Course Outline and Detailed Syllabus for B. Tech. Mechanical Engineering (4th Semester)

Semester-IV

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	MEC250C	Applied Thermodynamics	**3**	**0**	**0**	**3**	**3**
2.	MEC251C	Mechanics of Materials	**3**	**0**	**0**	**3**	**3**
3.	MEC252C	Theory of Machines and Mechanisms	**4**	**0**	**0**	**4**	**4**
4.	MEC253C	Materials Science and Engineering	**3**	**0**	**0**	**3**	**3**
5.	ECE280C	Basic Electronics Engineering	**3**	**0**	**0**	**3**	**3**
6.	MEC260C	Thermo-Fluids Lab	**0**	**0**	**2**	**2**	**1**
7.	ELE280C	Electrical and Electronics Lab	**0**	**0**	**2**	**2**	**1**
8.	-	Open Elective	**-**	**-**	**-**	**-**	**-**
Total Credits							**18**

MEC250C Applied Thermodynamics 3-0-0

Steam Power Cycles: Carnot cycle for steam, Rankine and modified Rankine cycle, deviation of actual cycles from ideal cycles, cycle efficiency, second law analysis of vapour power cycle, binary vapor power cycles, Types of nozzles, isentropic flow through nozzles, effect of friction, nozzle efficiency, critical pressure ratio for maximum discharge, throat and exit areas, supersaturated flow.

Steam Turbines: Position of steam turbine in power industry, types and applications, impulse turbines, pressure and velocity compounding, velocity diagram, work output, blade, stage, internal and overall efficiency, reaction turbines, velocity diagram, degree of reaction, work out put, losses and efficiency, Reheat cycle, regenerative feed heating, Direct and indirect feed heating, efficiency and work out put calculations, governing of steam turbines.

Compressors: Single stage compressor, induction diagram and power requirement, effect of clearance volumetric efficiency, Multistage compressors, indicators diagram with and without clearance, effect of intercooling, power requirement,

Air standard Cycles: Carnot, Otto, diesel and dual cycles, work output and efficiency, mean effective pressure, deviation of actual cycles from ideal cycles.

Refrigeration Cycles: Refrigeration: Reversed Carnot, vapor compression and air refrigeration cycle analysis; vapor absorption cycle; refrigerants; domestic refrigerators.

Text Books:

1. Eastop T. D., Applied Thermodynamics for Engineering Technologist, *Pearson Education.*

Reference Books:

1. Cengel Y. A., Thermodynamics: An Engineering Approach, *McGraw Hill Education (India).*
2. Moran and Shapiro, Engineering Thermodynamics, *John Wiley & Sons.*
3. Arora C. P., Refrigeration and Air Conditioning, *McGraw Hill Education (India).*

MEC251C Mechanics of Materials 3-0-0

Statically indeterminate beams: Slope and deflection, double integration method, singularity functions, moment area method, Clapeyron's three moment theorem, analysis of various statically indeterminate Beams.

Energy methods: Strain Energy for general state of stress, Strain Energy in axial, bending and torsional loads, energy of distortion, Castigliano's and Maxwell's Theorems, deflection of structures by energy methods.

Pressure vessels: Circumferential and longitudinal stresses in thin shells, cylindrical and spherical vessels, built-up cylindrical shells, wire wound cylinders, stresses in thick cylindrical and spherical shells, Lame's theory, compound cylinders, thick spherical shells.

Bending of curved bars: Stresses in curved bars, crane hooks, rings of circular and trapezoidal sections, deflection of curved bars and rings, deflection of rings by Castigliano's theorem, stresses in simple chain link, deflection of simple chain links.

Theories of elastic failure: Static strength, failure theories for ductile and brittle materials, maximum shear stress theory, distortion energy theory, maximum normal stress theory, Coulomb-Mohr theory, selection of failure criteria.

Text Books:

1. Irving H. S., Introduction to Solid Mechanics, *Prentice Hall India, New Delhi.*
2. Popov E. P., Mechanics of Materials, *Prentice Hall India, New Delhi.*

Reference Books:

1. Ferdinand P. B., Johnston Jr. E. R., DeWolf J. T., Mazurek D. F., Mechanics of Materials, *McGraw Hill Education (India).*
2. Crandall S. H., Dahl N. C., Lardner T. J., Sivakumar M. S., An Introduction to Mechanics of Solids, *McGraw Hill Education (India).*
3. Timoshenko S., Strength of Materials Part 1, Elementary theory and problems, *CBS Publishers.*
4. Timoshenko S., Strength of Materials Part 2, Advanced theory and problems, *CBS Publishers.*

MEC252C Theory of Machines and Mechanisms 4-0-0

Introduction to Mechanisms: Kinematics and dynamics, Lower pairs & higher pairs, Degree of freedom(DOF), Gruebler's and Kutzbach's criterion, Mechanisms and DOF, Inversions, Grashof's law and Quick return mechanism, Coupler curves, Velocity and acceleration analysis, Mechanical advantage, Transmission and deviation angle, Instantaneous centre.

Gears: Rolling contact and positive drive, classification of gears, Nomenclature, Law of gearing, Conjugate teeth, involute and cycloidal profile system of gear teeth, Length of path of contact, arc of contact, contact ratio, Interference and undercutting, interchangeable gears, Helical and spiral gears. Gear trains: Classification, Types, simple gear train, speed ratios, Compound, reverted, Epicyclic gear train, tabulation and algebraic method, Compound epicyclic gear trains.

Cams: Comparison with lower paired mechanisms, Classification of cams and followers, Terminology for cams, types of follower motions, pressure angle, considerations influencing choice of cam, construction of cam profiles, layout

Governors: Difference between flywheel and governor, Watt governor, Porter governor, analysis, effect of friction, Proell governor, Hartnell governor. Controlling force, sensitivity, stability, hunting, Isochronism, effort and power of a governor

Gyroscopes: Precessional motion and angular acceleration, Gyroscopic couple, reaction couple. Effects on an aero plane, naval ship, gyroscopic ship stabilization, Stability analysis of a two-wheel vehicle, Stability of a four-wheel drive on a curved path

Text Books:

1. Shigley J. E., Theory of Machines and Mechanisms, *McGraw Hill Education (India).*

Reference Books:

1. Mabie H. H., Reinholtz C.F, Mechanism and Dynamics of Machinery", Fourth edition, *John Wiley & Sons.*
2. Rattan S. S., Theory of Machines, *McGraw Hill Education (India).*
3. Ambekar A., Mechanisms and Machine Theory, *Prentice Hall India, New Delhi.*

MEC253C Materials Science and Engineering 3-0-0

Crystallography-crystals, space lattice, unit cell-BCC, FCC, HCP structures-effects of crystalline and amorphous structures on mechanical properties. Theoretical density; polymorphism and allotropy. Miller Indices: - Crystal plane and directions. Fundamentals and crystal structure determination by X-ray diffraction, SEM and TEM. Mechanism of crystallization: Homogeneous and heterogeneous Effects of grain size, grain shape Hall -Petch theory, simple problems.

Crystal defects-Classification of crystal imperfections: - types of dislocation- effect of point defects on mechanical properties, role of surface defects on crack initiation. Burgers vector –dislocation, correlation of dislocation density with strength and nano concept. Polishing and etching to determine the microstructure and grain size determination, diffusion in solids, Fick's laws, mechanisms, applications.

Phase diagrams: - Limitations of pure metals and need for alloying. Classifications of alloys and solid solutions, Hume- Ruthery rule, equilibrium diagram of common types of binary system. Liver rule and Gibb's phase rule. Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties change with phase transformation. Time temperature phase transformation diagram and heat treatments-applications. Surface hardening treatments and applications.

Strengthening mechanisms:- work hardening - precipitation strengthening and over ageing dispersion hardening , Cold working: Detailed discussion on strain hardening recovery; re-crystallization Alloy steels:- Effects of alloying elements on steel ,nickel steel ,high speed steel, stainless steel cast iron –classification and applications, principal nonferrous alloys

Failure of materials- Fracture:– Brittle and ductile fracture, Griffith theory of brittle fracture . - , Fatigue- Characteristics of fatigue failure and S-N curve, Creep: Creep curves

Composites: Need of development of composites, modern engineering materials, smart materials, shape memory alloys etc.

Text Books:

1. Raghavan V., Material Science and Engineering, *Prentice Hall India, New Delhi.*
2. Callister William. D., Material Science and Engineering, *John Wiley & Sons.*

Reference Books:

1. Askeland D. R., Fulay P. P., Essentials of Materials Science and Engineering, *Cengage Learning.*
2. George E. Dieter, Mechanical Metallurgy, *McGraw Hill Education (India).*

ECE280C Basic Electronics Engineering 3-0-0

Electronic Components: Active and Passive (Resistors, Capacitors and Inductors) components Introduction to Semiconductors: Extrinsic and intrinsic semiconductors, P and N type Semiconductors, Transport Mechanism of Charge Carriers, Charge Densities in a Semiconductor, Electric properties, Hall Effect, Generation, Recombination, Diffusion, Continuity Equation.

PN Junction Diodes and Rectifiers: PN junction Diode, Basic Principle, Operation and Volt-Ampere Characteristics of PN Junction Diode, Temperature Dependence of V/I Characteristics, Piecewise linear Diode Characteristics, Diode Resistance, Rectifiers: Half Wave Rectifier, Full Wave Rectifier (CT and bridge type), Diode Clipping and Clamping Circuits.

Transistors (BJT): Current Components of Transistor, Types, Transistor as a switch and as an Amplifier, Operation and Characteristics, CE, CB and CC Configurations, Input-Output Characteristics. Introduction to JFET, MOSFET and IGBT. Operation and Characteristics.

Number Systems and Codes: Binary, octal, and hexa- decimal number systems, binary arithmetic, binary code, excess-3 code, gray code, error detection and correction codes. Boolean algebra: Postulates and theorems, logic functions, minimization of Boolean functions using algebraic, Karnaugh map.

Combinational Logic Circuits: Introduction to combinational circuits, realization of basic combinational functions like Adder, Subtractor, Encoder/Decoder, Multiplexer, Demultiplexer. Introduction to Sequential Circuits, Realisation and Truth Table of RS, JK, D, T and Master Slave Flip-Flop.

Text Books:

1. C. Parikh, J. Millman, C. Halkias, Integrated Electronics, Analog & Digital Circuit System, *McGraw Hill Publishers*
2. Albert Malvino, David Dates, Electronic Principles, *McGraw Hill Publishers*
3. Kumar G.P, Principles of Electronics, *PHI Publishers*

Reference Books:

1. N.N. Bhargava and D.C. Kulshreshthaby N.N. Bhargava and D.C. Kulshreshtha, Basic Electronics and Linear Circuits, *McGraw Hill Publishers.*
2. S. Salivahnan , R Rengaraj, G R Venkatakrishnan, Basic Electrical, Electronics and Measurement Engineering, *McGraw Hill Publishers*

MEC260C Thermo-Fluids Lab 0-0-2

List of Experiments:

Applied Thermodynamics:

1. Determination of Flash Point and Fire Point
2. Determination of Dryness Fraction of Steam
3. Flue Gas Analysis
4. Determination of calorific value using Bomb Calorimeter.
5. Study of Various Types of Boilers, Boiler Mountings and Accessories
6. Performance and Energy Balance Test on a Fire Tube/ Water Tube Boiler.
7. Performance of Single Stage/ Multi Stage Reciprocating Compressor
8. Study of Refrigeration System and determination of it's COP.
9. Study of Air Conditioning System
10. Study of cooling tower.

Fluid Mechanics

1. To Study the Flow through a Variable Area Duct and Verify Bernoulli's Energy Equation.
2. To Determine the Coefficient of Discharge for an Obstruction Flow Meter (VenturiMeter/Orifice Meter)
3. To Determine the Discharge Coefficient for Notches And Weirs.
4. To Study the Transition from Laminar to Turbulent Flow and to ascertain Lower Critical Reynolds Number.
5. To Determine the Friction Coefficient for Pipes of Different Diameters.
6. To Determine the Head Loss in a Pipe Line Due to Sudden Expansion/ Sudden Contraction/ Bend.
7. To Determine the Velocity Distribution for Pipeline Flow with a Pitot Static Probe.
8. Flow Visualization
9. Study of fluid flow through wind tunnel.

ELE280C Electrical and Electronics Lab 0-0-2

List of Experiments:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. To study resonance in series and parallel RLC Circuits.
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line, and phase currents).
5. Measurement of Power in single phase and 3 phase Circuits.
6. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
7. Speed control of DC Motor by using Armature Voltage control and Field or flex control
8. VI characteristics of PN Junction diode
9. Design HW, FW rectifier
10. Plotting output characteristics of transistor
11. Operating of transistor as a switch and an Amplifier.
12. Design of Half adder and Full adder Circuit.