Scheme of Instruction & Syllabi

(In line with AICTE Model Curriculum with effect from AY 2025-26)

BACHELOR OF ENGINEERING

SEMESTERS III & IV

FOUR YEAR DEGREE PROGRAMME

IN

MECHANICAL ENGINEERING

(R–25 Regulation)

MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution
Affiliated to Osmania University, Approved by AICTE
Accredited by NBA & NAAC (A+)

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MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution)

Institute Vision

To be a part of the universal human quest for development and progress by contributing high caliber, ethical and socially responsible engineers who meet the global challenge of building a modern society in harmony with nature.

Institute Mission

- To attain excellence in imparting technical education from the undergraduate to through doctoral levels by adopting coherent and judiciously coordinated curricular and co-curricular programs.
- To foster a partnership with industry and Governmental agencies through collaborative research and consultancy.
- To nurture and strengthen auxiliary soft skills for overall development and improved employability in a multicultural workspace.
- To develop scientific temper and spirit of enquiry in order to harness the innovative talents.
- To develop a constructive attitude in the students towards the task of nation-building and empower them to become future leaders.
- To nourish the entrepreneurial instincts of the students and hone their business acumen.
- To involve the student and faculty in solving local community problems through economical and sustainable solutions.

Department Vision

To produce high caliber, competent, industry oriented Mechanical Engineers.

Department Mission

To impart quality education by providing state of art technical facilities and enhance the professional abilities to meet the demands of the ever-changing manufacturing industry.

Program Educational Objectives (PEO's)

PEO 1: Graduates will be capable of demonstrating analytical and practical engineering skills using various techniques and tools in solving engineering problems.

PEO 2: Graduates will communicate efficiently as professional engineers in a team or as an individual in local and global cross cultural working scenario.

PEO 3: Graduates will demonstrate lifelong learning through higher education, skill improvement and professional development.

PEO 4: Graduates will be successful in devising sustainable solutions to environmental, socio economic and professional problems, with due regard to professional ethics.

Program Specific Outcomes (PSO's)

PSO 1: The graduates will be able to function in software industry in the areas of design and development using software tools such as AUTO CAD, SolidWorks, Ansys, etc.

PSO 2: The graduates will be able to work in power plants and manufacturing industry in the sphere of operation and maintenance.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

SCHEME OF INSTRUCTION & EXAMINATION

(In line with AICTE Model Curriculum with effect from AY 2025-26)

B.E. (MECHANICAL ENGINEERING)

S E M E S T E R - III			Scheme of Instruction				Scheme of Examination			Credits
S. No.	Course Code	Name of the Course	Lecture	Tutorial	Practical	Contact Hrs./Wk	C.I.E.	S.E.E.	Duration in Hrs.	
1	25PC211ME	Metallurgy & Material Science.	3	-	-	3	40	60	3	3
2	25PC212ME	Mechanics of Materials	3	-	-	3	40	60	3	3
3	25BS213MT	Transformation Techniques & Statistics.	3	-	-	3	40	60	3	3
4	25ES214ME	Automobile Engineering	3	-	-	3	40	60	3	3
5	25PC215ME	Kinematics of Machines	3	1	-	4	40	60	3	4
6	25PC251ME	Metallurgy & Material Testing Lab	-	-	2	2	40	60	3	1
7	25PC252ME	Computer Aided Design Lab	-	-	2	2	40	60	3	1
8	25ES253ME	Design Thinking & Ideation Lab	-	-	2	2	40	60	3	1
9	25SD254EC	Skill Development Course-2 (IoT Applications)	-	-	2	2	50	-	-	1
		Total	**15**	**1**	**8**	**24**	**370**	**480**	**24**	**20**

S E M E S T E R - IV			Scheme of Instruction				Scheme of Examination			Credits
S. No.	Course Code	Name of the Course	Lecture	Tutorial	Practical	Contact Hrs./Wk	C.I.E.	S.E.E.	Duration in Hrs.	
1	25PC221ME	Design of Machine Elements	3	-	-	3	40	60	3	3
2	25PC222ME	Manufacturing Processes	3	-	-	3	40	60	3	3
3	25PC223ME	Dynamics of Machines	3	1	-	4	40	60	3	4
4	25PC224ME	Applied Thermodynamics	3	-	-	3	40	60	3	3
5	25PC225ME	Computer Aided Design & Manufacturing	3	-	-	3	40	60	3	3
6	25PC256ME	Thermal Engineering Lab	-	-	2	2	40	60	3	1
7	25PC257ME	Manufacturing Processes Lab	-	-	2	2	40	60	3	1
8	25PC258ME	Dynamics & Vibrations Lab	-	-	2	2	40	60	3	1
9	25PW259ME	Mini Project	-	-	6	6	40	60	3	3
		Total	**15**	**1**	**12**	**28**	**360**	**540**	**27**	**22**

S E M E S T E R - III			Scheme of Instruction				Scheme of Examination			Credits
S. No.	**Course Code**	**Name of the Course**	**Lecture**	**Tutorial**	**Practical**	**Contact Hrs./Wk**	**C.I.E.**	**S.E.E.**	**Duration in Hrs.**	
1	25PC211ME	Metallurgy & Material Science.	3	-	-	3	40	60	3	3
2	25PC212ME	Mechanics of Materials	3	-	-	3	40	60	3	3
3	25BS213MT	Transformation Techniques & Statistics.	3	-	-	3	40	60	3	3
4	25ES214ME	Automobile Engineering	3	-	-	3	40	60	3	3
5	25PC215ME	Kinematics of Machines	3	1	-	4	40	60	3	4
6	25PC251ME	Metallurgy & Material Testing Lab	-	-	2	2	40	60	3	1
7	25PC252ME	Computer Aided Design Lab	-	-	2	2	40	60	3	1
8	25ES253ME	Design Thinking & Ideation Lab	-	-	2	2	40	60	3	1
9	25SD254EC	Skill Development Course-2 (IoT Applications)	-	-	2	2	50	-	-	1
		Total	**15**	**1**	**8**	**24**	**370**	**480**	**24**	**20**

Course Code	Course Title					Core/Elective
25PC211ME	METALLURGY AND MATERIAL SCIENCE					Core
Pre-requisites	Contact hours per week			CIE	SEE	Credits
	L	T	P			
-	3	-	-	40	60	3

Course objectives:

1. To understand structure–property relationships and metal failure prevention.
2. To develop knowledge of phase diagrams and engineering materials.
3. To learn heat treatment processes and their applications.
4. To understand extractive metallurgy and material production.
5. To study the applications and failure mechanisms of metals and alloys.

Course Outcomes: Upon successful completion of the course, the students will be able to

CO1: Explain crystal structures, defects, mechanical properties, and plastic deformation of materials.
CO2: Analyze fracture, fatigue, and creep failures and their effects on material performance.
CO3: Interpret binary phase diagrams and apply the phase rule to predict phase transformations.
CO4: Evaluate the effects of alloying elements and heat treatment on the properties of alloys.
CO5: Compare properties and applications of non-ferrous metals, ceramics, polymers, and composites.

Unit-I

Introduction to Materials engineering, Space lattice, unit cell, crystal structure, crystal directions and planes, crystal imperfections- point defects, line defects, surface defects, volume defects. Effect of slip and twinning on the plastic deformation, Jogs and its effect on yield phenomenon, Hall-Petch equation, Orange peel effect, cold and hot working, strain hardening and Bauchinger effect. Recovery, Recrystallization, Grain growth and its effect on mechanical properties of metals. Mechanical properties of materials.

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

Unit-IV

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon and Tungsten. Titanium. Study about Stainless steels, HSS, Maraging steels, Brass, 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 –Cu and its alloys, Al and its alloys, Age hardening. Bronze, Muntz Metal, Invar, Duralumin and Ti Alloy (Ti-6Al-4V)-their composition properties.

Ceramics and Composites: Ceramics, crystalline ceramics, glasses, properties and applications of ceramics. Composites: concept of composites, matrix and reinforcement, rule of mixtures, classification of composites, applications of composites.

Suggested Reading:

1. V. Raghavan, Material Science and Engineering, Prentice Hall of India Ltd., 4th Edition, 1994.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd Edn.1997.
3. S.P. Nayak, Engineering Metallurgy and Material Science, Charotar Publishing House, 6th Edition, 1995.
4. E. Dieter, Mechanical Metallurgy, Metric Editions, Tata McGraw Hill, 3rd Edn, 1997.
5. Robert M Jones, Mechanics of Composite Materials, Taylor and Francis.

Course Code	Course Title					Core/Elective
25PC212ME	**MECHANICS OF MATERIALS**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**-**	**-**	**40**	**60**	**3**

Course objectives:

1.To understand the basic concept of stresses and strains for different materials.
2.To understand shear force, bending moment, and stresses in beams, thin cylinders, and spheres.
3.To know the theory of simple bending, direct & bending stress and distribution of shear stress.
4.To analyse and understand torsional shear stress and buckling of columns.
5.To study the methods to determine deflections in beams.

Course Outcomes: Upon successful completion of the course, the students will be able to

CO1: Understand the theory of elasticity and Hooke's law.
CO2: Analyse beams to determine shear force and bending moments.
CO3: Analyse shear stress distribution in different sections of beams.
CO4: Analyse and design structural members subjected to combined stresses.
CO5: Solve problems on bars and to determine deflections at any point of the beams.

Unit-I

Simple Stresses & Strains*:* Types of stresses & strains, Stress-Strain relations (Hooke's law), Relation between elastic constants, Volumetric strain, Composite bars, Thermal stresses.

Strain energy: Gradual, Sudden and Impact loading.

Compound Stresses: Stresses on oblique planes, Principal stresses and Principal planes. Mohr's circle and ellipse of stresses & strains.

Unit-II

Shear Force and Bending Moment: Construction of S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure and Relation between S.F & B.M.

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

Unit-III

Bending stresses in Beams: Assumptions made in pure bending, Derivation of bending moment equation, Modulus of section, Moment of resistance, Determination of bending stresses.

Distribution of shear stress: Equation of shear stress, Distribution across rectangular section. Circular, triangular cross sections.

Unit-IV

Torsion of Circular Shafts*:* Theory of pure torsion, Assumptions made, Derivation of basic torsion equation, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, combined bending and torsion.

Columns and Struts: Introduction to columns and struts, Buckling and Stability, types of supports, critical load, Euler's formulae and Rankine formulae, Equivalent length of the column, eccentric axial loads on column, core or kernel of section.

Unit-V

Deflection of Beams: Deflections of cantilever and simply supported beams including overhanging beams for point loads and uniformly distributed loads by Double integration method, Strain energy method, Moment area method.

Suggested Reading:

1. S. Ramamrutham, ―Strength of Materials", Dhanpat Rai & Sons, 1993.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.
3. R.K. Rajput, ―Strength of Materials", S. Chand & Co., 2003.
4. EgorP.Popov, ―Engineering Mechanics of Solids", Prentice Hall of India, NewDelhi, 2001.
5. Gere & Timoshenko, ―Mechanics of Materials", 2nd Edition, CBS Publishers and Distributors Pvt. Ltd.
6. Ferdinand P. Beer et.al., ―Mechanics of Materials", Tata McGraw-Hill Publishing Co. Ltd., New Delhi,2005.

Course Code	Course Title					Core/Elective
25BS213MT	**TRANSFORMATION TECHNIQUES AND STATISTICS**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**0**	**-**	**40**	**60**	**3**

Course Objectives:

1. To Perform Fourier series for a given range.
2. To Perform Fourier sine and cosine transformations.
3. To Understand the one dimensional wave equation, heat equation.
4. To Understand fundamental concepts of probability theory and random variables.
5. To Analyze statistical data using sampling distributions.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Obtain the Fourier series for a given function.
CO2: Obtain the Fourier sine and cosine transformations.
CO3: Determine the solution of a wave and heat equations by the method of separation of variables.
CO4: Evaluate statistical parameters of discrete and continuous probability distributions.
CO5: Test hypotheses of unknown statistical parameters using sampling methods and sampling distributions.

Unit-I:

Fourier Series: Even and Odd functions, Dirichlet's conditions, Expansion of a function for a given range $(0,2\pi), (-\pi,\pi), (0,2l), (-l,l)$, Half-range sine and cosine series.

Unit-II:

Fourier Transforms: - Fourier transformation - sine, cosine transformations - simple illustrations.

Unit-III:

Applications of Partial Differential Equations: Second order linear Partial Differential Equation and their classification, Method of separation of variables, vibrations of stretched string wave equation, one-dimensional heat equation, Laplace equation.

Unit-IV:

Probability: Review of fundamental concepts of probability, Discrete and continuous distributions, Poisson, and Normal distributions.

Unit-V:

Statistics: Hypothesis testing, comparison of single mean to specified value and comparison of equality of two means, Chi-square test for goodness of fit.

Text Books:

1. R. K Jain S.R.K Iyengar, Advanced Engineering Mathematics, Narosa Publication. 4^{Th} Edition, 2014.
2. S.C Gupta and V.K Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & sons, New Delhi, 2014.
3. M.D. Rai Singhania, Ordinary and Partial Differential Equations, S.Chand and Co., 2024, 20^{th} Edition.

Course Code	Course Title					Core/Elective
25ES214ME	**AUTOMOBILE ENGINEERING**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**-**	**-**	**40**	**60**	**3**

Course objectives:

1. To Understand the Working of Fuel, Ignition, and cooling Systems.
2. To Understand the Working of Lubrication and Electrical Systems
3. To Understand the Working of Suspension, Steering and Braking Systems.
4. To Understand the Working of Power Transmission.
5. To Understand the Necessity of Pollution Control and Maintenance.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Explain automobile classification, engine components, IC engine operation, and fuel systems.
CO2: Describe lubrication, cooling, ignition, battery, and air conditioning systems.
CO3: Explain steering, wheel alignment, balancing, suspension systems, and shock absorbers.
CO4: Explain power transmission and braking systems and their design considerations.
CO5: Apply modern techniques for vehicle maintenance, pollution control, and emission reduction.

Unit-I

Types of automobiles: Normal, Hybrid and Hydrogen fuel vehicles.
Engine location and its components, chassis layout, crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, mechanical fuel injection system & electronic fuel injection system.

Unit-II

Lubricating systems: Wet sump, dry sump and petrol systems, and Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds. Types of Ignition systems, modern ignition systems, types of batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit-III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly – recent trends Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, types of suspension system, independent suspension coil and leaf springs, torsion bar, shock absorbers.

Unit-IV

Power train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system. Brake systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder, hand brake linkage, recent trends.

Unit-V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul, testing equipment, pollution control technologies used for petrol and diesel engines, types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – recent trends.

Suggested Reading:

1. Crouse & Anglin, 'Automotive Mechanics' Tata McGraw Hill, Publishing Co., Ltd., New Delhi, Tenth edition - 2004.
2. Kirpal Singh, ―Automobile Engineering‖, Vol I & II Standard Publishers, Delhi.
3. Joseph Heitner, _Automotive Mechanics', Affiliated East West Pvt., Ltd.,
4. C.P. Nakra, ―Basic Automobile Engineering‖, Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2003.

Course Code	Course Title					Core/Elective
25PC215ME	**KINEMATICS OF MACHINES**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**1**	**-**	**40**	**60**	**4**

Course objectives:

1. To understand mechanisms, kinematic chains, and motion transmission systems.
2. To analyze the velocity and acceleration of planar mechanisms using graphical methods.
3. To apply the principles of friction in machine elements, belt drives, brakes, and dynamometers.
4. To understand the kinematics and design of cams and follower mechanisms.
5. To analyze the geometry, operation, and applications of gears and gear trains.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Understand kinematic pairs, chains, mechanisms, and their classifications.
CO2: Analyse the planar mechanisms for position, velocity and acceleration.
CO3: Design frictional systems like belt drives, rope drives, clutches, bearings and screw threads
CO4: Design cams and followers for specified motion profiles.
CO5: Evaluate gear tooth geometry and select appropriate gears for the required applications.

Unit-I

Definition of link, pair, kinematic chain, mechanism and machine, Kutzbach and Grubler criterion, Grashoff‘s law, inversions of quadric cycle chain, single and double slider crank chains. Fundamentals of coupler curves, Robert‘s law, Pantograph, Geneva mechanism, Hooke‘s joint, Davis and Ackerman‘s Steering gear mechanisms. Straight Line Motion Mechanisms: Peaucellier and Hart Mechanisms.

Unit-II:

Analysis of Mechanisms: Instantaneous centre, body centrode and space centrode, Kennedy‘s theorem, Graphical methods (relative velocity method, instantaneous center method) to find velocities and accelerations including Coriolis component of acceleration of planar mechanisms. Angular velocity theorem.

Unit-III

Laws of Friction: Friction in screw threads, pivots, collars and clutches, friction axis and friction circle of a link Belts and Rope drives: Open and closed belt drives, length of belt, ratio of tensions, effect of centrifugal tension and initial tension on power transmission, condition for maximum power transmission Brakes: Block or shoe brake, internal expanding shoe brake, differential band brake, block& band brake. **Dynamometers:** Prony brake, Rope brake, belt transmission and Torsion type dynamometers

Unit-IV

Cams: Types of cams and followers, Displacement, velocity, acceleration diagrams for follower motion, Analysis of uniform motion, parabolic motion, simple harmonic motion and cycloidal motion profiles. Design of Cam profiles: Cams with knife edge, roller and flat face followers.

Unit-V

Gears: Classification of gears. Spur gears- Nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycloidal tooth profiles. Gear trains- Simple, compound, reverted, and epicyclic gear trains.

Suggested Reading:

1. S.S. Rattan, ―Theory of Machines", Tata McGraw-Hill, 3rd Edition, 2009.
2. J. E. Shigley, ―Theory of Machines and Mechanisms", McGraw-Hill Publications, 2005.
3. Thomas Bevan, ―Theory of Machines", Pearson Education.
4. Norton RL, ―Kinematics and Dynamics of Machinery", McGraw-Hill Publications
5. Amitabha Ghosh and Ashok Kumar Mallik, ―Theory of Mechanisms and Machines", East West Press Pvt. Ltd, 2008.

Course Code	Course Title					Core/Elective
25PC251ME	METALLURGY AND MATERIAL TESTING LAB					Core
Pre-requisites	Contact hours per week			CIE	SEE	Credits
	L	T	P			
-	-	-	2	40	60	1

Course objectives:

1. To understand the iron–carbon diagram and its applications in engineering materials.
2. To perform metallographic studies and analyze the microstructure of various metals.
3. To determine and evaluate the hardness of metals before and after heat treatment.
4. To understand heat treatment processes and T–T–T curve applications in metallurgy
5. To correlate microstructure with the properties and performance of engineering materials.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Prepare specimen for metallographic observation.
CO2: Identify carbon steels, cast irons, and non-ferrous alloys through microstructural analysis.
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: Analyze heat-treated microstructures and relate material properties using an image analyzer.

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 and Hyper Eutectoid steel.
4. Metallographic Study of, White cast-iron, Malleable cast iron, Nodular cast iron and Grey cast-iron.
5. Metallographic Study of Aluminium, Brass and Bronze.
6. Metallographic study of Muntz metal and Babbit Material.
7. Jominy Quench test or Study of microstructure after heat treatment.
8. Study on OM/SEM/TEM

B: Materials testing Lab

1. Uni-axial tension test, to draw stress- strain diagram, and estimate modulus of elasticity, % of elongation and toughness.
2. Compression test on bricks and Impact test.
3. Hardness test: Brinell and Vickers.
4. Shear force & bending moments tests.
5. Bending test on fixed beam, simply supported beam.
6. Spring test and torsion test.
7. Heat treatment of Metals, Annealing, Normalizing and Quenching.

Note: At least ten (each 5 from A &B) experiments should be conducted

Course Code	Course Title					Core/Elective
25PC252ME	**COMPUTER AIDED DESIGN LAB**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**2**	**40**	**60**	**1**

Course objectives:

1. To understand the fundamentals of CAD modeling and design.
2. To create 2D sketches, solid models, and surface models using CAD tools.
3. To apply feature manipulation techniques for model modification.
4. To develop assembly models using constraints and interference analysis.
5. To prepare engineering drawings and model mechanical components and assemblies.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Use modern engineering tools and CAD software effectively.
CO2: Create accurate 2D part and assembly drawings.
CO3: Develop detailed 3D CAD models.
CO4: Generate 2D technical drawings from 3D models.
CO5: Perform assembly interference and fit analysis.

Exercises in modelling and drafting of mechanical components-assembly using parametric and feature based packages like PRO-E/SOLIDWORKS /CATIA.

- Introduction to CAD modelling.

Part Modelling

- *Sketch tools* – Offset, Trim, Extend, Fillet, Chamfer, Mirror, Scale and Stretch, etc.
- *Solid modelling* – Features like Extrude, Revolve, Swept, Loft, Shell, Draft, etc.
- *Surface modelling* – Features like Extrude, Sweep, Freeform, Trim, Boundary surface and Planar Surface, etc.
- *Feature manipulation* – Copy, Edit, Pattern, Suppress, History operations, etc.

Assembly Modelling

- *Assembly* - Constraints, Exploded Views, Interference check, etc.

Drawing

- *Drawing* - Layouts, Standard & Sectional Views, Detailing & Plotting, etc.
- *Exercises* – Stuffing Box, Steam Engine Cross Head, Knuckle Joint, Cross Head, Plumber Block, Universal Coupling, Oldham Coupling.

Note: The test is designed to assess the student's ability to read and interpret engineering drawings. The drawing provided will include a parts list formatted according to standard industry conventions.

Course Code	Course Title					Core/Elective
25ES253ME	**DESIGN THINKING & IDEATION LAB**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**2**	**40**	**60**	**1**

Course objectives:

1. To understand the design thinking process and user needs through empathy and observation.
2. To develop problem statements and creative engineering solutions.
3. To create prototypes of mechanical components using CAD and 3D printing tools.
4. To evaluate solutions and improve designs based on feedback and constraints.
5. To communicate design outcomes through reports, presentations, and demonstrations.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Identify user needs and explain the relevance of design thinking in real-world contexts.
CO2: Define clear and actionable problem statements aligned with design challenges.
CO3: Generate multiple innovative solutions and select optimal ideas using design thinking tools.
CO4: Develop, prototype and test mechanical systems or product solutions.
CO5: Collaborate and communicate design ideas through documentation and pitching.

Week 1 – ***Introduction and Identifying the Need*** - Introduces the design thinking process - Empathize, Define, Ideate, Prototype, and Test - with a focus on understanding user needs. Students will explore real-world applications through Case studies, Guest lectures, videos, Field visits, and design-focused films, fostering appreciation for human-centred design and its relevance in engineering.

Week 2 - ***Define Phase*** **-** Craft Point-of-View (POV) statements, reframe problems into opportunities.

Week 3 - ***Ideation Techniques I*** **-** Brainstorming, SCAMPER, "How Might We" statements, mind mapping.

Week 4 - ***Ideation Techniques II*** **-** Idea evaluation and selection, concept sketching, feasibility vs innovation matrix.

Week 5 - ***Prototyping I – Low Fidelity*** **-** Sketch models using paper, cardboard, foam; storyboarding, role play.

Week 6 - ***Prototyping II – CAD Modeling*** **-** Intro to SolidWorks or Fusion 360, mechanical concept modeling.

Week 7 - ***Prototyping III – 3D Printing & Fabrication*** **-** Print functional parts, integrate simple mechanisms, tolerance checks, etc.

Week 8 - ***Testing Phase*** **-** Usability testing, collecting user feedback, identifying failure points.

Week 9 - ***Iteration & Redesign*** **-** Reflect, refine, update prototypes; engineering calculations where necessary.

Week 10 - ***Engineering Validation*** **-** Strength/material checks, motion studies (if applicable), DFMA review.

Week 11 - ***Communication & Documentation*** **-** Design reports, user manuals, video demos, poster preparation.

Week 12 - ***Pitching and Final Preparation*** **-** Present to panel/industry mentors; mock demos, pitch polishing

Week 13 - ***Final Presentation & Demo Day*** **-** Team project showcase, viva, peer feedback, reflection submission

Course Code	Course Title					Core/Elective
25SD254EC	**SKILL DEVELOPMENT COURSE: IoT Applications**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**2**	**50**	**-**	**1**

Course objectives:

1. To understand embedded IoT systems using ESP32/Arduino/Raspberry Pi with sensors and actuators.
2. To develop programs to acquire, process, and display sensor data.
3. To implement wireless communication and cloud-based IoT monitoring and control.
4. To design IoT applications integrating hardware, networking, and cloud/mobile interfaces.
5. To build teamwork, problem-solving, and end-to-end IoT project development skills.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Interface sensors, actuators, and peripherals using ESP32/Arduino/Raspberry Pi.
CO2: Acquire, process, and display sensor data using embedded programming.
CO3: Develop wireless IoT applications using Bluetooth and Wi-Fi.
CO4: Implement cloud-based IoT monitoring and device management.
CO5: Design and demonstrate an end-to-end IoT application.

List of Experiments

1. Interface an LED with ESP32/Arduino/Raspberry Pi and write a program to blink the LED using digital output.
2. Interface a Push Button with ESP32/Arduino/Raspberry Pi and write a program to control an LED based on the button state.
3. IR/LDR Sensor Interfacing: Interface an IR or LDR sensor with ESP32/Arduino/Raspberry Pi and write a program to detect an object/light intensity and control an LED accordingly.
4. Interface a 16×2 LCD (I2C) with ESP32/Arduino/Raspberry Pi and write a program to display text and sensor readings.
5. Interface a DHT11 Temperature and Humidity Sensor with ESP32/Arduino/Raspberry Pi and display the measured values on the Serial Monitor/LCD.
6. Interface a Relay Module with ESP32/Arduino/Raspberry Pi and write a program to control a DC motor or AC load using a push button or sensor input.
7. Develop a Bluetooth Low Energy (BLE) or Bluetooth Serial application using ESP32 to control an LED or relay from a smartphone.
8. Interface an HC-SR04 Ultrasonic Sensor with ESP32/Arduino/Raspberry Pi and measure the distance to an object. Display the measured distance on the Serial Monitor/LCD.
9. Acquire temperature and humidity data from the DHT11 sensor using ESP32 and upload the sensor readings to the ThingSpeak Cloud. Visualize and analyze the data using ThingSpeak charts.
10. Develop a mobile-based IoT application using ESP32 to remotely monitor temperature and humidity and control an LED or relay through the Blynk IoT mobile dashboard.
11. Develop an embedded web server on ESP32 to monitor sensor data and control an LED/relay through a web browser over a Wi-Fi network.

Mini Project:

- Students shall implement a complete domain-specific IoT application (Smart Home, Smart Agriculture, Smart Energy Monitoring, Smart Environment Monitoring, Smart Healthcare, etc.) using ESP32/Arduino/Raspberry Pi, integrating sensors, actuators, wireless communication, and cloud/mobile monitoring.

Suggested Readings:

1. Michael Margolis – Arduino Cookbook
2. Simon Monk – Programming Arduino: Getting Started with Sketches
3. John Boxall – Arduino Workshop
4. Neil Cameron – ESP32 Essentials
5. Simon Monk – Programming the Raspberry Pi: Getting Started with Python

Online Resources:

1. ThingSpeak Documentation: https://www.mathworks.com/help/thingspeak/
2. Blynk IoT Documentation: https://docs.blynk.io/
3. Arduino Documentation: https://docs.arduino.cc/
4. Arduino-ESP32 Documentation: https://docs.espressif.com/projects/arduino-esp32/
5. ESP-IDF Documentation: https://docs.espressif.com/projects/esp-idf/
6. Raspberry Pi Documentation: https://www.raspberrypi.com/documentation/

S E M E S T E R - IV			Scheme of Instruction				Scheme of Examination			Credits
S. No.	**Course Code**	**Name of the Course**	**Lecture**	**Tutorial**	**Practical**	**Contact Hrs./Wk**	**C.I.E.**	**S.E.E.**	**Duration in Hrs.**	
1	25PC221ME	Design of Machine Elements	3	-	-	3	40	60	3	3
2	25PC222ME	Manufacturing Processes	3	-	-	3	40	60	3	3
3	25PC223ME	Dynamics of Machines	3	1	-	3	40	60	3	4
4	25PC224ME	Applied Thermodynamics	3	-	-	3	40	60	3	3
5	25PC225ME	Computer Aided Design & Manufacturing	3	-	-	3	40	60	3	3
6	25PC256ME	Thermal Engineering Lab	-	-	2	2	40	60	3	1
7	25PC257ME	Manufacturing Processes Lab	-	-	2	2	40	60	3	1
8	25PC258ME	Dynamics & Vibrations Lab	-	-	2	2	40	60	3	1
9	25PW259ME	Mini Project	-	-	6	6	40	60	3	3
		Total	**15**	**1**	**12**	**28**	**360**	**540**	**27**	**22**

Course Code	Course Title					Core/Elective
25PC221ME	DESIGN OF MACHINE ELEMENTS					Core
Pre-requisites	Contact hours per week			CIE	SEE	Credits
	L	T	P			
-	3	-	-	40	60	3

Course objectives:

1. To understand machine design fundamentals, material selection, stress analysis, and failure theories.
2. To analyse helical and leaf spring behaviour under various loading conditions.
3. To apply design principles to cotter and knuckle joints for power transmission.
4. To evaluate the strength of riveted and welded joints under different loads.
5. To design curved beams and screwed joints for reliable machine components.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Identify and use codes and standards, selection proper material & perform static design.
CO2: Analyze cyclic loading conditions and provide fatigue design of components.
CO3: Analyze helical coil springs and leaf springs for mechanical systems
CO4: Evaluate various joining techniques like welding, riveting and cotter joints.
CO5: Synthesize and design curved beams and screwed joints.

Unit-I

Introduction: Materials used in Machine design, General Classification and Procedure in Machine design, preferred numbers, Stresses due to Bi-axial and Tri-axial loads, Factor of Safety, Stress concentration.

Theories of failures for Bi-axial stress system: Rankine's Theory, , St. Venant's Theory, Haigh's Theory, Von-Mises and Hencky's Theory, Guest and Tresca's Theory, Fluctuating stresses, Fatigue strength, Notch sensitivity, Factor effecting fatigue strength, Gerber's, Soderberg's and Goodman's Theory, Cumulative fatigue.

Unit-II:

Springs: function of springs, Types of springs and materials used.

Helical Springs: Eccentric, Buckling and Surge of Compression Springs. Stress, Energy and Deflection of Helical Springs, Springs in Series and Parallel connection, Concentric or Composite Springs.

Leaf Springs: Construction of Leaf Springs Equalized, Stress in Spring Leaves (Nipping)

Unit-III

Cotter joint and Knuckle joint: Type of Cotter joints, Design of Socket and Spigot Cotter joints, Sleeve Cotter joints, Design of Knuckle joint.

Unit-IV

Riveted joints: Introduction, Type of Riveted joints, Terms used in Riveted joints, Caulking and Fullering, Failures of a Riveted joints, Efficiency of a Riveted joints, Design of Boiler joints and Lozenge joint, Riveted joints under eccentric loads.

Welded joints: Introduction, Type of Welded joints, Strength of Transverse, Parallel and Circular Fillet Welded joints, Strength of Butt joints, axially loaded Unsymmetrical sections Welded joints, eccentrically loaded Welded joints.

Unit-V

Curved beams: Theory of bending of members with initial curvature - rectangular, circular and Trapezoidal sections, Design of crane Hooks, Machine frames and C-clamps.

Screwed joints: Type of Screwed joints, Locking devices, Stresses in Screwed joints due to static loads, Bolts of uniform strength, Bolted joints under eccentric loading.

Note: Design data sheets to be provided for the examination

Suggested Reading:

1. V. B. Bhandari, —Design of Machine Elements‖, Tata McGraw-Hill Publ, 3rd Edn. 2010.
2. J.E. Shigley & Charles R. Mischke —Mechanical Engineering Design‖, Tata McGraw-Hill.,6th ed., 2010.
3. P. Kannaiah, Machine Design, Sci-Tech Publ., 2009.
4. P.C. Sharma & D.K. Aggarwal, "Machine Design", S.K. Kataria & Sons, 10th edn, 2003.
5. V. B. Bhandari, —Design Data Book, 2nd edition, Tata McGraw-Hill Publ, 2019.

Course Code	Course Title					Core/Elective
25PC222ME	**MANUFACTURING PROCESSES**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**-**	**-**	**40**	**60**	**3**

Course objectives:

1. To understand the fundamentals of casting, moulding, and powder metallurgy processes.
2. To Learn conventional and special manufacturing processes for engineering applications.
3. To understand the principles and applications of welding and joining processes.
4. To Gain knowledge of metal forming and sheet metal working operations.
5. To understand the manufacturing and applications of polymers and composite materials.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Explain foundry processes including pattern making, moulding, gating, and solidification.
CO2: Explain special casting, casting defects, plastics processing, and powder metallurgy.
CO3: Classify arc, gas, and advanced welding processes with their applications.
CO4: Differentiate solid-state and resistance welding processes and identify welding defects.
CO5: Explain metal forming, sheet metal operations, ceramics, and composite materials.

Unit-I

Basic Casting Process: Casting terms, pattern materials, types of patterns, pattern allowances and colour codes, moulding sands, properties of moulding sand and its ingredients, core sands, core making process, machine moulding techniques, directional solidification, use of chills, chaplets, gating and risering systems.

Unit-II:

Special Casting Processes: Shell moulding, CO2 moulding, die casting, centrifugal casting, investment casting or lost wax process; Casting defects, their causes and remedies, Inspection and testing of castings.
Polymers*:* Polymerization, Thermoplastics and thermosetting plastics, Processing of Plastics - Extrusion, Injection moulding, Blow moulding and Thermoforming.

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, Atomic hydrogen welding, principle of Electro slag welding, Gas cutting, Brazing and Soldering.

Unit-IV

Solid State Welding Process: Forge Welding, Friction Welding, Friction Stir Welding, and Explosive Welding.
Resistance welding processes: Spot welding, Seam welding, Projection welding, Butt welding, weldability, 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, metal spinning.
Powder Metallurgy: Powder production methods, steps in powder metallurgy processes, cold and hot isostatic pressing, typical industrial applications.

Suggested Reading:

1. P.N. Rao, "Manufacturing Technology", Vol. 1, Tata McGraw Hill Publ., Ed., 2011.
2. Amitabh Gosh & Mallick, "Manufacturing Science", Assoc. East West Press Pvt. Ltd. 4th Ed., 2011.
3. Roy A. Lidnberg, Materials & Processes of Manufacturing, Prentice Hall of India, 5th Ed. 1992.
4. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addison, Wesley Publishing Company, 2006.
5. J.P. Kaushish, Manufacturing Processes, PHI Learning Pvt. Ltd., 2nd Ed., 2010.
6. P.C. Sharma, A Test book of "Production Technology"– Manufacturing Processes, S. Chand Jan. 2007.
7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, "Principles of Metal Casting", Tata McGraw-Hill edition 1976.
8. Parmer, R.S., "Welding Engineering and Technology", Khanna Publishers, 1997.
9. Sinha, A.K. *Powder Metallurgy*. Dhanpat Rai & Sons. 2002

Course Code	Course Title					Core/Elective
25PC223ME	**DYNAMICS OF MACHINES**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**1**	**-**	**40**	**60**	**4**

Course objectives:

1. To understand static and dynamic force analysis of mechanisms.
2. To understand gyroscopic couples and flywheel principles.
3. To apply balancing concepts for rotating and reciprocating masses.
4. To evaluate natural frequencies, vibration isolation, and transmissibility with damping effects.
5. To understand torsional, transverse vibrations, encoders, and MATLAB-based vibration analysis.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Analyze static and dynamic forces in slider crank and other mechanisms.
CO2: Determine gyroscopic couple effects and design flywheels for speed and energy fluctuations.
CO3: Analyze balancing of rotating and reciprocating masses.
CO4: Evaluate natural frequencies of single degree of freedom systems with damping under free and forced vibrations.
CO5: Apply vibration analysis methods, encoders, and MATLAB for mechanical vibration analysis.

UNIT-I

Static and Dynamic Force Analysis: Static equilibrium: Constraint and Applied forces, Static Force analysis of Single slider crank mechanism without Friction and four bar mechanism.
Dynamic Equilibrium: D'Alembert's Principle, Dynamic force Analysis of Slider Crank Mechanism.
Engine Force Analysis: Piston effort, Force along connecting rod, thrust on sides of cylinder, crank effort. Thrust on bearing. Dynamically Equivalent System for Connecting Rod.

UNIT-II

Gyroscope: Gyroscopic Couple, gyroscopic effects on aeroplanes, naval ships, two-wheeler and four-wheeler.
Encoder: Types of encoders, working principle and applications of mechanical encoders.
Flywheels: Turning Moment Diagrams for different engines, Functions of flywheel, turning moment diagrams, flywheel analysis for I-C Engines and shearing/punching/riveting machines.

UNIT-III

Balancing of Rotating Masses: Static balancing, dynamic balancing, balancing of several masses rotating in several planes.
Balancing of Reciprocating Masses: primary balancing, shaking forces in single cylinder engine, partial balancing and its effects; hammer blow, variation of traction effort and swaying couple.

UNIT-IV

Vibrations: Vibrations of Single degree freedom system (axial, transverse and torsional);
Whirling speed of shafts.
Damped Vibrations: Types of damping, Vibrations with viscous damping, damping factor and logarithmic decrement.
Forced Damped Vibrations: Magnification factor, Resonance, Vibration isolation and transmissibility.

UNIT-V

Torsional Vibrations: Two rotor, three rotor and Geared systems with stepped shaft. Natural frequencies of two-degree freedom systems Modes of vibration.
Transverse Vibrations: Approximate methods for determining natural frequencies of Dunkerley's method, Rayleigh's method.
Introduction to MATLAB programming: Syntax, scripting, data visualization; Application to

Vibrations.

Suggested Reading:

1. S.S. Rattan, Theory of Machines, Tata McGraw-Hill, 5th Edition, 2019
2. John J.Uicker, J r. G o r d o n, R.Pennock, Joseph E.Shigley, Theory of Machines and Mechanisms, Oxford University Press, 2026.
3. Norton R.L., Kinematics and Dynamics of Machinery, McGraw-Hill Publications, 3rd Edition, 2020
4. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East-West Press Pvt. Ltd., 3rd Edition, 2010
5. Thomas Bevan, Theory of Machines, CBS Publishers & Distributors, 3rd Edition, 2005
6. J.S. Rao and Gupta, Theory and Practice of Mechanical Vibrations, Prentice Hall, 2nd Edition, 2010.
7. S.S. Rao, Mechanical Vibrations, Prentice Hall, 5th Edition, 2011.
8. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson, 6th Edition, 2015.

Course Code	Course Title					Core/Elective
25PC224ME	**APPLIED THERMODYNAMICS**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**3**	**-**	**-**	**40**	**60**	**3**

Course objectives:

1. To explain the fundamental concepts, terminology, and laws of thermodynamics.
2. To analyze energy interactions in closed and open systems using thermodynamic laws.
3. To study the principles, performance, and applications of reciprocating and rotary compressors.
4. To evaluate thermodynamic cycles and determine steam properties using charts and tables.
5. To analyze gas turbine cycles and methods for improving plant performance.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Explain thermodynamic systems, properties, equilibrium, and First Law applications.
CO2: Analyze thermodynamic processes using the Second Law and entropy concepts.
CO3: Evaluate compressor performance, efficiency, and effects of intercooling and clearance.
CO4: Analyze thermodynamic cycles and determine steam properties using tables and Mollier diagrams.
CO5: Analyze gas turbine cycles and evaluate performance enhancement methods.

UNIT-I

Definition and Concept of Thermodynamics, Microscopic and Macroscopic approach of thermodynamics, system, surroundings and property, Zeroth law of thermodynamics, Thermodynamic Equilibrium.

Statement of First Law- First Law applicable to Closed system, Thermodynamic processes and calculation of work, Heat transfer, and internal energy, Heat as Path Function, Steady flow energy equation for Calculation of work done .

UNIT-II

Statement of second law, Kelvin– Planck and Clausius statement of Second Law of thermodynamics, Equivalence of Kelvin– Planck and Clausius statement, Reversible and irreversible processes, Carnot theorem, Calculation of entropy change during various thermodynamic processes, principle of Entropy increase, T– S diagram, Available and Unavailable energies in steady flow.

UNIT-III

Reciprocating Air Compressors: Classification and applications. P-V diagrams, work input and efficiency relations for single and multi-stage compressors. Effect of clearance volume on work input and efficiency. Inter cooling.

Rotary Compressors: Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV

Air standard cycles: Otto, Diesel, Dual Combustion Cycle, Joule/ Brayton cycle.

Vapour Power cycles: Rankine cycle. Refrigeration cycles: Reversed Carnot cycle, Bell Coleman cycle,

Properties of pure substances, Concept of phase change, Properties of steam, Use of steam Tables and Mollier diagram, Thermodynamic relations involving entropy, Enthalpy, Internal Energy.

UNIT-V

Gas Turbines: Applications and 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.

Suggested Reading:

1. P. K. Nag and S. De, Engineering Thermodynamics, 7th Edition, McGraw Hill Education, 2025.
2. R. K. Rajput, A Textbook of Thermal Engineering, 11th Edition, Laxmi Publications, 2020.
3. R. S. Khurmi and J. K. Gupta, Thermal Engineering, S. Chand Publishing.
4. Y. A. Çengel, M. A. Boles and M. Kanoğlu, Thermodynamics: An Engineering Approach, 10th Edition, McGraw Hill Education, 2024.
5. M. J. Moran, H. N. Shapiro, D. D. Boettner and M. B. Bailey, Fundamentals of Engineering Thermodynamics, 9th Edition, Wiley India.

Course Code	Course Title					Core/Elective
25PC225ME	COMPUTER AIDED DESIGN & MANUFACTURING					Core
Pre-requisites	Contact hours per week			CIE	SEE	Credits
	L	T	P			
-	3	-	-	40	60	3

Course objectives:

1. To understand CAD modeling, geometric representation, and design methodologies.
2. To apply surface and solid modeling techniques for engineering design applications.
3. To develop CNC part programs and understand CAD data exchange standards.
4. To understand CNC systems, industrial robots, and automated manufacturing technologies.
5. To understand group technology, CAPP, FMS, CIMS, and computer-aided inspection systems.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Explain the concepts and theory of modeling and design in engineering applications.
CO2: Compare modeling techniques and explain the role of solid models in CAD/CAM product development.
CO3: Recognize the design applications and perform 2D transformations about arbitrary point.
CO4: Write part programs for simple components.
CO5: Describe the current state-of-the-art CAD/CAM technologies.

UNIT-I

Design Processes: Design criteria, Alternative solutions, Alternative design, Computer Aided Design and Review.

Drafting Techniques: Basic geometric elements and their creation

Geometric Modelling: Wireframe entities and their definition, Interpolation and Approximation curves. Concept of parametric and non-parametric representation of a circle and helix curves, properties of splines.

Synthetic curves: Parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Concept of NURBS

UNIT-II

Surface Modeling: Analytic surfaces: Definitions of planar, surface of revolution, Tabulated cylinder, synthetic surfaces: Cubic and Bezier surfaces and coons surface

Solid Modeling: C - rep and B - rep approaches feature based and parametric modelling

Design Applications: Mass property calculations, Mechanical tolerance, Finite Element Analysis.

2D Transformations: Translation, Scaling and Rotation about arbitrary point, Shearing and Reflection, Homogeneous representation, concatenation.

UNIT-III

CAD Database and Data Exchange: CAD Database and Structure, **CAD Exchange format:** IGES, STEP and STL format.

Numerical Control Machine Tools: Features and elements of NC, Positional, paraxial and contouring types. Definitions of axes. Definitions of interpolation, post - processor, preparatory and miscellaneous functions, canned cycles, Tool length and cutter radius compensation Manual and computer aided part programming (APT) for simple components. Programming with MACROS

UNIT-IV

Computer Numerical Control: CNC, DNC and Adaptive control systems. Typical configurations and relative features. Machining centers, Introduction to FANUC, SINUMERIC controllers.

Industrial Robots: Robot Anatomy, Configurations, Controls, Drivers, Programming methods and Applications.

UNIT-V

Group Technology: Part families, layout, part classification and coding system. Opitz, MICLASS, CODE system.

CAPP: Variant and Generative process planning.

FMS & CMS: Building blocks of Flexible Manufacturing systems and their control, Elements of CIMS.

Computer Aided Inspection and QC: Coordinate Measuring Machine, Non-contact inspection: Machine vision, Scanning Laser Beam Devices Quality control. CAD/CAM Integration, Turnkey CAD/CAM Systems, Introduction to Rapid Prototyping Technique, Reverse Engineering.

Suggested Reading:

1. Arvid R. Eide, Roland D. Jenison, Lane H. Mashaw, Larry L. Northup, "Introduction to Engineering Design" McGraw -Hill, 1998.
2. Ibrahim Zeid. CAD/CAM, "Theory and Practice", McGraw. Hill Inc. New York, 2011.
3. Grover, MP and Zimmers E.W. "CAD/CAM", Prentice Hall of India, 1989.
4. Rao, PN. "CAD/CAM: Principles and Applications", 2nd Edition, Tata McGraw Hill, New Delhi, 2004.
5. Yoram Koren, "Computer Control of Manufacturing Systems", McGraw Hill Int, New York, 1994.
6. Elanchezhian. C. Sunder Selwyn. T. Shanmuga Sunder, G, "Computer Aided" Manufacturing, Laxmi Publications (P) Ltd., 2nd Edition, New Delhi, 2007.

Course Code	Course Title					Core/Elective
25PC256ME	**THERMAL ENGINEERING LAB**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**2**	**40**	**60**	**1**

Course objectives:

1. To study various functional systems of Internal combustion Engines.
2. To understand applications of thermal engineering concepts through experimentation.
3. To provide knowledge in testing of properties of fuels and lubricating oils.
4. To demonstrate and conduct experiments, Interpret and analyse data and report results of IC engine testing.
5. To understand the importance of properties of lubrication oils and fuels.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Understand operation of different functional systems of IC Engines.
CO2: Perform experiments to find the efficiency of Petrol and Diesel engines.
CO3: Perform experiments on SI engines.
CO4: Perform experiments on CI engines.
CO5: perform experiments on flash point and fire point & viscosity

List of Experiments:

1. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI.
2. Study of ignition system components- coil, magneto and electronic ignition systems.
3. Study of Engine cooling system components.
4. Study of Engine lubrication system components.
5. To determine valve timing diagram of a Petrol/Diesel engine.
6. To determine port timing diagram of a Petrol/Diesel engine.
7. To conduct performance test on single cylinder Diesel engine.
8. To conduct heat balance test on a Diesel engine.
9. To conduct Morse test on multi cylinder Petrol engine.
10. To conduct performance test on multi cylinder Petrol engine.
11. To conduct performance test on a two-stroke Petrol engine.
12. To conduct performance test on multi cylinder Diesel engine.
13. To study the performance of a Petrol engine under different compression ratios.
14. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
15. Determination of viscosity of lubricating oil & flash and fire points of a fuel.

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

Course Code	Course Title					Core/Elective
25PC257ME	MANUFACTURING PROCESSES LAB					Core
Pre-requisites	Contact hours per week			CIE	SEE	Credits
	L	T	P			
-	-	-	2	40	60	1

Course objectives:

1. To understand the fundamentals of foundry, welding, and forming processes.
2. To develop skills in pattern making, moulding, and casting operations.
3. To gain practical experience in various welding techniques.
4. To perform and evaluate metal forming operations.
5. To understand plastic processing and component manufacturing.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Perform experiments on foundry, welding, forging, forming, and plastic manufacturing processes.
CO2: Apply theoretical concepts of manufacturing processes through group activities.
CO3: Develop clear laboratory reports with effective documentation skills.
CO4: Identify manufacturing defects, analyze causes, and suggest remedies.
CO5: Apply group learning to individual tasks and demonstrate oral communication skills.

Experiments:

Foundry Lab:

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 Lab:

Welding processes:

1. Butt Joint prepared by gas welding using different types of flames
2. Lap joint by resistance welding process
3. V-Joint /T- joint by Arc welding process
4. Exercises using TIG and MIG welding processes.
5. Performing Brazing and Soldering operations.

Study of defects in welded joints

Forming Lab:

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

Note: At least ten experiments should be conducted in a Semester on above mentioned topics.

Course Code	Course Title					Core/Elective
25PC258ME	**DYNAMICS OF MACHINES LAB**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**2**	**40**	**60**	**1**

Course objectives:

1. To understand the effects and importance of kinematic and dynamic analysis of mechanisms.
2. To understand effects of vibration on Single degree of freedom vibration systems.
3. To study the effect of gyroscopic couple and performance of governors and cams.
4. To carry out the static and dynamic analysis of four bar mechanisms and drives.
5. To analyze rotating mass balancing, critical speeds, and inertia properties of mechanical systems.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Evaluate centrifugal governor performance and stability.
CO2: Estimate gyroscopic couple and its effect on rotating members.
CO3: Determine balancing mass parameters and verify static and dynamic balancing.
CO4: Develop CAM profiles and analyze operating speed limits for CAM-follower systems.
CO5: Determine vibration responses of single and two-degree freedom systems and evaluate shaft critical speed.

List of Experiments:

1. Performance Characteristics and stability of Watt Governor
2. Performance Characteristics and stability of Porter Governor
3. Performance Characteristics and stability of Proell Governor
4. Performance Characteristics and stability of Hartnell Governor
5. Effect of Gyroscopic Couple on a rotating disc.
6. Static and Dynamic Balancing of Rotating Masses.
7. Longitudinal vibration of Spring-Mass System.
8. Torsional Vibration of Single Rotor System.
9. Torsional Vibration of Double Rotor System.
10. Whirling Speed of Shaft.
11. Free and Forced Vibration of Simply Supported Beam.
12. Free and Forced Vibration of Cantilever Beam.
13. Jump speed of cam with various cam and follower combinations
14. Cam Profile
15. Moment of Inertia of Flywheel.

Note:

1. Minimum ten experiments should be conducted in the semester.
2. Six sigma concepts to be applied to measurements of the experimental outcomes.

Course Code	Course Title					Core/Elective
25PW259ME	**MINI PROJECT**					**Core**
Pre-requisites	**Contact hours per week**			**CIE**	**SEE**	**Credits**
	L	**T**	**P**			
-	**-**	**-**	**6**	**40**	**60**	**3**

Course objectives:

1. To Identify and formulate engineering problems through literature survey and need analysis.
2. To apply engineering principles to design and develop a mechanical system or process.
3. To Use CAD tools for design, modeling, and documentation.
4. To develop skills in project planning, teamwork, and implementation.
5. To Test, evaluate, and document the developed project effectively.

Course Outcomes: Upon successful completion of the course the students will be able to

CO1: Identify engineering problems and propose suitable solutions.
CO2: Design and develop mechanical products or processes based on requirements.
CO3: Apply CAD tools for modeling, analysis, and documentation.
CO4: Demonstrate teamwork, project management, and communication skills.
CO5: Test, evaluate, and present projects with technical documentation.

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team. This is mechanical product design work/ manufacturing process with a focus on mechanical system design/manufacturing process.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based software.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.