-S equations. Heat transfer conduction equations for steady and unsteady flows. Steady convection-diffusion equation. Jacobi, Gauss Seidel and ADI (Alternative direct implicit method) methods.

UNIT-II

Concepts of Finite difference methods: Forward, backward and central difference. Finite difference Solution-Parabolic partial differential equations. Euler, Crank

Nicholson, Implicit methods. Higher order difference methods. Errors, consistency. stability analysis- von Neumann analysis. Convergence criteria.

UNIT-III

Introduction to turbulence, mixing length model, K-e turbulence Model. Classification of PDEs-Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems.

UNIT-IV

Numerical Methods: 1D and 2D Elliptic partial differential equations problems. Viscous incompressible flow, Stream function- Vorticity method. Introduction to Grid Generation- Types of grid-O, H & C type.

UNIT-V

Introduction to finite volume method: Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows, Staggered grid, SIMPLE Algorithm.

TEXT BOOKS:

1. Patankar, S V, Numerical Heat transfer and Fluid flow, Hemisphere Publishing Company, New York.
2. Muralidhar K, Sundararjan T, Computational Fluid Flow and Heat transfer, Narosa Publishing House.

REFERENCE BOOKS:

1. John D Anderson, Computational Fluid Dynamics, Mc Graw Hill, Inc.
2. Pradip Niyogi, Chakrabartty S K, Laha M K, Introduction to Computational Fluid dynamics.
3. Chung, T J, Computational Fluid Dynamics, Cambridge University Press.

Course Code	Course Title						Core/Elective
6PE714ME	FUNDAMENTALS OF ROBOTICS						PE-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
KOM	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Familiarize with basic terminologies of the robotic science and essential knowledge required to get started in the field of Robotics
- Learn different types of grippers and sensors used in robotics.
- Learn the concepts of forward and inverse kinematics, and understand their significance in robot motion planning
- Understand sensor selection criteria.
- Learn programming languages for robot programming.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Understand the principles and functions of robotic components.

CO2: Analyze the role of sensors, actuators, and controllers in robotic systems.

CO3: Apply kinematic principles to model and control robot movement.

CO4: Apply the basic concepts of robot dynamics.

CO5: Develop basic programming skills for robot control and simulation.

UNIT-I

Introduction to Robotics :

Brief History, Basic Concepts of Robotics such as Definition, Three laws, Types of robots, Elements of Robotic Systems , DOF, Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc .Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

UNIT-II

Grippers and Sensors for Robotics:

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system.

Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Selections of sensors. Need for sensors and vision system in the working and control of a robot.

UNIT-III

Drives and Control for Robotics: Drive - Types of Drives, Types of transmission systems & Actuators.

Control Systems: Types of Controllers, Introduction to closed loop control.

UNIT-IV

Robot Kinematics &Dynamics:

Basic Concepts of Robot Dynamics, Newton-Euler and Lagranzian Formulations, Dynamics of Serial and Parallel Manipulators, Dynamics and Control of Mobile Robots, Energy and Stability Analysis in Robotic Systems.

UNIT-V

Programming and Languages for Robotics: Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages, Generations of Robotic Languages, Introduction to VAL,RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

TEXT BOOKS:

1. "Robot Modelling & Control" by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, John Wiley & Sons, Inc.
2. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson.

REFERENCE BOOKS:

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano, Springer.
2. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu, McGraw-Hill Education.
3. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson.

Course Code	Course Title						Core/Elective
6PE715ME	MECHATRONICS						PE-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the interdisciplinary nature of Mechatronics and its applications in modern engineering.
- Learn the principles and applications of sensors and actuators in mechanical systems.
- Acquire skills in designing electronic circuits and interfacing them with mechanical systems.
- Develop competencies in programming microcontrollers for controlling mechatronic systems.
- Apply systems thinking for the design, analysis, and implementation of integrated mechatronic solutions

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Explain the fundamental concepts of Mechatronics and its role in advancing mechanical engineering technologies.

CO2. Implement sensor and actuator systems for mechanical applications.

CO3. Create and troubleshoot electronic circuits that interface with mechanical systems.

CO4. Program microcontrollers for the control and automation of mechatronic systems.

CO5. Analyse and design complex mechatronic systems using an integrated approach.

UNIT-I

Introduction to Mechatronics: Definition and scope of Mechatronics, Historical perspective and evolution of Mechatronics, Mechatronics in manufacturing, automation, and product design. Interdisciplinary nature of Mechatronics: mechanical systems, electronic systems, and information technology.

UNIT-II

Sensors and Actuators: Overview of sensors and actuators used in mechatronic systems Principles and operation of various sensors (Temperature, Pressure, Velocity and Position). Principles and operation of actuators (Electric, Hydraulic and Pneumatic). Signal conditioning and conversion.

UNIT-III

Electronic Systems for Mechatronics: Basic electronic components and circuits, Introduction to digital electronics, logic gates, flip-flops, counters microcontrollers and microprocessor basics, architecture, programming, and applications. Interfacing microcontrollers with sensors and actuators.

UNIT-IV

Control Systems for Mechatronics: Fundamentals of control theory, Open-loop and closed-loop control systems, Introduction to PID (Proportional-Integral-Derivative) control. Implementation of algorithms in mechatronic systems.

UNIT-V

Mechatronic System Design and Applications: Systems approach to mechatronic design, Case studies of mechatronic systems: automotive systems, robotic systems, smart devices. Design tools and software for Mechatronics (e.g., CAD, MATLAB/ Simulink), Future trends and challenges in Mechatronics.

TEXT BOOKS:

1. "Mechatronics: An Integrated Approach" by Clarence W. de Silva.
2. "Introduction to Mechatronics and Measurement Systems" by David G. Alciatore and Michael B. Histand.

REFERENCE BOOKS:

1. "Mechatronics: Principles and Applications" by Godfrey C.
2. "Mechatronics Systems: Sensors and Actuators" by Robert H. Bishop.
3. "Mechatronics: A Multidisciplinary Approach" by W. Bolton.

Course Code	Course Title						Core/Elective
6PE716ME	PRODUCT DESIGN AND DEVELOPMENT						Professional Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the fundamentals of designing products, their life cycle.
- Understand creativity techniques for effective product design and development.
- Understand Legal factors, social issues and Engineering ethics in product design.
- Understand the importance of value and value analysis job plan.
- Understand the product development process.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Understand the product design and development principles.

CO2. Apply anthropometric principles in product design.

CO3. Understand and navigate legal factors and social issues relevant to product design

CO4. Recognize the importance of value engineering in improving product performance and cost-effectiveness.

CO5. Understand the concept of modern product development process.

UNIT-I

Introduction: Product design and development, product life cycle, Product development process, Essential factors of product design , Product strategies, Analysis of the product, Basic design considerations, Time to market, Role of aesthetics in product design, Innovative thinking, Morphology of design.

UNIT-II

Industrial Ergonomics: Anthropometry, Man-Machine interaction. Concepts of size and texture colour. Comfort criteria. Psychological & Physiological

considerations. Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design.

UNIT-III

Design for Manufacturing & Assembly: Methods of designing for Manufacturing & assembly. Design for maintainability. Design for environment. Legal factors and social issues. Engineering ethics and issues of society related to design of products.

UNIT-IV

Value Engineering: Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study. Materials and process selection in value engineering.

UNIT-V

Product Development: Modern product development process, Re-engineering and redesign product development process, product development teams, Product development planning, Manufacturing & economic aspects of product development. Basic concepts of Concurrent Engineering, Tools for product design – Drafting / Modelling software QFD, CAM Interface. Overview of Patents & IP Acts. Report generation.

TEXT BOOKS:

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGraw-Hill New Delhi.
2. Design for Manufacturability & Concurrent Engineering" by Michael F. Mense.

REFERENCE BOOKS:

1. "Value Engineering: Analysis and Methodology" by Larry D. Miles and Christopher H. S. Kim.
2. "Concurrent Engineering: Contemporary Issues and Modern Design Tools" edited by Andrew T. Campbell and Stephen B. Tully.
3. "Patent Strategy for Researchers and Research Managers" by H. Jackson Knight.

Course Code	Course Title						Core/Elective
6PC760ME	FINITE ELEMENT ANALYSIS LAB						Core
Pre requisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Strength of Material, Heat Transfer & Any CAD software	-	-	-	2	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand fundamentals of the analysis software, its features and applications.
- Learn the basic element types in Finite Element analysis.
- Know the concept of discretization of continuum loading conditions.
- Analyze the structure using pre-processor and post-processor conditions.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Determine Stress, Strains and deflections under static, thermal and combined loading.

CO2. Analyse Plane stress, plane strain conditions & axi-symmetric loading on plane members to predict the failure behavior.

CO3. Analyse component with tetrahedron and brick elements.

CO4. Predict the natural frequencies and modes shapes using Modal and Harmonic analysis.

CO5. Simulate steady state heat transfer analysis of chimney, Transient heat transfer of casting.

EXPERIMENTS:

1. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static, thermal and combined loading.
2. 2D & 3D beam analysis with different sections, different materials for different loads (forces and moments with different end supports).
3. 1D, 2D and 3D meshing with different element sizes for different CAD geometry (Proposed Experiment).

4. Static analysis of plates with a hole to determine the deformations, the Stresses to study the failure behavior and Stress Concentration Factor.
5. Plane stress, plane strain and axi-symmetric loading on the plane members with in plane loading to study the stresses and strains.
6. Static analysis of connecting rod with tetrahedron and brick elements
7. Static Analysis of flat and curved shell due to internal pressure and moments to estimate the strains, stresses and reaction forces and moments with different boundary conditions.
8. Buckling analysis of plates, shells and beams to estimate Bending Factor and modes.
9. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
10. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to stepped and damped loading with varying time.
11. Steady state heat transfer Analysis of chimney and transient heat transfer analysis of solidification of castings.
12. Non-linear analysis of cantilever beam with non-linear materials at tip moment and post buckling analysis of shells for critical loads
13. Coupled field analysis static and thermal loads.
14. Flow analysis of pipe with different fluids/gasses/air for velocity and pressure gradients.
15. Implicit and Explicit Analysis of car with 300m/s (Proposed Experiment)

Note : Any 12 experiments to be conducted

Course Code	Course Title						Core/Elective
6PC751ME	AUTOMATION AND ROBOTICS LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-	-	2	40	60	1

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the principles of robotic sensing and actuation:
- Learn programming techniques for robot control.
- Explore simulation software for robotic design and testing.
- Design and build robotic systems for specific applications.
- Gain skills in using simulation software to solve real-world engineering challenges.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1 :Understand the fundamentals of robotic systems:
CO2:Develop practical skills in robot design and programming:
CO3: Apply theoretical in developing various path planning techniques.
CO4: Illustrate the working of innovative robotic devices
CO5: Gain proficiency in using simulation software.

LIST OF EXPERIMENTS:

1. Build a robot that can follow a line on a flat surface.
2. Develop a robot that can autonomously avoid obstacles using ultrasonic sensors.
3. Program a robotic arm to pick up objects from one location and place them in another.
4. Program a robot to navigate a complex course using sensors and algorithms.
5. Develop a simple interactive application where a robot can respond to human gestures or commands.
6. Create a robot that can detect the colour of objects and sort them into designated areas.
7. Control a robot wireless using Bluetooth or Wi-Fi.
8. Operate a robot using voice commands.
9. Demonstration of Robot with 2 DOF, 3 DOF, 4 DOF etc.
10. Hydraulic equipment simulation using H –Simulator.
11. Pneumatic equipment simulation using P-Simulator.
12. Simulation of PLC.

Course Code	Course Title						Core/Elective
6PW752ME	INTERNSHIP-II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	40	60	2

COURSE OBJECTIVES:

1. Produce an accurate record of work performed during the Internship
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

COURSE OUTCOMES:

After the completion of course the students will be able to:

1. Able to design a small and simple product in hardware or software.
2. Able to complete the task or realize a pre specified target, with limited scope, rather than taking up a complex task and leave it.
3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to pre specified criteria.
4. Able to implement the selected solution and document the same.
5. Able to develop a small and simple product in hardware or software.

Summer Internship is introduced as part of the curriculum of encouraging students to work on problems of interest to industries. A batch of two to three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 4 weeks. This will be during the summer vacation following the completion of the VI Semester Course work.

One faculty coordinator will also be attached to each group (of 2 or 3 students) to monitor the progress and to interact with the industry co-ordinator (person from industry). The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the internship/training.

2. Present the work through a seminar talk (to be organized by the Department)

Award of Sessional marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (40 Marks) followed by presentation before the committee constituted by the department (60 Marks).

One faculty member will co-ordinate the overall activity.

Note: Students have to undergo Internship-II of 4 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

Course Code	Course Title						Core/Elective
6OE703ME	INTRODUCTION TO ROBOTICS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Familiarize with basic terminologies of the robotic science and essential knowledge required to get started in the field of Robotics.
- Learn different types of grippers and sensors used in robotics.
- Understand sensor selection criteria.
- Learn programming languages for robot programming.
- Understand the socio economic aspects and interdisciplinary applications of robotics.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Understand the principles and functions of robotic components.

CO2: Analyze the role of sensors, actuators, and controllers in robotic systems.

CO3: Apply kinematic principles to model and control robot movement.

CO4: Develop basic programming skills for robot control and simulation.

CO5: Understand socio economic aspects of robotics.

UNIT-I

Introduction to Robotics:

Brief History, Basic Concepts of Robotics such as Definition, Three laws, Types of robots, Elements of Robotic Systems , DOF, Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc .Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

UNIT-II

Grippers and Sensors for Robotics:

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system.

Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Selections of sensors. Need for sensors and vision system in the working and control of a robot.

UNIT-III

Drives and Control for Robotics: Drive - Types of Drives, Types of transmission systems & Actuators.

Control Systems: Types of Controllers, Introduction to closed loop control.

UNIT-IV

Programming and Languages for Robotics: Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages, Generations of Robotic Languages, Introduction to VAL,RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

UNIT - V

Socio-Economic aspect of Robotisation: Socio-Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.

TEXT BOOKS:

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano, Springer.
2. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson.

REFERENCE BOOKS:

1. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu.
2. "Robot Modeling and Control" by Mark W. Spong.
3. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu, McGraw-Hill Education.
4. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson.

Course Code	Course Title						Core/Elective
4OE703EE	PROGRAMMABLE LOGIC CONTROLLERS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understanding of PLC programming, ladder logic.
- Analysis and classification of the process control
- Understanding PLC hardware units and utilizing them

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Describe typical components of a Programmable Logic Controller.

CO 2. State basic PLC terminology and their meanings.

CO 3. Use latch, timer, counter, and other intermediate programming functions.

CO 4. Explain and apply the concept of electrical ladder logic, its history, and its relationship to programmed PLC instruction.

CO 5. Design and program a small, automated industrial production line.

UNIT–I:

Introduction to PLC

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, and limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc

UNIT– II:

Working of PLC

Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure, Programming terminal, power supply

UNIT-III:

Instruction Set

Basic instructions like latch, master control self-holding relays, Timer instruction like retentive timers, resetting of timers, Counter instructions like up counter, down

counter, resetting of counters, Arithmetic Instructions (ADD,SUB,DIV,MUL etc.), MOV instruction, RTC(Real Time Clock Function), Watch Dug Timer, Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal.

UNIT–IV:

Ladder Diagram Programming

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

UNIT–V:

Applications of PLCs

Object counter,On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction, Star-Delta, DOL Starters, Filling of Bottles, Room Automation.

TEXTBOOKS :

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh

REFERENCE BOOKS :

1. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
2. Module on "Allen BradlagPlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
3. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
4. CHUNGPA, "User's Manual :Universal PLC Training System CPS-3580U", English ver1, 2020.
5. Handbook, P. L. C. "Practical Guide to Programmable Logic Controllers." AutomationDirect. com.

Course Code	Course Title						Core/Elective
1OE703AD	MACHINE LEARNING						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To learn the concepts of machine learning and types of learning
- To study various supervised learning algorithms.
- To learn ensemble techniques and various unsupervised learning algorithms.
- To understand assessment methods and evaluation parameters of machine learning algorithms.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Describe types of data and their pre processing methods

CO2. Describe supervised, unsupervised learning methods and their appropriate evaluation procedures and metrics

CO3. Apply different supervised and unsupervised machine learning algorithms to different datasets

CO4. Evaluate different machine learning approaches and infers the best learning model for a given scenario

UNIT-I

Introduction: Types of Machine Learning Algorithms: Parametric and Non-parametric Machine Learning Algorithms, Supervised, Unsupervised, Semi-Supervised and Reinforced Learning.

Data Objects and Attribute Types: Nominal Attributes, Binary Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes.

Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode. Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation.

UNIT II

Representation and Learning: Feature Vectors, Feature Spaces

Supervised Algorithms: Regression: Linear Regression, Logistic Regression. Evaluation Measures: SSE, RMSE, R2

UNIT III

Classification: Decision Tree, Naïve Bayes, K-Nearest Neighbors, Support Vector Machines.

Evaluation of classification: cross validation, hold out The Confusion Matrix, Accuracy, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve

UNIT IV

Unsupervised Learning: Cluster Analysis: Similarity Measures.

Categories of clustering algorithms, k-means, Hierarchical Clustering.

UNIT V

Ensemble Algorithms: Bagging, Random Forest, Boosting

TEXTBOOKS :

1. Machine Learning, Tom Mitchell, McGraw-Hill Science/Engineering/Math; (1997).
2. Data Mining -Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, III Edition, Morgan Kauffmann Publisher, 2012.

REFERENCE BOOKS :

1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, II Edition, Chapman & Hall.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer. (2006)
3. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson, 2014.

Course Code	Course Title						Core/Elective
OE703CE	ESSENTIALS OF ROAD SAFETY ENGINEERING						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

C1. Comprehend global and Indian road accident trends to grasp fundamental road safety principles.

C2. Apply statistical and engineering tools to analyze traffic safety data effectively.

C3. Design road infrastructure with safety features considering vehicle and human factors.

C4. Manage traffic effectively to enhance road safety outcomes.

Conduct thorough road safety audits and propose evidence-based improvement strategies.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Understand fundamental principles of road safety.

CO 2. Analyze traffic safety data using statistical methods and engineering techniques.

CO 3. Apply geometric design principles and integrate safety features into road infrastructure.

CO 4. Master traffic management systems to enhance road safety.

CO 5. Conduct road safety audits and develop comprehensive safety management systems.

UNIT - I :

Global and Indian Road Safety Landscape: Current state of road safety, leading causes of accidents, comparison with global trends.

Accident Characteristics: Analyzing real-world accident data, understanding the "who, what, when, where, and why" of crashes.

UNIT-II:

Traffic Engineering Fundamentals: Traffic flow, capacity analysis, role of traffic control devices like signs and signals.

Statistical Methods for Action: Applying regression analysis and other statistical tools to identify correlations between factors and accidents, predicting high-risk areas.

UNIT-III:

Accident Investigations and Risk Management: Conducting thorough accident investigations, understanding root causes, and preventing future incidents.

Human Factors and Vehicle Characteristics: The impact of human behavior, perception limitations, and vehicle design features on road safety.

Road Design for Safety: Geometric design elements influencing safety (lane width, curves, sight distance) and road equipment (guardrails, delineators).

Road Lifecycle Approach: Strategies for safe and efficient road maintenance, reconstruction, and rehabilitation.

UNIT-IV:

Traffic Signals & Street Lighting: Principles of traffic signal design considering traffic flow and pedestrian needs. Importance of proper street lighting for nighttime safety.

Provisions for Vulnerable Users: Dedicated infrastructure and design considerations for the safety of pedestrians, cyclists, and other vulnerable road users.

The Power of Signs and Markings: Different types of road signs and pavement markings, design standards, and their role in guiding drivers and improving safety.

UNIT-V:

Traffic Management Systems (TMS) & Intelligent Transportation Systems (ITS): Implementing technology to improve traffic flow and mitigate accidents.

Road Safety Audits: Conducting comprehensive road safety audits to identify potential safety issues in existing or planned road infrastructure.

Safety from Start to Finish: Best practices for construction site safety, including worker protection measures and proper signage.

TEXT BOOKS:

1. Sarkar, Pradip Kumar, Maitri, Vinay, Joshi, G.J., Transportation Planning: Principles, Practices And Policies, Third Edition, 2021.
2. L.R. Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, 9th Edition, 2019.

REFERENCE BOOKS:

1. Geetam Tiwari (Editor), Dinesh Mohan (Editor), Transport Planning and Traffic Safety, CRC Press, 1st edition, 2016.
2. HSS Committee, Manual on Road Safety Audit (IRC:SP-088), Indian Road Congress, First Revision, 2019.

Course Code	Course Title						Core/Elective
3OE703CS	HUMAN COMPUTER INTERACTION						Open
Prerequisite	Contact Hours per Week				CIE	SEE	Elective-III
	L	T	D	P			Credits
--	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To gain an overview of Human-Computer Interaction (HCI),
- To understand user interface design and alternatives to traditional "keyboard and mouse" computing.
- To become familiar with the vocabulary associated with sensory and cognitive systems as relevant to task performance by humans.
- To apply models from cognitive psychology to predicting user performance in various human-computer interaction tasks.
- To analyze the importance of a design and evaluation methodology that begins with and maintains a focus on the user.

COURSE OUTCOMES:

After completing the course, student will be able to:

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
2. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Describe and use HCI design principles, standards and guidelines.
5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT-I

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT-II

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT-III

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colours, uses problems, choosing colours.

UNIT-IV

HCI in the software process, The software life cycle Usability Engineering Iterative design and proto typing Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

UNIT-V

Cognitive models Goal and task hierarchies

Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research

Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience

Design Focus: Applications of augmented reality Information and data visualization

Design Focus: Getting the size right.

TEXT BOOKS :

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
2. Human – Computer Interaction. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg,Pearson Education

REFERENCE BOOKS :

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.

Course Code	Course Title						Core/Elective
5OE703EC	MEDICAL ELECTRONICS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. To familiarize students with the fundamental principles of medical electronics and the nature of bioelectric signals.
2. To provide students with the knowledge and skills necessary for the acquisition, processing, and interpretation of biosignals such as ECG, EEG, EOG, and EMG.
3. To enable students to understand the common artifacts and sources of noise in biosignals and develop techniques for artifact removal.
4. To introduce students to the clinical applications of biosignal analysis in the diagnosis and monitoring of various medical conditions.
5. To foster an understanding of emerging trends and technologies in medical electronics and their potential impact on healthcare.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Demonstrate an understanding of the principles underlying bioelectric signals and their relevance in medical diagnostics.
2. Apply appropriate techniques for the acquisition and preprocessing of biosignals using specialized instrumentation.
3. Analyze and interpret biosignals such as ECG, EEG, EOG, and EMG to identify normal and abnormal patterns.
4. Implement signal processing algorithms to remove artifacts and enhance the quality of biosignals for accurate diagnosis.
5. Evaluate the clinical significance of biosignal analysis in the context of specific medical conditions and treatment strategies.

UNIT-I

Medical Electronics Overview: Definition, scope, and importance in healthcare. Bioelectric Signals Basics: Nature, characteristics, and acquisition techniques. Signal Processing Fundamentals: Basics and artifact removal techniques.

UNIT – II

Physiology of the Heart: Understanding the cardiac cycle and ECG signal generation. ECG Signal Acquisition: Electrodes, instruments, and techniques. ECG Interpretation: Normal/abnormal waveforms analysis. ECG Artifacts and Noise: Sources and minimization methods.

UNIT – III

Fundamentals of Brain Signals: EEG signal generation and EEG signal acquisition techniques. EEG Signal Analysis: Preprocessing, feature extraction, and classification. EEG Artifacts: Identification and mitigation strategies.

UNIT – IV

Muscle Physiology: EMG signal generation and EMG signal acquisition techniques. EMG Signal Interpretation: Normal/abnormal waveforms analysis, Noise Sources and minimization methods.

UNIT – V

Other Biosignals Introduction: EOG and EDA overview. Wearable Medical Electronics: Continuous monitoring and diagnosis applications. Medical Electronics Trends: Recent advancements and future directions. Case Studies and Practical Applications: Real-world examples.

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Engineering", 4th Edition, Academic Press, 2012.
2. C. Raja Rao and Sujoy K. Guha, "Principles of Medical Electronics and Biomedical Instrumentation", 5th Edition, McGraw Hill Education, 2018.

REFERENCE BOOKS:

1. Malcolm S. Milner, Iain Hunter, and David G. Sixto Jr., "Biomedical Signal Analysis: A Practical Guide", 3rd Edition, Artech House, 2012.
2. IEEE Transactions on Biomedical Engineering.

Course Code	Course Title						Core/Elective
5OE704EC	INDUSTRIAL ELECTRONICS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
BEE	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims at

1. Introducing electronic device characteristics suitable for industrial applications
2. Designing AC to DC, DC to AC Converters, Amplifiers , inverters and SMPS
3. Understanding various voltage control techniques in power converters.
4. Comprehending quadrant operation of various power converters
5. Introducing various electronic techniques for industrial heating to minimize EM interference.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Understand Industrial Semiconductor devices SCR , DIAC, TRAIC, and MOSFET respectively.
2. Comprehend DC amplifiers, Operational amplifier and Instrumentation amplifier.
3. Design and analysis of DC to DC converters and DC to AC converters and different types of Choppers.
4. Develop skills to build and troubleshoot power electronic circuits.
5. Synthesis of PWM Inverters, UPS and Switched mode regulators

UNIT - I

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT (Qualitative Treatment only), Protections and thermal considerations. Brief introduction to power devices: DIAC and TRIAC, MOS controlled thyristor, Power Integrated Circuit (Smart Power), Concept of fast recovery and Schottky diodes as free-wheeling and feedback diodes.

UNIT – II

DC Amplifiers: Need for DC amplifiers, DC amplifiers: Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Operational Amplifiers, and Instrumentation Amplifiers.

Choppers circuits: Principle, methods and Configurations operations of Type A, Type B, Type C, Type D and type E choppers, TRIACS: Triggering modes, Firing Circuits, Control techniques for choppers: TRC and CLC.

UNIT – III

Regulated Power Supplies: Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques: Short Circuit, over voltage and Thermal Protection. Switched Mode and IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators.

UNIT – IV

Single-Phase Inverters: Principle of operation of full bridge square wave, quasi square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters voltage and harmonic control at output of inverter, Filters at the output of inverters, Single phase current source inverter. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings.

UNIT – V

Industrial Applications-I: Industrial timers, Classification, types, Electronic Timers –Classification, RC and Digital timers. Electronic DC Motor Control.

Industrial Applications-II: High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating: principle, material properties, Electrodes and their Coupling to RF generator.

TEXT BOOKS:

1. Theodore. H. Bogart, “Electronic Devices and circuits”, Pearson Education, 6th Edition, 2003.
2. P.C. Sen., “Modern Power Electronics", 2nd Edition, Chand & Co., 2004.
3. V.R. Moorthi, “Power Electronics”, Oxford University Press, 2005.

REFERENCE BOOKS:

1. G. K. Mithal and Maneesha Gupta, “Industrial and Power Electronics”, Khanna Publishers, 19th Edition, 2003.
2. Ned Mohan, Robbins, “Power electronics”, 3rd Edition, John Wiley and sons, 2002.
3. Biswanth Paul,” Industrial Electronics and Control”, PHI Learning, 3rd edition 2014.
4. S.Chatterjee and Bhattacharya ,” Industrial Electronics and Control”, Technical education series,1st edition 2017.

B.E. (Mechanical Engineering)

SEMESTER - VIII

S. No.	Code No.	Subject	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	PE	Professional Elective V							
		/ MOOCs	3	-	-	3	40	60	3
2	PE	Professional Elective VI / MOOCs	3	-	-	3	40	60	3
3	6PW853ME	Project Work	-	-	16	16	50	100	8
		Total	**6**	**-**	**16**	**22**	**130**	**220**	**14**

Professional Elective – 5

S. No.	PE Stream	Course Title
1	6PE817ME	Gas Dynamics and Jet Propulsion
2	6PE818ME	Automation in Production Systems
3	6PE819ME	Business Analytics
4	6PE820ME	Total Quality Management

Professional Elective – 6

S. No.	PE Stream	Course Title
1	6PE821ME	Heating Ventilation and Air Conditioning
2	6PE822ME	Operations and Supply Chain Management (MOOC’s-3C)
3	6PE823ME	Electric Vehicle Technology
4	6PE824ME	Non Destructive Techniques

#Open Elective – 4

S. No.	Course Code	Course Title
1	6OE804ME	Industrial Engineering & Management

offered by Mechanical Engineering Department to other departments.

Course Code	Course Title						Core/Elective
6PE817ME	GAS DYNAMICS AND JET PROPULSION						PE-V
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand basic concepts and isentropic flows
- Learn the flow through the ducts
- Learn normal and oblique shocks
- Learn the jet propulsion and space propulsion

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Apply the fundamentals of compressible flow concepts and the use of gas tables.

CO2. Analyze the compressible flow behaviour in constant area ducts.

CO3. Analyze the development of shock waves and its effects.

CO4. Explain the types of jet engines and their performance parameters.

CO5. Explain the types of rocket engines and their performance parameters

UNIT-I

Basic Concepts of Compressible Flow

Compressible fluid flow-energy and momentum equations, stagnation stages, various regions of flow, reference velocities, effect of Mach number on compressibility. Types of waves, Mach cone, Mach angle.

UNIT-II

Flow through Ducts

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT-III

Normal and Oblique Shocks

Governing equations, variation of flow parameters across the normal and oblique shocks. Prandtl Meyer relations. Flow in variable area ducts with normal shocks. Use of Tables and Charts.

UNIT-IV

Jet Propulsion

Types of jet engines-turboprop, turbojet, ramjet, pulsejet. Aircraft propulsion theory, performance analysis of turbo jet, parameters affecting flight performance, thrust augmentation.

UNIT-V

Rocket Propulsion

Types of rocket engines, propellants, combustion instabilities, rocket propulsion theory, performance of rocket engine, multistage rockets, specific impulse orbital and escape velocities calculations.

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", .McGraw Hill.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, NewDelhi.

REFERENCE BOOKS:

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley Publishing company.
2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley.

Course Code	Course Title						Core/Elective
6PE818ME	AUTOMATION IN PRODUCTION SYSTEMS						PE-V
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Learn principles and strategies of automation in manufacturing systems.
- Understand flow lines and assembly systems.
- Understand principles of inspection & testing methods in manufacturing systems.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Understand the importance of automation in production systems.

CO2. Analyze the automated flow lines in production systems.

CO3. Understand various types of assembly systems.

CO4. Classify different types of automated inspection & testing methods.

CO5. Understand the principles of Programmable Logic Controllers.

UNIT-I

Introduction: Definition of Automation, Types of Production systems, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation.

Manufacturing Systems- Components & classifications, Automation in manufacturing systems, principles and strategies, costs of manufacturing systems, Single-station manufacturing cells.

UNIT-II

Automation Production Lines: Automated Flow lines, Methods of workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations.

Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines without Storage, Partial Automation, Automated Flow Lines with Storage Buffers.

UNIT-III

Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi station Assembly Machines, Analysis of a Single Station Assembly Machine.

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT-IV

Automated Inspection and Testing Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods.

UNIT-V

Programmable Logic Controllers (PLCs):

Introduction, definition & history of PLC, Principles of PLC, various parts of PLC: CPU, Monitor, PLC input & Output Modules: Solid state memory, processor, power supplies, PLC advantages, disadvantages & applications.

TEXT BOOKS:

1. M. P. Groover - Automation, Production Systems and Computer Integrated Manufacturing, PHI.
2. Frank Lamb - Industrial Automation, Mc Graw Hill.
3. W. Buekinsham – Automation.

REFERENCE BOOKS:

1. Nick Dawkins - Automation and Controls.
2. Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang - Computer Aided Manufacturing, Pearson.
3. Peter G. Martin and Gregory Hale - Automation Made Easy.

Course Code	Course Title						Core/Elective
6PE819ME	BUSINESS ANALYTICS						PE-V
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the role of business analytics within an organization.
- Become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Manage business process using analytical and management tools.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Understand core principles of business analytics, scope and advantages.

CO2. Apply statistical and analytical techniques to solve business problems.

CO3. Implement organizational structures, information policies, and analyse strategies for data quality.

CO4. Create predictive and prescriptive models, Monte Carlo simulations and advanced analytics techniques to address complex business scenarios.

CO5. Implement various domains of business analytics to formulate strategical decisions.

UNIT-I

Business analytics: Overview of business analytics, scope of business analytics, business analytics process, relationship of business analytics process and organization, competitive advantages of business analytics. statistical tools: statistical notation, descriptive statistical methods, review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II

Trends and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data

and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III

Organization Structures of Business analytics: Team management, Management Issues, Designing information policy, Outsourcing, ensuring Data Quality, Measuring contribution of business analytics, Managing changes. Descriptive analytics, predictive analytics, predicative modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, Nonlinear optimization.

UNIT-IV

Forecasting Techniques: Qualitative and judgmental forecasting, statistical forecasting models, forecasting models for stationary time series, forecasting models for time series with a linear trend, forecasting time series with seasonality, regression forecasting with casual variables, selecting appropriate forecasting models. Monte Carlo simulation and risk analysis, Monte Carle simulation using analytic solver platform, new product development model, newsvendor model, overbooking model, cash budget model.

UNIT-V

Decision Analysis: Formulating decision problems, decision strategies with and without outcome probabilities, decision trees, the value of information, utility and decision making. recent trends in embedded and collaborative business intelligence, visual data recovery, data storytelling and data journalism.

TEXT BOOKS:

1. Business Analytics: Data Analysis & Decision Making" by Wayne L. Winston.
2. Business Analytics: Methods, Models, and Decisions" by James R. Evans.

REFERENCE BOOKS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Code	Course Title						Core/Elective
6PE820ME	TOTAL QUALITY MANAGEMENT						PE-V
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Statistics	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Introduce the concept of Total Quality management.
- Learn and understand the principle of Total Quality management.
- Develop feedback and suggestion systems for quality management.
- Enhance the knowledge of tools and techniques in quality management.
- Acquaint with different aspects of quality system in manufacturing industries.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Apply TQM techniques in engineering applications.

CO2. Apply quality management philosophies and quality circle concepts in engineering industries.

CO3. Apply statistical techniques in TQM.

CO4. Application of tools and methods for quality management in TQM.

CO5. Implement TQM Systems.

UNIT - I

Introduction

Introduction to quality management: Definition and framework of TQM, benefits, awareness and obstacles. Quality statements – vision, mission and policy statements. Customer perception of quality, Translating needs into requirements, Customer retention and cost of quality.

UNIT - II

TQM Principles

Quality management philosophies: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction,

loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle.

UNIT - III

Statistical Process Control

Introduction to statistical quality control (SQC), capability and Reliability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributes. Process capability – meaning, significance. Reliability– definitions, reliability in series and parallel systems, product life characteristics curve.

UNIT - IV

TQM Tools and Techniques

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector. Bench marking . Quality functions development (QFD) –House of quality (HOQ), building a HOQ, QFD process. POKA YOKE, Management tools for quality improvement, Juran's improvement programme, Tools for process improvement.

UNIT - V

Quality Systems

Need for ISO 9000, ISO 9001-2008 Quality System: Elements, Documentation, Quality Auditing: QS 9000 - ISO 14000 - Concepts, Requirements and Benefits. TQM Implementation in manufacturing and service sectors.

TEXT BOOKS:

1. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd.
2. Total Quality Management/P. N. Mukherjee/PHI.

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning.
2. Quality Management/Kanishka Bedi/Oxford University Press.
3. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education.
4. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint.

Course Code	Course Title						Core/Elective
6PE821ME	HEATING VENTILATION & AIR-CONDITIONING						PE-VI
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Applied Thermodynamics & Heat Transfer	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand effects of solar radiation and internal heat sources on heating/ cooling loads.
- Understand air quality, effects of relative humidity, control of microbial growth in building ventilation.
- Familiarize with design air conditioning systems using cooling load calculations.
- Learn the fundamental principles of air conditioning systems and different methods for load calculation during summer and winter.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Analyse the effects of relative humidity in building ventilation.

CO2. Understand the necessity of indoor air quality and need for building ventilation.

CO3. Develop air conditioning system for summer and winter load calculation.

CO4. Identifying the selection of outside and inside design conditions of air conditioning systems.

CO5. Design an HVAC system for a residential or commercial building.

UNIT-I

Introduction to heating system: Heat gain through glass-calculation of solar heat gain through ordinary glass tables-shading devices-effect of shading devices. Thermal resistance of various building materials.

Heating load calculations: Winter heating load calculation-heat losses through structure-heat losses due to infiltration. Effects of solar radiation and internal heat sources on heating loads. Methods for estimating energy requirements for heating.

UNIT-II

Introduction to ventilation system- Fundamentals of good indoor air quality Need for building ventilation, Effects of R.H. in building ventilation, Control of microbial growth.

Supply systems: Air Inlet system, Filters, heating & cooling equipment, Supply Fans, Ducts, Grills, Diffusers, For distribution of air in the work place.

Exhaust systems: General exhaust systems. Local exhaust system, Removal of pollutants and contaminated air. Air cleaning devices, Exhaust Fans.

UNIT-III

Psychrometry: Properties of moist air. Important Psychrometry properties, Dry bulb temperature, Wet bulb temperature, Relative humidity, Humidity ratio, degree of saturation, Dew point temperature and Enthalpy, Psychometric chart, Psychrometric process in air conditioning equipment, Bypass factor and sensible heat factor.

Applied psychrometry: Use of Effective and Grand sensible heat factor, Selection of air conditioning equipment for cooling and dehumidification.

UNIT-IV

Air conditioning processes: Mixing process. Summer, winter and year round air Conditioning system, Hot and dry outdoor conditions. Hot and humid outdoor conditions. Winter air conditioning system. Year round air conditioning system.

Comfort air conditioning: Thermodynamics of human body. Body regulation process against heat and cold. comfort chart, effective temperature, factors governing optimum effective temperature, Design consideration. Selection of outside and inside design conditions,

Air conditioning control system: Basic elements of the control system, temperature, humidity & pressure controls, refrigeration, room thermostat.

UNIT-V

Air conditioning systems: All water, All air, Air water system. Unitary System, Window air conditioner, Split and Central air conditioning system.

Cooling load calculations: Occupancy load, lighting load, appliance load, product load, difference between summer & winter load calculations.

Air distribution: Room air distribution, types of supply air outlets, mechanism of flow through outlets, selection and location of outlets, Distribution patterns of outlets.

Ducts: Definition and types, materials for ducts and its specification, friction loss in ducts, grills, diffusers, registers, rectangular equivalent of circular duct.

Air duct designs: Equal friction method, static regain method, velocity reduction method, duct construction.

TEXT BOOKS:

1. Refrigeration & Air-Conditioning by C.P. Arora.
2. Refrigeration & Air-Conditioning by Domkundwar.

REFERENCE BOOKS:

1. Refrigeration & Air-Conditioning by V.K. Jain.
2. ASHRAE Hand Book.
3. Hand Book of Air Conditioning System design by Carrier.

Course Code	Course Title						Core/Elective
6PE822ME	OPERATIONS AND SUPPLY CHAIN MANAGEMENT						PE-VI
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Learn the concepts and principles of operations and supply chain management.
- Acquire skills in operational processes in manufacturing and service environments.
- Understand the role of inventory management and logistics in optimizing supply chain performance.
- Explore strategies for coordinating and managing the flow of materials and information across the supply chain.
- Learn quantitative and qualitative tools and techniques to solve operations and supply chain management problems.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Analyze operational processes to identify areas for improvement.

CO2. Implement strategies to optimize inventory levels and reduce supply chain costs.

CO3. Apply quantitative techniques to solve operations and supply chain management problems.

CO4. Understand the importance of coordination and collaboration among supply chain partners.

CO5. Understand supply chain management issues and solutions.

UNIT-I

Introduction to Operations and Supply Chain Management: Definitions and Scope of Operations and Supply Chain Management, Historical Perspective and Evolution of Operations Management, Role of Operations and Supply Chain Management in

Business Strategy, Globalization and Outsourcing in Supply Chain Management, Trends and Challenges in Operations and Supply Chain Management.

UNIT-II

Operations Strategy and Process Design: Operations Strategy Formulation and Implementation. Product and process design, Process analysis and improvement Techniques. Lean Manufacturing principles and practices, Six Sigma and Total Quality Management (TQM).

UNIT-III

Inventory Management and Logistics: Inventory Types and Costs, Inventory Control Models (EOQ, ROP), Supply Chain Network Design, Transportation and Distribution Management, Warehousing and Materials Handling.

UNIT-IV

Supply Chain Coordination and Collaboration: Demand Forecasting and Planning, Supplier Relationship Management (SRM), Vendor Managed Inventory (VMI) and Collaborative Planning, Forecasting, and Replenishment (CPFR), Information Sharing and Technology in Supply Chain Management, Risk Management in Supply Chains.

UNIT-V

Current Trends and Future Directions in Operations and Supply Chain Management: Sustainable Operations and Green Supply Chain Management, Omni-channel Retailing and E-commerce Logistics, Supply Chain Resilience and Agility, Digital Transformation and Industry 4.0, Ethical and Social Responsibility in Supply Chains.

TEXT BOOKS:

1. "Operations and Supply Chain Management" by F. Robert Jacobs and Richard Chase
2. "Supply Chain Management: Strategy, Planning, and Operation" by Sunil Chopra and Peter Meindl

REFERENCE BOOKS:

1. "Essentials of Supply Chain Management" by Michael H. Hugos.
2. "Manufacturing Planning and Control for Supply Chain Management" by F. Robert Jacobs, William Berry, D. Clay Whybark, and Thomas Vollmann.
3. "Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies" by David Simchi-Levi, Philip Kaminsky, and Edith Simchi-Levi.

Course Code	Course Title						Core/Elective
6PE823ME	ELECTRIC VEHICLE TECHNOLOGY						PE-VI
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Elements of Electrical Engineering & Auto mobile Engineering	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to learn:

- The basics of electric vehicles and their working
- The basics of batteries and their role for electric vehicle applications
- The knowledge of various types of electric vehicles
- The real time challenges in the implementation of this technology

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Understand the concepts and design of electric vehicle.

CO2. Understand charging methods of batteries and sizing of ultra-capacitors.

CO3. Apply a suitable drive scheme for developing an electric vehicle for specific application.

CO4. Design and develop basic schemes of electric vehicles.

CO5. Analyse battery charging and discharging characteristics and estimate electric vehicle battery capacity.

UNIT-I:

Introduction to Electric Vehicles: Sustainable Transportation - EV System - EV Advantages –Vehicle Mechanics - Performance of EVs - Electric Vehicle drive train - EV Transmission Configurations and Components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

UNIT-II

Electric Vehicle Modelling - Consideration of Rolling Resistance - Transmission Efficiency – Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration -

Unit-III

Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity- electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging- electric vehicle battery performance – testing.

UNIT-IV

Modelling Electric Vehicle Range -Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

UNIT-V

Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks –Sizing Ultra capacitors for Hybrid Electric Vehicles.

TEXT BOOKS:

1. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - New Delhi.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd.

REFERENCE BOOKS:

1. Hybrid electric Vehicles Principles and applications with practical perspectives -Chris Mi, Dearborn- M. Abul Masrur, David Wenzhong Gao - A John Wiley & Sons, Ltd.
2. Electric & Hybrid Vehicles – Design Fundamentals -Iqbal Hussain, Second Edition, CRC Press.

Course Code	Course Title						Core/Elective
6PE824ME	NON DESTRUCTIVE TECHNIQUES						PE-VI
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Know various types of non-destructive testing methods.
- Learn the principle and process of various non destructive techniques like LPT, MPI, ECT, UT and Radiography.
- Understand advantages, limitations and applications of LPT, MPI, ECT, UT and Radiography.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Understand the basics of non-destructive testing (NDT) in finding surface and sub surface defects.

CO2. Select and Identify suitable non destructive technique to detect defects in materials with physical contact.

CO3. Select and Identify suitable non destructive technique to detect defects in materials without physical contact.

CO4. Apply X-rays and Gamma rays to find sub surface defects.

CO5.Apply Ultrasonic techniques to identify the location of flaws.

UNIT-I

Introduction: Introduction and fundamentals of destructive and non-destructive testing. Merits and demerits of NDT, NDT versus destructive testing, Overview of Non Destructive testing methods for the detection of manufacturing defects.

Visual Inspection: Fundamentals of Visual Testing – vision, lighting, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibro scopes – light sources and special lighting.

UNIT-II

Liquid Penetrate Testing Principle, procedure, characteristics of penetrant, types of penetrants, Preparation of test materials – Application of penetrants to parts, removal

of excess penetrants, post cleaning – Control and measurement of penetrant process variables – selection of penetrant methods – solvent removable, water washable, post emulsifiable , Interpretation and evaluation of test results - dye penetrant process , applicable codes and standards.

UNIT-III

Eddy Current Testing: Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents – eddy current sensing elements, probes, type of coil arrangement – absolute, differential, lift off, operation, advantages, limitations and application. Factors affecting sensing elements and coil impedance - test part and test system –Signal to noise ratio – equipment's, reference samples, calibration, inspection of tubes, cylinders, steel bars, welded tubing, plates and pipes.

UNIT-IV

Ultrasonic Testing : Principle of sound propagation, types of sound waves, principles of UT, methods of UT, advantages and limitations. Various types of transducers, probe – calibration methods, contact testing and immersion testing methods, ultra sonic testing techniques , through transmission techniques, pulse echo testing techniques , reference of standard block techniques for normal beam inspection flaw , characterization technique, defects in welded products tested by UT.

UNIT-V

Radiography : Principle & uses of radiography, limitation principle, radiation sources, production of X-rays, X-ray spectra, attenuation of radiation, shadow formation enlargement and distortion, radiographic film and paper, inspection of simple and complex shapes, radiation hazard, protection against radiation. **Acoustic Emission:** Physical principles, sources of emission, instrumentation and applications. Other NDT Techniques: Neuron radiography, laser induced ultrasonics, surface analysis, and thermography.

TEXT BOOKS:

1. J. Prasad and C.G.K. Nair, Non-Destructive Test and evaluation of materials, Tata McGraw-Hill Education, 2nd edition .
2. B. Raj, T. Jayakumar and M. Thavasimuth, Practical Non-Destructive Testing, Alpha Science International Limited, 3rd edition .

REFERENCE BOOKS:

1. Barry Hull & Vernon John, =Non-Destructive Testing.
2. Non-Destructive examination and quality control, ASM International.
3. T. Rangachari, J. Prasad and B.N.S. Murthy, Treatise on Non-Destructive Testing and Evaluation, Navbharath enterprises.
4. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.

Course Code	Course Title						Core/Elective
6PW803ME	PROJECT WORK						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Statistics	-	-	-	16	50	100	8

COURSE OBJECTIVES:

It is intended to make the students to:

- Enhance practical and professional skills.
- Familiarize with tools and techniques of systematic literature survey and documentation.
- Learn industry practices and team work.
- Work with innovative and entrepreneurial ideas.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the Academic program to the real-world problems.

CO2. Evaluate different solutions based on economic and technical feasibility.

CO3. Effectively plan a project and confidently perform all aspects of project management.

CO4. Demonstrate effective written and oral communication skills.

CO5. Present effective outcome/result of the research work carried out for the project.

The aim of Project work is to make student implement and evaluate the proposal of their interest in field of engineering. Students can also be encouraged to do full time internship as part of Project work based on the common guidelines for the department. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Grouping of students in a batch of three student
2. Allotment of Project guide to students group

3. Project monitoring at regular intervals.

Re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

Both project and internship will be monitored at least twice in a semester through student presentation for the award of sessional marks.

Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the department. The students are required to submit draft copies of their project report within one week after completion of instruction and before conduct of final viva-voce.

Note: Three periods of contact load will be assigned to each project guide.

Course Code	Course Title						Core/Elective
4OE804EE	SENSORS AND TANSDUCERS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1. To understand the principle of operation of Transducers and Sensors
2. To understand the application of Transducers and Sensors

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Explain the basic principle of operation of Transducers and Sensors. Distinguish different sensors and transducers.
2. Identify suitable transducer by comparing different industrial standards and procedures for measurement of physical parameters
3. Estimate the performance of different transducers.
4. Design real life electronics and instrumentation measurement systems.
5. Apply smart sensors, bio-sensors, PLC and Internet of Things to different applications.

UNIT – I:

Introduction: Definition, significance of measurement and instruments. Principle of sensing & transduction, transducer classification, Transducer characteristics, emerging fields of sensor technologies.

Resistive transducers: Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.

UNIT – II :

Inductive transducers: Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics. Optical Sensors: LDR, Photo Diode, Stroboscope, IR Sensor.

Capacitive transducers: Variable distance-parallel plate type, variable area- parallel plate type, cylindrical type, differential type, variable dielectric constant type, calculation of sensitivity. Capacitive microphone, fluid level measurement.

UNIT-III:

Piezoelectric transducers: piezoelectric effects, Materials, natural and synthetic types – their comparison, Charge and voltage coefficient, Force and stress sensing, displacement measurement.

Magnetic Transducer: Hall effect sensors

Magneto strictive transducers: principle, positive and negative magneto striction

UNIT –IV:

Thermal sensors: Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple, thermocouple types, construction. IC temperature sensor, PTAT type sensor. Radiation sensors: types, characteristics and comparison. Pyroelectric type.

UNIT – V:

Micro-sensors and smart sensors: Construction, characteristics and applications. Standards for smart sensor interface.

Recent Trends in Sensor Technologies: Introduction; Film sensors (Thick film sensors, thin film sensor)

TEXT BOOKS:

1. Transducers and Instrumentation , D.V.S. Murthy, Prentice Hall, 2008
2. Sensors and Transducers, D. Patranabis, Prentice Hall India, 2003
3. Measurement Systems - Application and Design, E.O. Doebelin, McGraw-Hill, 2008

REFERENCE BOOKS :

1. Instrument Transducers - An Introduction to their Performance and Design", H.K.P. Neubert, Oxford University Press, 1999.
2. Measurement Systems and Sensors, WaldemarNawrocki Artech House, 2016.
3. Semiconductor sensors", S.M. Sze, Wiley - Interscience, 1994
4. Instrumentation Measurement and Analysis", B. C. Nakara&Chaudhry TATA McGraw-Hill, 2009.
5. Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, 2011.

Course Code	Course Title						Core/Elective
1OE804AD	BIG DATA ANALYTICS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the Big Data Platform and overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide handson Hadoop Eco System Pig, Hive
- Understand various Hadoop Eco Systems like H base, Zookeeper

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Explain the foundations, definitions, and challenges of Big Data.

CO2. Use Hadoop file system interfaces.

CO3. Program using HADOOP and Map reduce.

CO4. Understand various Hadoop Eco Systems like Pig, Hive.

CO5. Outline Hadoop Eco System using H Base, Zookeeper.

UNIT-I

Introduction to Big Data and HadoopTypes of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with UNIX tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System.

UNIT-II

HDFS (Hadoop Distributed File System)The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file systeminterfaces, Data flow, Hadoop I/O: Compression, Serialization, Avro and File-BasedData structures.

UNIT-III

Map ReduceAnatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort,

Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT IV

Hadoop Eco System-IPig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig withDatabases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

UNIT V

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, Hive QL, Tables, Querying Data and User Defined Functions.

TEXTBOOKS :

1. Hadoop: The Definitive Guide, Tom White, III Edition, O'reily Media, 2012.

REFERENCE BOOKS :

1. Big Data Analytics, Seema Acharya, Subhasini Chellappan, Wiley 2015.
2. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.

Course Code	Course Title						Core/Elective
OE804CE	REMOTE SENSING AND GIS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

C1. Basics of remote sensing and Sensor Characteristics

C2. Energy interactions with atmosphere and Earth surface features

C3. Map projections and Data models in GIS

C4. Spatial Data creation

C5. Spatial data and Terrain modelling analysis

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Explain the basics of Remote Sensing, different types of satellite and sensors

CO 2. Define the principles of satellite remote sensing, able to comprehend the energy interactions with earth surface features, spectral properties of water bodies

CO 3. Demonstrate the basic concept of GIS and its applications, know different types of data representation in GIS

CO 4. Create the spatial data using various techniques

CO 5. Develop models using spatial & Terrain Analysis

UNIT-I:

Basics of Remote Sensing: Definition, History, Advantages, Aerial Photography and Satellite Remote Sensing, Components of Remote Sensing System: Energy Source, Energy-Atmosphere Interaction, Energy Interaction with Atmosphere and Surface Materials, Spectral Signatures

UNIT-II:

Remote Sensing Platforms: Aircrafts and Satellites, Orbital Characteristics of Sun-synchronous and Geostationary satellites - Special Purpose Satellites; Remote

Sensing Sensors: Types of Sensors, Active and Passive; Framing Systems (Cameras) - Scanning System; Sensor Characteristics: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.

UNIT-III:

Introduction to GIS: History of development of GIS- Geo Spatial Data - GIS operations- Standard GIS packages, Applications of GIS;

Datum and Map Projections: Concept of Datum, Coordinate Systems and Map Projections , Transformations

UNIT-IV:

Data Models: Spatial and Non-Spatial Data models; Spatial Digital formats

Spatial Data Creation: Scanners, digitizers; Digital Elevation Models; Sources of Errors & Corrections- Rotation and Resampling methods, Morphometric analysis- Triangular Irregular Network (TIN).

UNIT-V:

Spatial Data Analysis: Raster data analysis; Vector data analysis - Buffering, Overlay, Union, Intersect, Merging, splitting operations

Terrain Modelling & Analysis: Contouring, Vertical profiling, Hill shading, 3D perspectives; Slope & Aspect analysis, Viewshed & watershed analysis.

Software: Introduction to QGIS or ARCGIS software and its interface to perform spatial analysis

TEXT BOOKS:

T1. M.Anji Reddy – "Textbook of Remote Sensing and Geographic Information Systems", 3rd Edition, BS Publications, 2008.

T2. K.T.Chang –"Introduction to Geographic Information Systems", 4th Edition, McGraw Hill International Edition, 2016.

REFERENCE BOOKS:

R1. Lillesand, T., Kiefer, R. W., & Chipman, J. – "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons, 2015.

R2. Punmia, B.C. & Jain A.K.—"Higher Surveying", 15th Edition, Laxmi Publications, 2005.

Course Code	Course Title						Core/Elective
3OE804CS	DATA SCIENCE						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Learn fundamental knowledge on basics of data science.
- Understand various statistical concepts like linear and logistic regression
- Learn fundamentals of how to obtain, store, explore, and model data efficiently.
- Understand the concepts of classification and clustering

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Recognize the different levels of Data Science concepts for visualization of data.

CO 2. Demonstrate the data visualization and statistical techniques, for describing data structure property.

CO 3. Analyze the basics of probability and statistics models for data exploration

CO 4. Make use of Hypothesis testing for statistical analytics for destroying target based on the mission requirements.

CO 5. Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies

UNIT-I

Introduction: What is Data Science, Where Do We See Data Science, and How Does Data Science Relate to Other Fields, The Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science.

UNIT-II

Data Collection and Data Pre-Processing: Data Types-Structured Data, Unstructured Data, Challenges with Unstructured Data, Data Collections- Open Data, Social Media

Data, Multimedia Data, Data Storage and Presentation, Data Pre-processing -Data Cleaning, Data Transformation, Data Reduction, Data Discretization

UNIT-III

Exploratory Data Analysis: data summarization, data distribution, Frequency Distribution, Measures of Centrality, Dispersion of a Distribution, Diagnostic Analytics-Co-relations Predictive Analytics, Perspective Analytics, Exploratory Analysis, hypothesis testing using confidence intervals, using p-values.

UNIT-IV

Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression, Robust Regression. Evaluation Measures: SSE, RMSE.

UNIT-V

Classification: Decision Tree Induction, Support Vector Machine, K-Nearest neighbours (KNN), performance measures: The Confusion Matrix, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve. Clustering: K-means Clustering.

TEXT BOOKS :

1. A Hands on Introduction to Data Science, Chirag Shah, Cambridge University Press 2020.
2. Practical Statistics for Data Scientists, Peter Bruce and Andrew Bruce,O.Reilly, 2017.
3. R for Data Science,Hadley Wickham and Garrett Grolemund, O.Reilly, 2017

REFERENCE BOOKS :

1. R Programming for Data science, Roger D Peng, Lean Publishing, 2016.
2. Introduction to Data Science, Rafael A Irizarry, Lean Publishing, 2016.
3. R Data Analysis cookbook, VishwaVishwanathan and Shanthi Vishwanathan, 2015.

Course Code	Course Title						Core/Elective
6OE804ME	INDUSTRIAL ENGINEERING AND MANAGEMENT						Open Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES

It is intended to make the students to :

- Learn the concept of Management.
- Understand role of PERT and CPM techniques in project management.
- Learn various material procurement policies.
- Understand the costing and cost control in engineering industries.
- Learn job evaluation methods.

COURSE OUTCOMES

After completing the course, student will be able to:

CO1. Understand the concept of scientific management.

CO2. Apply different types of inventory models in material management.

CO3. Apply the concepts of PERT and CPM techniques in project management.

CO4. Analyse the elements of costing and determine the selling price.

CO5. Apply job evaluation and merit rating techniques to evaluate the performance of employees.

UNIT-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process. Personnel Management, Functions of personnel management, types of training, Collective bargaining and labour participation in management.

UNIT-II

Cost Accounting and Control: Introduction, Elements of cost, types of cost- prime cost, overhead cost, factory cost, total cost. Selling price, nature of cost, control and accounting of materials, labor, and over head cost, depreciation, break even analysis, break even chart.

UNIT III

Job Evaluation and Merit Rating: Job evaluation: Introduction, definition and concept, objectives, procedure and methods-ranking method, classification or grading method, factor comparison method and point method, Merit rating: Introduction, definition, objectives, and methods- rating scale, check list and employee comparison method.

UNIT-IV

Material Management: Importance of inventory control, types of inventory models Inventory costs, deterministic inventory models, Basics of EOQ models, production model without shortages, Purchase model with instantaneous replenishment, production model with shortages, Inventory model with price breaks, Inventory model with probabilistic demand.

UNIT-V

Project Management: Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management, Assessment of tax burden.

TEXT BOOKS:

1. OP Khanna, Industrial engineering and management, Dhanpat Rai Publications.
2. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons.

REFERENCE BOOKS:

1. M.Mahajan, "Industrial Engineering and Production Management", Dhanpatrai& sons, New Delhi.
2. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd.
3. V. K. Kapoor , "Operations Research", S. Chand, New Delhi.

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M21 - SCHEME OF INSTRUCTIONS

and

SYLLABI of III – VIII Semesters

for

B.E. Four Year Degree Programme

in

Mechanical Engineering

(With Effect from the Academic Year 2022-23)
(As approved in Academic Council Meeting)

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