SYLLABUS

FOR

B.TECH. PROGRAMME

IN

MECHANICAL ENGINEERING

INSTITUTE OF TECHNOLOGY

ZAKURA CAMPUS

UNIVERSITY OF KASHMIR

SRINAGAR J&K, 190006

COURSE STRUCTURE FOR
B.Tech 4th Semester Mechanical
AT UNIVERSITY OF KASHMIR

Course Code	Course Title	Teaching Periods per week			Credits
		L	T	P	
MEE- 4117	Materials Science	2	1	0	3
MEE-4217	Mechanics of Materials- II	3	1	0	4
MEE-4317	Theory of Machines -I	3	1	0	4
MEE- 4417	Applied Thermodynamics-I	2	1	0	3
MEE- 4517	Manufacturing Technology -II	3	1	0	4
ELE- 4617	Electrical Engineering Technology	2	1	0	3
MEE-4317L	Theory of Machines-I Lab.	0	0	2	1
MEE- 4417L	Applied Thermodynamics-I Lab.	0	0	2	1
MEE- 4517L	Manufacturing Technology –II Lab	0	0	2	1
ELE- 4617L	Electrical Engineering Technology Lab.	0	0	2	1
	Total	**15**	**6**	**8**	**25**

MEE-4117

Material Science

UNIT I

Introduction to material science and engineering: Why to study material science and engineering, classification of materials, modern and advanced materials, human needs and materials selection, and design considerations. Atomic structure and bonding, fundamentals of electron arrangements and modern periodic table, primary bonds and secondary bonds, energy related concepts, structure of metals and ceramics, concept of unit cells and lattice arrangements.

UNIT II

Density computations for metals: Ceramic crystal structure and density computations, polymorphism and allotropy, crystal systems, crystallographic directions and planes, atomic densities (linear and planar), single crystals, polycrystalline materials anisotropy, x-ray diffraction and determination of crystal structures, polymer structure, hydrocarbon molecules, polymer molecules and their chemistry, molecular weight and shape and structure, thermoplastic and thermosetting polymers, imperfections in solids, point defects, line defects and volume defects.

UNIT III

Impurities and their role in materials: grain size determination, diffusion mechanism, steady state diffusion, non steady state diffusion, factors that influence diffusion, diffusion in ionic and polymeric materials,deformation and strengthening mechanisms, plastic deformation of polycrystalline metals, deformation by twining, strengthening by grain size reduction, phase diagrams, solubility limit, phases, micro-structure and phase equilibrium, dielectric materials, Gauss equations, electro-thermo elasticity.

Text Book:

1. Callister, W.D, “Fundamentals of Materials Science and Engineering”, *John Wiley & Sons, Inc.*2001.

Reference Books:

1.Cahn, R.W., Haasen P., “Physical Metallurgy”, Vo I, II, III, North-Holland, 1996.
2.Ashby, M., Johonson, K., “Materials and Design” Butterworth-Heinemann, 2002.

MEE-4217
Mechanics of Materials-II

UNIT I

Strain energy due to normal and shear stresses: the total elastic strain of dilation and distortion, the energy elastic theorems, theorems on virtual work, Castigliano's theorem, complementary energy theorems, strain energy due to axial bending and torsional loads, stresses due to suddenly applied loads, use of energy theorems to determine deflection of beams and twists of shafts, Maxwell's theorem of reciprocal deflections and its corollaries, unit couple and unit load methods of determining slopes, deflections,theories of elastic failures, various theories of elastic failure, significance of the theories of failure, comparison and graphical representation, stresses in rotating disc of constant thickness, stresses in hollow & solid discs, stresses in rotating solid and hollow cylinders, stresses in spooked rim.

UNIT II

Overview of I_{xx}, I_{yy}, &I_{xy}: stresses due to unsymmetrical bending, combined bending & axial loads, shear centre for symmetrical and unsymmetrical sections, alternative procedures for calculation of stresses, deflection of straight beams subjected to unsymmetrical bending, bending of beams with large initial curvature, circumferential stresses, location of the neutral axis, application to beams with rectangular, circular and trapezoidal cross sections, stresses in crane hook, stresses in a ring, stresses in a chain link, deflection of curved bars, deflection of curved bars by Castigliano's theorem.

UNIT III

Close coiled helical spring: axial load, axial torque, strain energy in the spring, spring under impact load, springs in series and parallel, concentric springs, open coiled helical spring, axial load, axial torque, stresses in spring wire, combined action of axial load and moment, flat spiral springs, leaf springs, semi-elliptical spring, quarter elliptical leaf spring, graduated & full length leaves, equalized stress in spring leaves, conical springs.

Text Books:

1. Popov, E.P., Balan,T.A, "Mechanics of Solids", *PrenticeHall of India*,New Delhi, 2007.
2. Shames, I.H., Pitaresi, J.M., "Introduction to Solid Mechanics"*Prentice Hall of India, EEE*, New Delhi, 2006.
3. Stephen H. Crandell, Norman C. Dahl, "An Introduction to the mechanics of solids", *McGraw Hill*, 1st Edition, 2012
4. R.C. Hibbeler, "Mechanics of Materials", *Prentice Hall*, 8th Edition, 2010.

Reference Books:

1. Fung, Y.C., "Foundations of Solid Mechanics", *PrenticeHall of India, New Delhi*,1968.

MEE-4317

Theory of Machines-I

UNIT I

Introduction: kinematics and dynamics, lower pairs & higher pairs, degree of freedom (DOF), Grubbler's equation and Kutzbach's criterion, mechanisms and DOF, inversions, Grashoff's law and quick return mechanism, coupler curves, velocity and acceleration analysis, mechanical advantage, transmission and deviation angle, instantaneous centre, friction, types, laws, friction of nut and screw, screw jack, torque required to lift and lower loads, efficiency, pivot and collars & journal bearings, friction clutches, single and multidisc plate clutch, brakes, classification, braking of vehicle, 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.

UNIT II

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 train.

UNIT III

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, offset followers, precessional motion and angular acceleration, gyroscopic couple, reaction couple, effects on an aeroplane, naval ship, gyroscopic ship stabilization, stability analysis of a two-wheel vehicle, stability of a four-wheel drive on a curved path, acceleration in cartesian and spherical co-ordinates, inertia forces and D'Alembert's principle.

Text Book:

1. Shigley J.E, "Theory of Machines and Mechanisms", McGraw Hill, New York,1995.

Reference Book:

1. Mabie H.H., Reinholtz C.F, "Mechanism and Dynamics of Machinery" Fourth edition, *John Wiley & Sons*, 1987.
2. Ambekar A., "Mechanisms and Machine Theory", *Prentice Hall*, New Delhi, 2007.

MEE-4417

Applied Thermodynamics-I

UNIT-I

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.

UNIT II

Classification of boilers: Water tube, fire tube, boiler mountings and accessories, boiler draught, boiler rating, boiler performance, heat balance, 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.

UNIT III

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.

Text Books:

1. Eastop, T.D., "Applied Thermodynamics for Engineering Technologist", *Pearson education*, 1990.
2. Rogers G.F.C., Mayhews, "Engineering Thermodynamics", *Pearson Education*,1990.

Reference Book:

1. Kearton, W.J., "Steam Turbines", *CBS Publishers*, New Delhi, 1960.

MEE-4517

Manufacturing Technology-II

UNIT I

Brief history of NC and CNC machines: Introduction, open loop & closed loop CNC machines, classification of CNC machines, advantages of CNC machines, setup time reduction, introduction to CNCprogramming, adaptive control, machining parameters selection, introduction to robotics and automated guided vehicles(AGV's), introduction to flexible manufacturing systems (FMS), elements of FMS and its advantages, cellular manufacturing, expert systems in manufacturing & simulation, maintenance automation.

UNIT II

Mechanical working of materials: Hot and cold working, theory and principles, press forging, general principles of die design, forging defects, principles of metal rolling, hot and cold extrusion indirect and impact extrusion processes, wire drawing and tube drawing and spinning, welding, selection of welding process, arc welding, resistance welding, submerged arc welding. GMAW, GTAW, thermit and friction welding technique.

UNIT III

Introduction to unconventional machining processes: abrasive jet machining (AJM), abrasive water jet machining (AWJM), advantages and applications, ultra sound machining(USM), process variables and advantages, electro discharge machining (EDM), process variables, metrology, limits, fits and tolerances, hole basis and shaft basis system, unilateral and bilateral system, Taylor's principles of gauge design, sine bars and gauge blocks manufacturing method and their applications, use of Dial indicators, comparators and coordinate measuring machine (CMM).

Text Books:

1. S. K HajraChoudhury , Elements of workshop technology – Vol. II,, *Media Promoters And Publishers*, Mumbai,2014.
2. Amitabh Ghosh and AsokkumarMallik, Manufacturing science, *Ellis* Horwood Ltd,2012.
3. Mikell. P. Grover, Fundamentals of Modern Manufacturing, *Pearson Publications*,2004.
4. P. C. Sharma, Production Engineering, *S. Chand Publication*, 2008.

Reference Book:

1. Serop K. Steven, "Manufacturing Processes for Engineering Materials", *Prentice Hall of India*, New Delhi, 2004.

ELE-4617

Electrical Engineering

UNIT I

Network analysis and theorems: basic circuit theory (D.C and A.C), resistance, inductance and capacitance, Ohm's law, KCL,KVL , power and energy relations, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, sinusoidallyexcited circuits,basic definitions of A.C. circuits, phasor algebra and complex number representations, solutions of sinusoidally excited R.L.C circuits, Introduction to 3-phase circuits.

UNIT II

Transformers: Construction, principle of operation, e.m.f. equation, phasor diagrams, no load and on load, equivalent circuit model, voltage regulation and test, introduction to 3-phase transformers, applications, D.C. generators and motors, basic construction, principles of operation, types of D.C. generators and motors, applications.

UNIT III

Transducers: Definitions, types of transducers and their applications for mechanical measurements, ammeters and voltmeters, meter range extension and their connections in their circuits, bridge methods to measure, resistance, inductance and capacitance, various types of bridges and their applications for measuring, R, L and C, measurement of power and energy,Wattmeters, measurement of power using watt meters, energy meters and measurement of electrical using energy meters, digital instruments, introduction to digital meters for the measurement of various electrical quantities.

Text Book:

1. Nagrath, I.J., Kothari, D. P., "Electrical Machines*," Tata McGraw Hill*, New Delhi, 1985.

Reference Books:

1. Del Toro, V., "Principles of Electrical Engineering," *Prentice Hall International*, 1985.

MEE-4317L

Theory of Machines-I Lab

Experiments to be conducted

1. Study of kinematic pairs & working of stroboscope.
2. Slider crank motion, reciprocating engine mechanism, inversion of four bar chain, oscillating cylinder mechanism and Whitworth quick return mechanism.
3. Various models of brakes, and working of a clutch using clutch model.
4. Study the characteristics of a Watt Governor.
5. Study the characteristics of a Proell Governor.
6. Study the characteristics of a Porter Governor.
7. Study the characteristics of a Hartnell Governor.
8. Generation of involute gear tooth profile.
9. Involute teeth in contact & interference and under cutting of gear and its significance.
10. Study of pairs of cams and follower.
11. Determine the velocity of precession of a given motorized gyroscope.

MEE-4417L

Applied Thermodynamics-I

Experiments to be conducted

1. Study of typical boiler.
2. Calculation of dryness fraction of steam.
3. Calculation of heat balance sheet of a boiler.
4. Determination of COP of a refrigeration system.
5. Study of cooling tower.

MEE-4517L

Manufacturing Technology –II Lab

Experiments to be conducted

A)Jobs on CNC lathe machine.

Safety precautions and study of CNC lathe machine.

(i)Performing step turning.

(ii)Performing taper turning.

(iii)Performing radius turning.

(iv)Performing multiple turning cycles.

(v)Performing pattern repetition cycle operation.

B)Jobs on CNC milling machine.

Study of CNC milling machine.

(i)Performing linear cuts and circular cuts.

(ii) Performing linear and circular cuts using subroutines.

(iii)Performing pocket milling.

C) Metrology

(i)Use of sine bars and slips gauges for angle measurement.

(ii)Use of bevel protector and dial gauges.

MEE-4617L

Electrical Engineering-II Lab

Experiments to be conducted

1. To study the overall safety procedures to be employed, while working with electric circuits.
2. To study the series and parallel operations of resistors, inductors and capacitors.
3. To verify
   - KVL and KCL in DC circuits.
   - Superposition theorem.
   - Thevenin's Theorem.
4. To measure electric power in a single phase AC circuit with resistive load, R – L and RLC load.
5. To study the overall construction of electric machines.
6. Measurement of electric energy by
   - KWH meter.
   - Watt meter.
7. Measurement of power factory by
   - Power factor meter.
   - Voltmeter, Ammeter and Watt meter method.