Department of Mechanical Engineering
National Institute of Technology Raipur
(Institute of National Importance)
G. E. Road, Raipur-492010 (CG)

B. Tech. in Mechanical Engineering
III Semester CBCS Scheme

Sl. No	Course Title	Course Code	Course Name	Type	L	T	P	TA		MSE		ESE		Total Marks	Credits
								Max	Min	Max	Min	Max	Min		
1.	Program Core	ME103101ME	Material Science	T	3	1	0	20	0	30	0	50	0	100	4
2.	Program Core	ME103102ME	Mechanics of Solids - I	T	3	1	0	20	0	30	0	50	0	100	4
3.	Program Core	ME103103ME	Applied Thermodynamics	T	3	1	0	20	0	30	0	50	0	100	4
4.	Program Core	ME103104ME	Manufacturing Science - I	T	3	1	0	20	0	30	0	50	0	100	4
5.	Program Core	ME103105ME	Machine Drawing	T	1	3	0	20	0	30	0	50	0	100	4
6.	Program Core	ME103001MA	Mathematics- III	T	4	0	0	20	0	30	0	50	0	100	4
7.	Laboratory	ME103401ME	Mechanical Lab-1	P	0	0	2	40	0	20	0	40	0	100	1
8.	Laboratory	ME103402ME	Mechanical Lab-2	P	0	0	2	40	0	20	0	40	0	100	1
					17	7	4							800	26

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Semester-III

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Machine Drawing**
3.	L-T-P Structure	**1+3+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103105ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Engineering Graphics
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. To understand conventional representation of machine elements, limits, fits, tolerances, and fasteners, welded and riveted joints. 2. To familiarize in drawing of different types of shaft couplings, bearings, pipe joints, pulleys and gears in mesh. 3. To understand the concepts of half section and full section view of various components. 4. To understand and illustrate the detailed drawings of various engine parts and boiler mountings. 5. To read production drawings at the site. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Describe conventional representation of machine elements, limit, fits, tolerances, and fasteners, welded and riveted joint. 2. Draw and identify different types of shaft couplings, bearings, pipe joints, pulleys and gears in mesh. 3. Understand and recognize the half section and full section views of various engineering components. 4. Understand and illustrate the detailed drawings of various engine parts and boiler mountings. 5. Apply their knowledge to read production drawing at the site.	
10.	**Course Syllabus** **Unit 1. Fasteners and Riveted joints** Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. Fasteners: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Set-screw, Locknuts and foundation	

	bolts. Riveted joints: Forms and proportions of rivet heads, Different views of different types of riveted Lap and Butt joints **Unit2. Drawings of various views** Shaft joints: Cotter joint and Knuckle joint. Keys & Shaft coupling: Muff, Flanged, Flexible, Universal and Oldham's coupling. Shaft bearing: Solid and bush bearing, Plummer block, Footstep bearing. Pipe joint: Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Gland & Stuffing Box, Expansion joint **Unit-3. Pulley and Gears** Pulley: Belt pulley, V-belt pulley, Fast and loose pulley, Speed cone pulley, Built up pulley. Gears: Spur gear in mesh with approximate construction of tooth profile, Rack and pinion. **Unit-4 Assembly and detailed drawings of Engine Parts and Valves** Assembly and detailed drawings of Engine Parts: Piston, Stuffing box, cross head, vertical and horizontal engine, Connecting rod, Crank and Eccentric. Valves: Steam stop valves, Feed check valve, Safety valves, Blow off cock. ***NOTE***– *Study of assembly production drawing/blue print is to be practiced in the tutorial/practical. Few drawings are to be practiced on AutoCAD. The parts are to be shown during practice.*
11.	**Text Books-** 1. Machine drawing- N. D. Bhatt., published by R. C. Patel, Charotar Book Stall Tulshi Sadan, Station Road, Annad, India. 2. Machine drawing – P. S. Gill S. K. Kataria & Sons Delhi.
12.	**Reference Books-** 1. Machine drawing – T. Jones.

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Semester-III

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Material Science**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103101ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. Acquire basic foundation of solid crystal structures, crystal imperfections of materials. 2. Understanding the effects of solidification rate on mechanical properties of materials. 3. Ability to construct multicomponent phase diagrams using concept of phase rule. 4. Understand variation of properties with the microstructure evolution during heat treatment processes. 5. Get acquainted with the Iron Carbon phase diagram for calculating the composition of the constituents to evaluate the mechanical properties of materials. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Conceptually explain the classification of engineering materials and professional responsibilities in the selection of materials in engineering design. 2. Describe the basic structures and explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing. 3. Use binary phase diagrams to predict microstructures and also to understand precipitation hardening. 4. Understand how thermal treatments affect the microstructure and, thus, properties of materials.	
10.	**Course Syllabus** **Unit-1 Structure of Crystalline Solids** Material Science and Engineering: Classification of materials, cast iron, recent advantages in material science and technology and future trends. Structure of Materials: Crystalline structure of solid: Concept of unit cell and space lattice, Miller Indices, Crystal structure determination by X-ray diffraction, Crystal imperfections. Solidification of Metals and Alloys: Mechanism of solidification, nucleus formation and crystal growth, metal ingot structure-dendritic and columnar grains, grain boundaries,	

	grain growth, effect of grain size on properties of metals. **Unit-2 Elastic-Plastic Deformation** Basic Mechanical Properties: Hardness, Ductility, Malleability, Toughness, Brittleness, stiffness, fatigue and creep, Stress – Strain Curve for ductile and brittle material etc. Mechanism of plastic deformation: Role of dislocations, slip and twinning, yield point phenomena and related effects, strain hardening, Bauschinger effect, cold working and hot working processes, effect on properties like recovery, recrystallization, grain growth and grain size. Fracture of Metals: fatigue of metals, fatigue crack propagation rate, creep and stress rupture of metals and their importance in manufacturing. Destructive and non-destructive testing method. **Unit-3 Phase Diagram** Definitions and Basic Concepts: Solubility Limit, Phases, Microstructure, Phase Equilibrium, One-Component (or Unary) Phase Diagrams. Binary Phase Diagrams: Binary Isomorphous Systems, Interpretation of Phase Diagrams, Development of Microstructure in Isomorphous Alloys, Binary Eutectic Systems, Development of Microstructure in Eutectic Alloys, Eutectic and Peritectic Reactions, The Gibbs Phase Rule, Iron–Carbon System: The Iron–Iron Carbide Phase Diagram, Development of Microstructure in Iron–Carbon Alloys, The Influence of Other Alloying Elements. **Unit-4 Heat Treatment** Introduction, purpose of heat treatment, T-T-T curve and micro constituents in steel. Heat treatment processes: hardening, hardenability, precipitation hardening, tempering, austempering, martempering, annealing, normalizing, Effects of heat treatment on properties of materials. Surface treatment processes: carburizing, nitriding, cyaniding, Carbo-nitriding etc.
11.	**Text Books-** 1. Materials Science and Engineering – William D. Callister, Jr. 2. Materials Science and Engineering – William F. Smith (Mc Graw Hill)
12.	**Reference Books-** 1. Mechanical Metallurgy: G.E. Dieter (Mc Graw Hill) 2. Physical Metallurgy - Clark & Varney, East West Edn., New Delhi 3. Engineering Materials - Woulf series. 4. A Text Book of Material Science & Metallurgy – O. P. Khanna – Dhanpat Rai & Sons

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Semester-III

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Mechanics of Solids-I**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103102ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Engineering Mechanics
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** The Mechanics of Solids-1 course is designed with a basic objective of giving an insight into understanding the type of loadings and the corresponding stress they develop in machine members. The course is designed particularly with an idea of imparting the knowledge of core engineering practices leading to the design of mechanical members considering the strength, stiffness and stability aspects. Emphasis has also been put on providing preliminary understanding which can be applied for high end stress and strain analysis of components. The syllabus is also designed so as to enhance the knowledge of young graduates with an insight into real time mechanical problems. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Apply mathematics to obtain analytical solutions in solid mechanics. 2. Visualize the concept of stress, strain, bending, torsion and the significance of principal stress and principal strain. 3. Discover basic concepts of stress in solving problems involving combined bending and torsion stresses. 4. Develop appropriate models to formulate solutions.	
10.	**Course Syllabus** **Unit-1 Introduction and Bending of beam** (a) Introduction: Basic of stress & strain, Elastic constant, Stress-strain diagram, Hooke's law, Stresses in the components subjected to multi-axial forces, Temperature stresses, statically indeterminate system. (b) Bending of Beams: Bending of beams with symmetric section, boundary condition, pure bending and Bending equation. **Unit-2 Shear Stresses and Deflection of Beams** (a) Shear Stresses in Beams: Traverse shear stress distribution in circular, hollow circular, I & T section. (b) Deflection of Beams: Relation between slope deflection and radius of curvature,	

	solution of beam deflection, problem by Macaulay's method, direct integration method, Method of super position, Moment Area Method. **Unit-3 Torsion and Spring** (a) Torsion: Deformation in circular shaft due to torsion, Basic assumptions, Torsion equation, Stresses in elastic range, Angular deflection, hollow and stepped circular shaft. (b) Spring: Closed and Open coil helical spring subjected to axial load, spring in parallel & series. **Unit-4 Principal Stresses and Strain** Principal stresses and strain, Transformation of plane stresses, Principal stresses, Maximum shear stresses, Mohr's circle for plane stresses, Plain strain and its Mohr's circle representation, Principal strains, Maximum shear strain. Combined Loading: Components subjected to bending, torsion & axial loads.
11.	**Text Books-** 1. Elements of Strength of Materials – S. P. Timoshenko & D. H. Young, EWP Press 2. Mechanics of Solids – F. P. Beer & E. R. Johnston, Tata McGraw Hill Publications
12.	**Reference Books-** 1. Strength of Materials – G. H. Ryder, MacMillan Publishers 2. Introduction to Solid Mechanics – I. H. Shames, PHI 3. Strength of Materials – J. P. Den Hartog – Dover Publication 4. Strength of Materials – S. S. Rattan, Tata McGraw Hill Publications 5. Strength of Materials – R. K. Rajput, S. Chand & Company Ltd 6. Mechanics of Solids – A. Mubeen, Pearson Education.

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Semester-III

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Applied Thermodynamics**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103103ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. To able to understand and apply the laws of thermodynamics to real time systems. 2. To able to understand the concept of ideal gas and real gas. 3. To apply the vapour power cycle in a steam power plant. 4. To able to analyze the reciprocating compressor. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. To understand the possibilities of thermodynamic processes and to optimize thermodynamic equipment. 2. To understand the deviation of real gas with ideal gas. 3. To get the idea of generating power from steam cycles. 4. Analysis and working of reciprocating compressor and compressible fluid properties.	
10.	**Course Syllabus** **Unit –I: Second Law Analysis and Availability** Second Law Analysis: Introduction to the second law of Thermodynamics, Causes of Irreversibility, Clausius inequality, Entropy change for ideal gases, Entropy principle, Entropy generation. Availability: Quality of energy, Second law analysis of closed system, second law analysis of steady-flow system, useful work, irreversibility, second law efficiency. **Unit –II: Thermodynamic Relationships and Equation of state** Thermodynamic Relationships: Helmholtz and Gibbs functions, coefficient of volume expansion and isothermal compressibility, Differential relations of internal energy, Maxwell's relation, Cp, Cv relations, T-dS equations, Energy Equation, Clapeyron equation, Joule-Kelvin effect. Equation of state: Ideal gas equation of state, Real gas deviation with ideal gas, Vander-waals equation, evaluation of its constants, Virial expansions and the law of corresponding states.	

	Unit –III: Vapour and Vapour Power Cycle Properties diagrams and processes in ideal vapour, use of steam tables and Mollier's diagram, Carnot and Rankine cycle as applied to steam power plants, Reheat cycle, ideal regenerative cycle, practical regenerative cycle, characteristics of ideal working fluids, binary vapor cycle. **Unit –IV: Reciprocating Air Compressors and Thermodynamics of Compressible Fluids** Reciprocating Air Compressors: Working of reciprocating compressor, equation of work (with & without clearance), volumetric efficiency, multistate compressors, efficiency of compressor, Effect of atmospheric condition on output of the Compressor, analysis of reciprocating compressor. Thermodynamics of Compressible Fluids: One dimensional Isentropic flow, stagnation properties, Critical conditions, Throat area for maximum discharge, flow through variable area, duct, converging nozzle, Convergent divergent nozzle, Normal Shock waves, operation of convergent divergent nozzle for different back pressures, Flow with friction and heat transfer, Fanno flow and Rayleigh flow.
11.	**Text Books-** 1. Engineering Thermodynamics – P. K. Nag – TMH Publishers 2. Thermodynamics- An Engineering Approach- Cengel and Boles – McGraw Hill 3. Fundamental of thermodynamics – Van Wylen - Wiley
12.	**Reference Books-** 1. Thermodynamics – C.P. Arora – TMH Pub. 2. Engineering Thermodynamics –Eastop & McConkey – Pearson 3. Engineering Thermodynamics –Rogers & Mayhew – Pearson

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1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Manufacturing Science-I**
3.	L-T-P Structure	**3+1+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103104ME**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once in a Year
9.	**Course Objectives:** 1. Understand the basic concept of manufacturing processes and technological definitions of manufacturing processes. 2. Understand foundry practices, pattern making, mould making and casting. 3. Understand various forming processes like forging, extrusion, rolling drawing, press working etc. 4. Understand drilling, boring, broaching, reaming, grinding and other surface finishing operations. 5. Understand various metal joining processes like welding, gas welding, arc welding, resistant welding and low temperature joining processes. **Course Outcomes (CO):** At the end of the course, the students will be able to: 1. Identify various manufacturing processes and techniques for different industrial applications. 2. Analyze and identify various processes and steps involved in foundry practices. 3. Understand and identify various metal forming processes. 4. Describe the principle of various machining and surface finishing processes. 5. Describe the principle of metal joining processes such as welding, brazing, and soldering.	
10.	**Course Syllabus** **Unit-I Introduction to manufacturing processes** Introduction to manufacturing processes: Basic concept of manufacturing processes & classifications. Foundry practice: Pattern making- classification, materials, allowances, core & its classifications. Mould making and casting - Types of sand moulding, design considerations, moulding machines and moulding procedures, moulding sand – types, properties, compositions and applications. Special casting processes: Investment casting, centrifugal casting, shell moulding, die casting and casting defects.	

	UNIT – II Forming Processes Forging: Principle, types and tools, forging dies, forging machines, forging design, drop forging die design, upset forging die design, forging practice and forging defects. Extrusion: Principle, extrusion processes, process parameters, extrusion equipments and extrusion defects. Rolling: Principle, classification of rolled products, types of rolling, rolling mill train components and roll pass design. Drawing: Principle and setup of wire drawing and tube drawing. **UNIT – III Machining and Finishing Processes** Drilling: Introduction, drill nomenclature, types of drilling machines, other operations like counter boring, counter sinking, spot facing and etc. Boring, broaching and reaming: Introduction, operations and applications. Grinding operation: Processes, machines, specifications of grinding wheels and its components. Other surface finishing processes: Honing, lapping, super finishing, polishing and buffing. **UNIT – IV Joining Processes** Welding: Types of joining processes, principles of welding. Gas welding: Basic concepts of gas welding, types of flames and applications. Arc welding: SMAW, MIG and TIG, atomic hydrogen welding, electrode- classifications and applications of flux. Resistance welding: Principle, spot welding, butt welding, seam welding, thermit welding and welding defect. Low temperature joining process: Brazing, soldering and its applications.
11.	**Text Books-** 1. Manufacturing Engineering and Technology – Serope Kalpakjian and Steven R. Schmid– Pearson Education, Delhi. 2. Manufacturing Technology (Vol. – I & II) – P. N. Rao – McGraw Hill Education (India) Pvt. Ltd., New Delhi.
12.	**Reference Books-** 1. Manufacturing Science – A. Ghosh & A. K. Mallik – East West Press Pvt. Ltd., New Delhi 2. Manufacturing Science (Vol. – I) – G. S. Sawhney – I. K. International Publishing House Pvt. Ltd., New Delhi 3. Production Technology – R. K. Jain – Khanna Publishers, New Delhi 4. A Text Book of Production Technology (Vol. I& II) – O. P. Khanna – Dhanpat Rai & Sons, New Delhi. 5. Shop Theory-James Anderson and Earl E Tatra, T Tata McGraw Hill, New Delhi. 6. Manufacturing Process (Vol- I & II)-H. S. Bawa-Tata McGraw Hill Pub. Company, New Delhi.

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Semester-III

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Mathematics-III**
3.	L-T-P Structure	**4+0+0**
4.	Credits / # of period	4
5.	Course Number (Code)	**ME103001MA**
6.	Status (Core/Elective)	**Program Core**
7.	Pre-requisites (course no./title)	Mathematics-I and Mathematics-II
8.	Frequency of offer	Once in a Year
9.	**Course Objectives (CO):** To enable the students to apply the knowledge of Mathematics in various fields: 1. Introduce the Fourier Series and Fourier Transform 2. Introduce the concepts Laplace Transform and its application in solution of differential equations and improper integral 3. Able to form and solve the partial differential equation using different analytical techniques with application in solution of wave and Laplace equations 4. Introduce to probability and basic statistical data analysis.	
10.	**Course Syllabus** **Unit –I FOURIER SERIES AND FOURIER TRANSFORM** Expansion of function as Fourier series, Functions having points of discontinuity, Change of interval, Even & Odd functions, Half-range series, Harmonic analysis, Fourier Transformation, Inverse transformation, Finite cosine and sine transform. **Unit –II LAPLACE TRANSFORM** Definition, Transform of elementary functions, Properties of Laplace transform, Transform of derivatives and integrals, Multiplication by t^n , Division by t, Evaluation of Integrals, Periodic functions, Inverse Laplace transform, Convolution theorem, Application of Laplace transform to solutions of ordinary differential equations. **Unit –III PARTIAL DIFFERENTIAL EQUATION** Formation, Solutions by direct integration method, Linear equations of first order, Homogeneous linear equations with constant coefficients, Non-homogeneous linear equations, Method of separation of variables with application in solution of Wave, Heat and Laplace equations. **Unit –IV INTRODUCTION TO PROBABILITY AND STATISTICS** Definitions of Probability, Conditional Probability, Random Variables, Discrete and continuous probability distributions, Expectation, Mean & Standard deviation, Moment	

	Generating Function, Binomial, Poisson and Normal distributions, Descriptive Statistics: Collection and classification of data, Measure of Central Tendency, Measure of Dispersion, Correlation, Line of Regression.
11.	**Text Books-** 1. Higher Engineering Mathematics by B. S. Grewal - Khanna Publishers. 2. Advanced Engineering Mathematics by Erwin Kreyszig - John Wiley & Sons.
12.	**Reference Books-** 1. Advanced Engg. Mathematics by R. K. Jain and S. R. K. Iyengar–Narosa Publishing House. 2. Higher Engineering Mathematics by B. V. Ramana, McGraw Hill