NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR (HP) – 177 005

B.Tech. Mechanical Engineering, Second Year [3ʳᵈ Semester]

Sr. No.	Course No.	Subject	L	T	P	Hours	Credits
1.	MA-213	Differential Equation and Integral Transforms	3	1	0	4	4
2.	ME-211	Applied Thermodynamics	3	1	0	4	4
3.	ME-212	Manufacturing Process-1	4	0	0	4	4
4.	ME-213	Engineering Metallurgy	3	0	0	3	3
5.	ME-214	Mechanics of Materials	3	1	0	4	4
6.	EE-214	Electrical Machines Drive & Control	3	1	0	4	4
7.	ME-211 (P)	Thermal Lab-I	0	0	2	2	1
8.	ME-212 (P)	Production Lab-1	0	0	4	4	2
9.	ME-213 (P)	Production Lab-II	0	0	2	2	1
10.	ECA - 201	Extra Curricular Activity – I	0	0	2	2	1
					Total =	33	28

ME-211   **APPLIED THERMODYNAMICS**

L T P/D Cr
3 1   0   4

1. **BASIC CONCEPT:-** Review, the concepts, energy-kinetic, potential and internal, heat and work, zeroth law, concept of temperature, temperature scale, definition of ideal gas, laws and properties of ideal Gas, non-ideal gas behaviour.

2. **PROPERTIES OF STEAM:-** Phase transformation, phase diagram, generation of steam, condition of steam- saturated steam, dry-saturated steam, wet steam, superheated steam, dryness fraction, property of steam, steam tables, methods of determination of dryness fraction of steam, use of Mollier charts, process of vapours and various process.

3. **LAWS OF THERMODYNAMICS:-** First law for control mass (closed system), internal energy, enthalpy, specific heats, non-flow processes of ideal gases, cyclic process, first law for control volume (open system), general energy equation, one dimensional steady flow, Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements, their equivalence, reversible processes, reversible cycles, and Carnot cycle, corollaries of the second law, thermodynamics temperature scale, Clausius inequality, entropy, principle of increase of entropy, isentropic efficiency.

4. **ENERGY ANALYSIS:** Energy, Reversible work and irreversibility, Second law efficiency, energy of closed and open system, exergy transfer by heat, work and mass, Decrease of energy principle.

5. **THERMODYNAMIC PROPERTY RELATIONS:** Maxwell relations, Clapeyron Equation, general relations for change in internal energy, enthalpy, entropy and specific heats, Joule Thomson coefficient

 BOOKS RECOMMENDED:

1. Engineering Thermodynamics   : P.K. Nag
2. Engineering Thermodynamics   : Yunus Cengel
3. Engineering Thermodynamics   : Van Wylen

ME-212   **MANUFACTURING PROCESS-I**

L T P/D Cr
4 0   0   4

1. **INTRODUCTION:** Introduction to manufacturing, Environmentally conscious design and manufacturing, General trends in Manufacturing, Responsibility of manufacturing engineer. Classification of materials and selection of materials for mechanical design; Mechanical, Physical and Thermal properties materials and Mechanical testing of materials.

2. **METAL CASTING PROCESS:** Introduction, Solidification of metals, cast structures, concept Fluid flow and heat transfer in casting process, Furnaces, Casting alloys. Pattern, Pattern materials and Pattern allowances, moulds, gating and riser types and design principles,Various casting techniques, casting defects and their remedy; Casting design principles and Economics of casting.

3. **METAL AND SHEET METAL FORMING PROCESSES:** Introduction, Elastic and Plastic deformation, yield criterion, hot working and cold working. Bulk deformation processes with analysis: Forging, Rolling, Extrusion, Rod, Wire and Tube drawing, Swaging, Die manufacturing method and Die failures. **Sheet Metal forming**: Processes and classification with analysis, Formability of sheet metals, Equipments for sheet metal forming, Design considerations, Economics of sheet metal.

4. **JOINING AND FASTENING PROCESSES:** Introduction, Classification of welding processes: Arc-welding processes, High energy beam welding, Fusion welding joints, Cold welding, Ultrasonic welding, Friction welding, Resistance welding, Explosion welding, Diffusion bonding, Brazing and Soldering, Mechanical Fastening, Joining Plastics, Ceramics and Glasses, Design consideration in Joining, Economic considerations in welding; Introduction to fabrication of microelectronic and mechanical devices.

5. **PROCESSING OF METAL POWDER, CERAMICS, GLASSES, COMPOSITES and SUPER CONDUCTORS:** Introduction, Production of Metal Powders, Compaction of metal powders, Sintering, Secondary and Finishing Operations, Design consideration of Powder Metallurgy, Economics of Powder metallurgy. Ceramics: structure, properties and applications, Shaping ceramics, Glasses: structures properties and applications, Shaping and forming glasses, Design consideration ceramics and glasses, Processing of metal matrix and ceramic matrix composites, Processing of Super conductors.

6. **PROCESSING OF POLYMERS AND REINFORCED PLASTIC COMPOSITES:** Introduction, Structure, Behavior, Properties, General characteristics and applications of Thermo Plastics and Thermosets. High temperature Polymers, electrically conducting polymers and biodegradable Plastics. Elastomers, Rinforced Plastics, Processing of Plastics, Processing of Polymer-Matrix-reinforced Plastics, Desin considerations and Economics of Processing of Plastics.

BOOKS RECOMMENDED:
1.Manufacturing Process for Engineering Material by Kalpakjian;Person Pub.(Text Book)
2.Manufacturing Engineering and Technology by Kalpakjian;Person Pub.
3.Manufacturing Engineering and Technology by Groover;TMH Pub.
4.ASM Hand Books on Casting, Welding and Forming
5.Manufacturing Technology P.N.Rao

ME-213   **ENGINEERING METALLURGY**

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L   T   P/D   Cr
3   0   0   3

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1. **FUNDAMENTALS OF MECHANICAL BEHAVIOR**: Engineering materials, Material properties: Tension, compression, torsion, hardness, Fatigue, creep etc

2. **STRUCTURE OF METALS AND ALLOYS**: Elementary consideration of structures of metals, space lattices, crystal systems allotropy, grain boundaries.

3. **PHASE DIAGRAMS**: Solidification of metals, cooling curves, phase rule, solid solution, Eutectic and peritectic systems, Inter-metallic compounds. Interpretation of Equilibrium diagrams.

4. **FERROUS ALLOYS**: Iron carbon equilibrium diagram, Plain carbon steels, alloys steels, tool steels and heat resistant steels-classification composition and uses. Impurities in steel, hot shortness, and cold shortness, Manufacture, properties and uses of cast irons – Grey, malleable and nodular, ISI specifications.

5. **NON-FERROUS METALS AND ALLOYS**: Copper, aluminum, magnesium, nickel, zinc, and lead – base alloys, Equilibrium diagrams of some important alloys like bronze, brass, bearing materials, Agehardening of non-ferrous metals.

6. **HEAT TREATMENT OF STEEL**: Critical temperatures on heating and cooling, equilibrium structures – annealing normalizing, Martensitic transformation and tempering isothermal transformation diagrams, Quenching and hardening, Harden ability and harden ability tests, Interrupted quenching, surface hardening processes.

7. **MECHANICAL WORKING OF METALS**: Hot and cold working, Recovery, Recrystallisation, Soldering and brazing alloys.

8. **CORROSION AND OXIDATION**: Types of corrosion, oxidation Design against corrosion, protective coatings and environment control.

BOOKS RECOMMENDED:
1. Engineering Metallurgy A.G.Guy
2. Engineering Metallurgy S.P.Nayak
3. Fundamentals of Engineering Metallurgy F.W.J.Bailey
4. Physical Metallurgy Avener
5. Metallurgy for Engineers E.C. Rollason
6. Physical Metallurgy V. Raghavan

ME- 214   **MECHANICS OF MATERIALS**

                                                          L   T   P   Cr
                                                          3   1   0   4

1. **ANALYSIS OF STRESS & STRAIN:** State of stress, stress on arbitrary plane, Equality of cross shear, stress invariants, Principal planes, Mohr's Circle for 3-D state of stress, Octahedral stresses, state of pure shear, Cauchy's stress quadric, Introduction to strain and rectangular strain components, state of strain at point, cubical dilatation, compatibility conditions.

2. **SLOPE AND DEFLECTION OF BEAMS:** Review of bending theory, relationship between slope, deflection and radius of curvature, Slope and deflection of various types of beams with various loadings by Macaulay's method, Double integration method and Moment area method, Fixed & continuous beams.

3. **CURVED BEAMS**: Bending of beams with initial curvature, Division of curved beams on the basis of radius of curvature, Beams with large radius of curvature, Values of link radius $(h^2)$for –Rectangular, Trapezoidal, Circular, T, I, and Triangular section Position of neutral axis, Stresses in a crane hook, chain link and ring ,variation of stresses across the section.

4. **COLUMNS AND STRUTS:** Types of columns Failure of column, Euler's column theory, Slenderness ratio, End conditions for long columns, Equivalent length of columns, Limitation of Euler's formula, Factor of safety, Empirical relations-Rankine's Straight line and Johnson's parabolic formula

5. **UNSYMMETRICAL BENDING AND SHEAR CENTER:** Definitions, product of inertia, parallel axis theorem of product of inertia, Unsymmetrical bending ,stresses due to unsymmetrical bending –combined and axial loads, shear center –for symmetrical section, Equal leg angle section and channel section.

6. **THICK PRESSURE VESSELS:** Thick cylindrical shell. Stresses in thick shells Derivation for radial and circumferential stress for a thick shell subjected to internal fluid pressure Longitudinal and shear stresses, Distribution of stresses across the shell thickness, Cylindrical shell subject to both internal and external fluid pressure compound cylinders distribution of stresses across the thickness of compound cylinder, thick spherical shells under internal fluid pressure, wire wound cylinders.

7. **THEORIES OF ELASTIC FAILURE:** Introduction to theories of failure, Graphical representation of theories of Elastic Failure and significance, Application of theories of elastic failure. Utility of factor of safety in design.

BOOKS RECOMMENDED:
    1. Mechanics of Materials Vol. & II   E.J.Hearn
    2. Strength of Materials   Timoshenko
    3. Mechanics of Solids   Kazmi
    4. Mechanics of Materials   Beer, Johnston & DeWolf
    5. Advanced Mechanics of Materials   Boresi and Schmidt
    6. Advanced Mechanics of Material   Solecki & Conant
    7. Engineering Mechanics of Solids   Egor P. Popov

EE – 214   ELECTRICAL MACHINES DRIVES AND CONTROL

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L   T   P   Cr
3   1   0   4
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1. **D. C. MACHINES**: Basic parts of electric machines, EMF equation, Generator Characteristics, Types of DC Motors, Torque speed characteristics, types of starters and speed control, losses and efficiency.

2. **THREE-PHASE A.C. MACHINES**: Construction, Principle of working, Rotating magnetic field production, Slip, Equivalent circuit, Torque-slip characteristics, Speed control and method of starting, Alternators, EMF equation and regulations, Synchronous motor.

3. **CONTROL SYSTEMS**: Types of Control Systems - Open Loop & Closed Loop Systems with Examples; Control System Terminology

4. **TRANSFER FUNCTION, BLOCK DIAGRAMS, SIGNAL FLOW GRAPHS & STABILITY CRITERION**: Physical system and mathematical models, linear control system, Laplace transform and Transfer function, Block diagram, signal flow graphs, system stability – characteristic root locus, Routh stability criterion, Hurwitz stability criterion, Bode Plot, Niquist Criterion.

5. **INDUSTRIAL APPLICATIONS**: Case study of motor drive system for steel mills/ paper mills/ machine tool application.

BOOKS RECOMMENDED:

1. Electric Machines   Ashfaq Hussain
2. Electrical Machinery   P. S. Bhimbra
3. Electrical Machinery   Chapman
4. Modern Control Engineering   Ogata