DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Instructions, Examinations & Syllabi

(Autonomous BE Curriculum for the Academic Years 2021-2025)

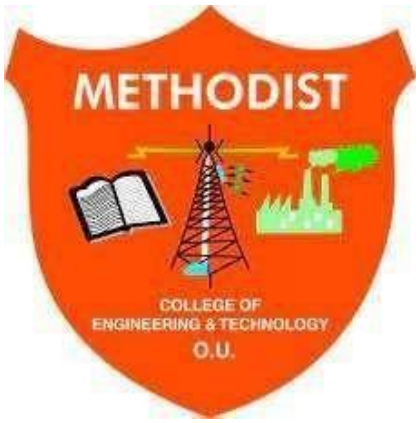
for

III & IV Semester of

Four Year Degree Programme for Bachelor of Engineering (B.E)In

Mechanical Engineering

(With effect from the academic year 2021-22)



Methodist College of Engineering & Technology,

Affiliated by Osmania University Hyderabad, approved by AICTE, New Delhi,

King Koti Road, Abids, Hyderabad, Telangana 500001.

B.E. (Mechanical Engineering) - I SEMESTER

S. No.	Code No.	Subject	Scheme of Instructions				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs.	CIE	SEE	
Theory Courses									
1	6BS101HS	Engineering Mathematics–I	3	1	-	4	40	60	4
2	6HS101HS	English for Engineers	2	-	-	2	40	60	2
3	6BS105HS	Engineering Chemistry	3	1	-	4	40	60	4
4	6ES101ME	Engineering Mechanics - I	3	-	-	3	40	60	3
Practical / Laboratory									
5	6BS152HS	Engineering Chemistry Laboratory	-	-	3	3	40	60	1.5
6	6HS151HS	English Laboratory	-	-	2	2	40	60	1
7	6ES152ME	Engineering Workshop	-	-	4	4	40	60	2
8	6MC151SP	Yoga/NSS/Sports	-	-	2	2	50	*S/U	-
Total			**11**	**2**	**11**	**24**	**330**	**420**	**17.5**

#Mandatory Requirement: Three weeks induction program to be conducted before commencement of the coursework of Semester – I as per the guidelines given by AICTE

*S=Satisfactory, U= Unsatisfactory

B.E. (Mechanical Engineering) - II SEMESTER

S. No.	Code No.	Subject	Scheme of Instructions				Scheme of Examination		Credits
			L	T	P/D	Duration in Hrs.	CIE	SEE	
Theory Courses									
1	6BS202HS	Engineering Mathematics–II	3	1	-	4	40	60	4
2	6BS204HS	Engineering Physics	3	1	-	4	40	60	4
3	6ES202ME	Engineering Mechanics -II	3	-	-	3	40	60	3
4	6ES201EE	Elements of Electrical & Electronics Engineering	3	-	-	3	40	60	3
5	6MC201CE	Environmental Science	2	-	-	2	40	60	-
Practical / Laboratory									
6	6BS251HS	Engineering Physics Lab	-	-	3	3	40	60	1.5
7	6ES251EE	Elements of Electrical & Electronics Engineering Lab	-	-	2	2	40	60	1
8	6ES251ME	Engineering Graphics	1	-	4	5	40	60	3
Total			**15**	**2**	**9**	**26**	**320**	**450**	**19.5**

B.E. (Mechanical Engineering) - III SEMESTER

S. No.	Code No.	Subject	Scheme of Instructions				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) - IV SEMESTER

S. No.	Code No.	Subject	Scheme of Instructions				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**

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 Trigonometric results	**3**	**1**	**-**	**-**	**40**	**60**	**4**

Course Objectives:	**Course Outcomes**:
The objective of this course is to make the student ➢ 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	After completion of the course, the student will be able to **CO1**. Find the solution of algebraic and transcendental equations using numerical methods. (PO1,PO2) **CO2.** Apply numerical techniques to solve ordinary differential equations and definite integrals. (PO1,PO2) **CO3.** Apply numerical methods to interpolate values and fit different curves from given data. (PO1,PO2) **CO4** Find solutions of first order linear and non linear partial differential equations. (PO1,PO2) **CO5** Apply the solution of partial differential equations to physical problems. (PO1,PO2,PO4)

UNIT 1:
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 2:
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 3 :
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 4 :
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 5 :
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.EngineeringMathematics,KhannaPublicatins,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.

REFERENCES/ SUGGESTED READING :

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	Course Type					
6HS303HS	**HUMAN VALUES AND PROFESSIONAL ETHICS**	Mandatory Course					
		L	**T**	**P/D**	**Credits**	**CIE**	**SEE**
		2	0	0	0	40	60

Pre-requisites: Adaptive

COURSE DESCRIPTION:

The methodology of this course is universally adaptable, involving a systematic and rational study of the human being vis-à-vis the rest of existence. It is free from any dogma or value prescriptions. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with and within the student himself/herself finally.

COURSE OBJECTIVE:	**COURSE OUTCOMES:**
The objective of this course is: - 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.	On completion of this course, the students will be able to 1. Understand the significance of value inputs in a classroom and start applying them in their life and profession 2. Assess their own ethical values and the social context of problems 3. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc. 4. Understand the role of a human being in ensuring harmony in society and nature. 5. 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:	Course Outcomes:
The objective of this course is to make the student To introduce the basic concepts of Computing environment, algorithms and flowcharts To acquire knowledge about the basic concept of writing a program To understand modular and structured programming constructs in C To learn the usage of structured data types, data handling and memory management using pointers	After completion of the course, the student will be able to **1.**Formulate algorithmsand 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 problems **4**. 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, Bitfields.

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 usingC, Behrouz A. Forouzan and Richard F.

Gilberg , Cengage Learning , 2007 ,Third Edition(Unit 1-5)

2. Schaum's Outline of Programming with C, ByronGottfried, McGraw-Hill ,2019, FourthEdition (Unit 1-5)
3. Data Structures and Program Design in C, Robert Kruse, Bruce Leung,Tondo, Pearson, II Edition

References/ Suggested Reading

1. C Programming Language, Brian W Kenningham, Dennis M Ritchie, Pearson, II Edition
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
	L	T	D	P			
Engineering 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 $T/J = q/R = G\Theta/L$ 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 mke 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, e**xplain** 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			
Mathematical Knowledge, Logical and Analytical Thinking	-	-	-	2	40	60	1

Course Objectives:	Course Outcomes:
The objective of this course is to make the student ➢ Understand the fundamentals of programming in C Language. ➢ Write, compile and debug programs in C. ➢ Formulate solution to problems and implement in C. ➢ Effectively choose programming components to solve computing problems	After completion of the course, the student 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 makingand 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 ofelasticity, % 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 TorsionTest.
5. To determine the Young's Modulus (E) of given material by conducting thedeflection test on Cantilever beam, simply supported beam

   To determine the stiffness and rigidity modulus of the given spring byConducting 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						
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

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

UNITI

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

T1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2nd Edition, 2017, Cengage Learning

T2. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India

REFERENCE BOOKS

R1. Mark Summerfield. —Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009.
R2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,,,,, 2nd edition, Updated for Python 3, Shroff/O,,Reilly Publishers, 2016
R3: NPTEL Course, Programming, Data Structures and Algorithms using Python,
Link: https://nptel.ac.in/courses/106106145
R4: NPTEL Course, The Joy of Computing using Python,
Link: https://nptel.ac.in/courses/106106182
R5: 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 behaviour of reciprocating compressors
2. **Explain** the thermal design and working principles of IC Engines and their supportingsystems
3. **Describe** the working principle of IC Engines and combustion phenomenon of SI and CIengines 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						
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
THERMODYNAMICS	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

CO1. Describe the concepts of Foundry Technologies consisting of pattern making, mould making, gating design and solidification.
CO2.Discuss the importance of special casting processes, categorize various casting defects and describe the processing of plastics and powder metallurgy concepts.
CO3. Classify and differentiate various Arc welding, Gas welding and Advanced welding processes, discuss their advantages, applications and limitations.
CO4. Differentiate various Solid State welding and Resistance welding processes, discuss their applications, and identify various welding defects.
CO5. 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, velocitytriangles, 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", (5^{th} 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, 5^{th} Edition, New Delhi.
3. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", TataMcGraw- Hill, 2^{nd} 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:

1. Identify links & joints, determine mobility & explain motion of a connected system of links
2. Analyse motion of planar mechanisms & their equivalent chains.
3. Identify & explain the applications of commonly used mechanisms.
4. Solve problems involving velocity & acceleration of planar mechanisms with given dimensions at specified positions.
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 (Common for all branches)	MandatoryCourse					
		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: 8177023101ISBN Nitin Singhania,Indian Art and Culture, 4th Edition, ISBN: 9354601804.
3. 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. 1.7-Position paper, National Focus Group on Arts, Music, Dance and Theatre NCERT, March 2006, ISBN 81-7450-494-X, NCERT, New Delhi.
3. Founders of Sciences in Ancient India,Satya Prakash, Vijay Kumar Publisher, New Delhi.
4. Essentials of Indian Philosophy,M. Hiriyanna, Motilal Banarsidass Publishers, New Delhi.
5. NCET Books from VI to XII standards
6. 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			
Experience with a high level language (C/C++, Java, MATLAB) is suggested	-	-	-	2	40	60	1

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