DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

Evaluation Scheme & Syllabus
For
B.Tech. 2nd Year

- **Mechanical Engineering**
- **Automobile Engineering**
- **Manufacturing Technology**
- **Production Engineering**
- **Industrial Production Engineering**

(Effective from the Session: 2023-24)

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

SEMESTER –III

SN	Subject Code	Subject	Type	Category	Periods			Sessional Component		Sessional (SW) (TS/PS)	End Semester Examination (ESE)	Total SW+ESE	Credit Cr
					L	T	P	CT	TA	CT+TA	TE/PE		
1	BOE3** / BAS303	Science Based Open Elective/BSC (Maths-III/Math IV/ Math V)	T	ES/BS	3	1	0	20	10	30	70	100	4
2	BVE301 / BAS301	Universal Human Value and Professional Ethics/ Technical Communication	T	VA/HS	2	1	0	20	10	30	70	100	3
3	BME301	Thermodynamics	T	PC	3	1	0	20	10	30	70	100	4
4	BME302	Fluid Mechanics & Fluid Machines	T	PC	3	1	0	20	10	30	70	100	4
5	BME303	Materials Engineering	T	PC	2	1	0	20	10	30	70	100	3
6	BME351	Fluid Mechanics Lab	P	PC	0	0	2		50	50	50	100	1
7	BME352	Material Testing Lab	P	PC	0	0	2		50	50	50	100	1
8	BME353	Computer Aided Machine Drawing-I Lab	P	PC	0	0	2		50	50	50	100	1
10	BCC301 / BCC302	Cyber Security/Python programming	T	VA	2	0	0	20	10	30	70	100	2
11	BCC351	Internship Assessment /Mini Project*	P							100		100	2
		Total			**15**	**5**	**6**						**25**

- **Mathematics –III** for CE / ENV and allied branches
- **Mathematics-IV** for Computer/Electronics/Electrical & allied Branches, Mechanical & Allied Branches Textile/Chemical & allied Branches
- **Mathematics-V** for Bio Technology / Agriculture Engineering

SEMESTER –IV

SN	Subject Code	Subject	Type	Category	Periods			Sessional Component		Sessional (SW) (TS/PS)	End Semester Examination (ESE)	Total SW+ESE	Credit Cr
					L	T	P	CT	TA	CT+TA	TE/PE		
1	BAS403 / BOE4**	BSC (Maths-III/Math IV/ Math V)/Science Based Open Elective	T	BS/ES	3	1	0	20	10	30	70	100	4
2	BAS401 / BVE401	Technical Communication / Universal Human Value and Professional Ethics	T	HS/VA	2	1	0	20	10	30	70	100	3
3	BME401	Applied Thermodynamics	T	PC	3	1	0	20	10	30	70	100	4
4	BME402	Engineering Mechanics & Strength Material	T	PC	3	1	0	20	10	30	70	100	4
5	BME403	Manufacturing Processes	T	PC	2	1	0	20	10	30	70	100	3
6	BME451	Applied Thermodynamics Lab	P	PC	0	0	2		50	50	50	100	1
7	BME452	Manufacturing Processes Lab	P	PC	0	0	2		50	50	50	100	1
8	BME453	Computer Aided Machine Drawing-II Lab	P	PC	0	0	2		50	50	50	100	1
9	BCC402 / BCC401	Python Programming/Cyber Security	P	VA	2	0	0	20	10	30	70	100	2
10	BVE451 / BVE452	Sports and Yoga - II / NSS-II	P	VA	0	0	3			100		100	0
		Total			**15**	**5**	**9**						**23**
		Minor Degree/ Honors Degree MT-1/HT-1											

*****The Mini Project or internship (4 weeks) will be done during summer break after 4th Semester and will be assessed during V semester.

SYLLABUS
BME301- THERMODYNAMICS

Objectives:

CO1: To understand the basic terms of thermodynamics: **K2**
CO2: To apply I law to various energy conversion devices: **K3**
CO3: To evaluate the changes in properties of substances in various processes: **K3**
CO4: To understand the difference between high grade and low-grade energies: **K2**

UNIT I (08 Lecture)
Review of Fundamental Concepts and Definitions:
Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work.
Zeroth law of thermodynamics: Concept of Temperature and its' measurement, Different Temperature scales.

UNIT II (08 Lecture)
First law of thermodynamics:
First Law for closed system, Work and Heat Transfer in various processes, Internal Energy, Enthalpy, Derivation of General energy equation for a control volume; Steady Flow Energy Equation, Examples of steady flow devices: Boilers, Nozzles, Condensers, Turbine, Throttling Device, Pumps etc.; Unsteady processes and its examples, Limitations of first law of thermodynamics, PMM-I.

UNIT III (08 Lecture)
Second law of thermodynamics:
Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. **Entropy:** Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, TdS equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT IV (08 Lecture)
Availability and Irreversibility:
Available and unavailable energy, Availability and Irreversibility, Second law efficiency
Thermodynamic Relations:
Conditions for exact differential, Helmholtz & Gibb's function, Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNIT V (08 Lecture)
Properties of steam and Rankine cycle:
Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub- cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables &Moller chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

Course Outcomes:
1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Students can evaluate changes in thermodynamic properties of substances.
3. The students will be able to evaluate the performance of energy conversion devices.
4. The students will be able to differentiate between high grade and low-grade energies.

Books and References:

1. Basic and Applied Thermodynamics by P.K Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by CP Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Thermodynamics by Prasanna Kumar, Pearson Education
12. Engineering Thermodynamics by Mishra, Cengage Learning.

BME302- FLUID MECHANICS AND FLUID MACHINES

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to		
CO 1	Understand the application of mass and momentum conservation laws for fluid flows.	**K2**
CO 2	Understand the importance of dimensional analysis.	**K2**
CO 3	Evaluate the velocity and pressure variations in various types of simple flows.	**K3**
CO 4	Mathematically analyze the flow in water pumps and turbines.	**K3**
CO 5	Understand about the functioning of centrifugal and reciprocating pumps.	**K2**
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Incompressible flow, Bernoulli's equation and its applications - Pitot tube, orifice meter, and venturi meter.	**08**
II	Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two- and three dimensional flows, streamlines, continuity equation for 3D and 1D flows.	**08**
III	Equation of motion for laminar flow through pipes resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer. Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift.	**08**
IV	Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency Selection of water turbines.	**08**
V	Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps.	**08**

Books and References:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
2. Fluid mechanics and machines by R.K Bansal.
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
4. Fluid Mechanics and Its Applications by V.K. Gupta et.al. 5. Fluid Mechanics by Yunus Cengel.
5. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
6. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford University Press.
7. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley, 2004.
8. Fluid Mechanics and Hydraulic Machines, 5/ed by Mahesh Kumar, Pearson Education
9. Fluid Mechanics, 2e in SI Units, by R.C Hibbeler, Pearson Education

BME303- MATERIALS ENGINEERING

CO-1: Students will be able to identify the crystal structure and measure the mechanical properties of materials. **K3**
CO-2: Students will be able to test the various failures of materials. **K3**
CO-3: Students will be able to identify the mechanical properties based on composition of micro-constituents depicted in the phase-diagram. **K3**
CO-4: Students will understand the concept of improving the mechanical properties through heat treatment. **K2**
CO-5: Students will learn the structure and properties of alloys and composites. **K2**

UNIT-I (08 Lecture)

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. Mechanical Properties and its measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT-II (08 Lecture)

Alloys, substitutional and interstitial solid solutions- Hume-Rothery Rule, Phase diagrams: Interpretation of binary phase diagrams and micro-structure development; Lever Rule, eutectic, eutectoid, peritectic, peritectoid and monotectic reactions. Iron and Iron-carbide phase diagram, microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron, High Speed Steel

UNIT-III (08 Lecture)

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons-copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys, Carbon Fibre and alloys, Structure and properties of Graphene Material, Composite Materials, Reinforcement

UNIT-IV (08 Lecture)

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V (08 Lecture)

Creep and failures, Introduction to non-destructive testing (NDT): Visual Inspection, Liquid Penetrate Testing, Magnetic Particle Inspection, Ultra-sonic Testing, Acoustic Testing, Radiography, X-ray Differaction, Eddy Current Testing etc., Material behaviour / properties at a very low (Cryogenics) and high temperature.

Books and References:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. Mechanics of materials by James M. Gere.
5. Introduction to engineering materials by B.K. Agarwal.
6. Physical metallurgy and advanced materials by R.E. Smallman.
7. Engineering mechanics of composite materials by Isaac M. Daniel.
8. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.
9. Introduction to Materials Science For Engineers by Shackelford, 9th edn, 2023, Pearson Education
10. Engineering Materials: Properties and Selection, 9edn by Budinski, Pearson Education

BME351- FLUID MECHANICS LAB

Course Outcome (CO)		Bloom's Knowledge Level (KL)
	At the end of course , the student will be able to	
CO 1	Understand the principles and performance characteristics of flow and thermal devices.	**K2**
CO 2	Know about the measurement of the fluid properties	**K1**
CO 3	Understand and analyze various properties of fluids	**K3**
CO 4	Evaluate the performance characteristics of fluid/thermal machinery	**K3**
CO 5	Evaluate the velocity and pressure variations in various types of simple flows.	**K3**
	DETAILED SYLLABUS	**0-0-2**

List of Experiments:(At least 8 of the following)

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturi meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vortex flow.

BME352- MATERIALS TESTING LAB

CO-1: Students will be able to perform different destructive and non-destructive testing methods to measure various mechanical properties. **(K2)**
CO-2: Students will be able to analyse the effect of different heat-treatment processes on the Hardness. **(K4)**
CO-3: Students will be able to simulate the material using simulating software / measure the mechanical properties of 3-D printed components. **(K3)**

List of Experiments: (At least 8 of the following)

1. Strength test of a given mild steel specimen on UTM with full details and stress versus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testing machines (this test should be conducted on MS Specimen – prior and after the various heat-treatment processes like Annealing / Normalizing / Hardening etc.; with this, 2 experiments can be designed: one for Annealing or Normalizing and another for Hardening / Tempering).
5. Fatigue test on fatigue testing machine.
6. Creep test on creep testing machine.
7. Study of NDT (non-destructive testing) methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.
8. Modelling of Graphene / any other materials structure using LAMMPs (LAMMPS Molecular Dynamics Simulator) or any other simulation software and studying the mechanical properties.
9. Measurement of mechanical properties (tensile test, compression test, hardness test / flexural test) of specimen made by 3-D printing

BME353- COMPUTER AIDED MACHINE DRAWING-I LAB

Course Outcome (CO)		Bloom's Knowledge Level (KL)
	At the end of course , the student will be able to	
CO 1	Understand and apply 2D software to develop a part model	**K3**
CO 2	Understand about temporary and permanent fasteners	**K2**
CO 3	Understand the need for free hand sketching, Free hand sketching of foundation bolts etc.	**K2**
CO 4	Create assembly drawing of simple machine elements like rigid or flexible coupling	**K3**
CO 5	Create 2D drawings and assemblies of various machine components	**K3**
	DETAILED SYLLABUS	**0-0-2**

UNIT-I

Computer aided drafting (1 drawing) Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Pro-E, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts. Course Outcomes: Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

UNIT-II

Fasteners (2 drawing sheets) Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

UNIT-III

Riveted joints (1 drawing sheet) Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc. Free hand sketching (1 drawing sheet) Introduction, need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

UNIT-IV

Assembly drawing (2 drawing sheets) Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.

Books and References:

1. Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.
3. Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.
5. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
6. Engineering Drawing, Pathak, Wiley.
7. Textbook of Machine Drawing, K C John, PHI.
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY
9. Engineering Drawing, 2nd edn by Shah & Rana
10. Fundamentals of Engineering Drawing, 11th edn by Warren J. Luzadder, Pearson Education

SEMESTER-IV
BME401- APPLIED HERMODYNAMICS

Objectives:
CO1: To learn about Air Standard Cycle.
CO2: To learn about of I law for reacting systems and heating value of fuels.
CO3: To learn about gas and vapor cycles
CO4: To learn about gas dynamics of air flow and steam through nozzles.
CO5: To analyze the performance of steam turbines.

UNIT I
Introduction to Air Standard Cycle- Otto, Diesel and Dual cycles and analysis, Introduction to Turbocharger & Supercharger.

UNIT II
Vapour Power cycles:
Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.
Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III
Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.
Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV
Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.
Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V
Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Course Outcomes:
- After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
- They will be able to understand phenomena occurring in high speed compressible flows.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, Mcgraw hill India.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kear

BME402- ENGINEERING MECHANICS & STRENGTH OF MATERIAL

Course Outcomes: The student will be able to		Bloom's Taxonomy
CO1	Understand the force systems and application of force equilibrium to various two-dimensional problems.	**K3**
CO2	Understand the concept of stress and strain under different loading conditions.	**K3**
CO3	Determine the principal stresses and strains in structural members	**K3**
CO4	Understand and determine the stresses, slope, and deflection of the transversely loaded members	**K3**
CO5	Apply the concepts of stresses and strain in solving problems related to springs, buckling of columns and thin and thick cylinders.	**K3**

Unit I (10 Hours)

Introduction: Review of two-dimensional force systems, free body diagram, equilibrium of force systems, laws of friction, equilibrium analysis of simple systems involving friction.

Trusses: Introduction, simple truss and solution of a simple truss, methods of joints, methods of sections.

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Unit II (8 Hours)

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, concept and importance of principal moment of inertia.

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stress on inclines sections, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, theories of failure, strain energy, impact loads and stresses, thermal Stresses, introduction to three-dimensional stresses.

Unit III (8 Hours)

Stresses in Beams: Pure Bending, normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Differential equation of the elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams.

Torsion: Torsion, combined bending and torsion of solid and hollow shafts, torsion of thin-walled tubes.

Unit IV (8 Hours)

Helical and Leaf Springs: Deflection of springs, helical springs under axial load and under axial twist (for circular cross sections), axial load and twisting moment acting simultaneously both for open and closed coiled springs, concept of laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin-ended columns, effect of end conditions on column buckling, Ranking Gordon formulae.

Unit V (8 Hours)

Thin cylinders & spheres: Introduction, difference between thin-walled and thick-walled pressure vessels, thin-walled spheres and cylinders, hoop and axial stresses and strain, and volumetric strain.

Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shafts and cylinders, stresses due to interference fits.

Books:

1. Bansal, A Textbook of Engineering Mechanics, Laxmi Publications.
2. Bhavikatti and Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers.
3. Meriam and Kraige, "Engineering Mechanics- Statics - Volume 1, 3ed., John Wiley & Sons.
4. Gupta S C, Strength of Materials, Pearson Education
5. Jindal, Strength of Materials, Pearson Education
6. Hibbeler, Mechanics of Materials, Pearson education.
7. Gere, Mechanics of Materials, Cengage learning.
8. Bere, Johnston, Mechanics of Materials, McGraw Hill.
9. Pytel, Mechanics of Materials, Cengage learning
10. Engineering Mechanics, Manoj, K. Harbola, Cengage learning
11. Strength of Material, J.K.Gupta, S.K.Gupta, Cengage learning

BME403- MANUFACTURING PROCESSES

CO-1 : Students will learn the various conventional manufacturing processes / casting and forming processes. **K2**
CO-2 : Students will understand the concepts of metal cutting and CNC machining. **K2**
CO-3 : Students will comprehend the knowledge of grinding and super finishing processes. **K2**
CO-4 : Students will understand the concepts of metal joining processes. **K2**
CO-5 : Students will learn the concepts of unconventional machining processes. **K2**

UNIT-I (08 Lecture)
Conventional Manufacturing processes:
Casting and moulding: Metal casting processes and equipment, Types of Patterns and Pattern Allowance, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending), principles of powder metallurgy.

UNIT-II (08 Lecture)
Metal cutting:
Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes,
Introduction to CNC machining, Additive manufacturing, Rapid prototyping and rapid tooling

UNIT-III (08 Lecture)
Grinding & Super finishing:
Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding.
Super finishing: Honing, lapping and polishing.

UNIT-IV (08 Lecture)
Metal Joining (Welding):
Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes, Survey of welding and allied processes., Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Weld decay in HAZ.

UNIT-V (08 Lecture)
Unconventional Machining Processes:
Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

BME451- APPLIED THERMODYNAMICS LAB

Objectives:

CO1: To understand the principles of various boilers: **K2**
CO2: To understand the basic principles IC engines and determination of various performance parameters of IC Engines: **K3**
CO3: To understand the principles of steam engine and Steam & Gas Turbine: **K2**

List of Experiments: (At least 8 of the following)

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

BME452- MANUFACTURING PROCESSES LAB

CO-1 : Students will be able to make the component using casting and finishing methods. **K2**
CO-2 : Students will be able to make the component using metal cutting / unconventional machining methods. **K2**
CO-3 : Students will be able to make the component using metal joining processes. **K2**

List of Experiments: (At least 8 of the following along-with study of the machines/processes)

1. Making of Pattern (Wax / Wooden)
2. Preparation of Mould and Casting
3. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
4. Bolt (thread) making on Lathe machine.
5. Tool grinding (to provide tool angles) on tool-grinder machine.
6. Gear cutting on Milling machine.
7. Finishing of a surface on surface-grinding machine.
8. Drilling holes on drilling machine and study of twist-drill.
9. Study of different types of tools and its angles & materials.
10. Experiment on tool wear and tool life.
11. Experiment on jigs/Fixtures and its uses.
12. Gas welding experiment.
13. Arc welding experiment.
14. Resistance welding experiment.
15. Soldering & Brazing experiment.
16. Experiment on Unconventional Machining (any one among - Laser Cutting, CO2 Cutting, ECM, EDM etc.)

BME453- COMPUTER AIDED MACHINE DRAWING-II LAB

Course Outcome (CO)		Bloom's Knowledge Level (KL)
	At the end of course , the student will be able to	
CO 1	Understand and apply 3D software to develop a part model	**K3**
CO 2	Understand conventional representation of machine components, and welded joints	**K2**
CO 3	Understand and apply the basis of fit or limit system	**K3**
CO 4	Understand about Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box.	**K2**
CO 5	Create 3D part models and assemblies of various machine components	**K3**
	DETAILED SYLLABUS	**0-0-2**

Unit I

Introduction to Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).

Unit II

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Unit III

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. List of Standard Abbreviation used.

Unit IV

Part Modelling & Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Note: All drawing conforms to BIS Codes.

Books and References:

1. Textbook of Machine Drawing, K C John, PHI.
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria& Sons.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications.
5. Engineering Graphics with AutoCAD, Bethune, PHI.
6. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.
8. Autodesk Inventor by Examples, Sam Tikoo, Wiley.