AJ Institute of Engineering and Technology
Mangaluru.

VTU Question Papers

Mechanical Engineering
III to VIII Semester
2022 SCHEME

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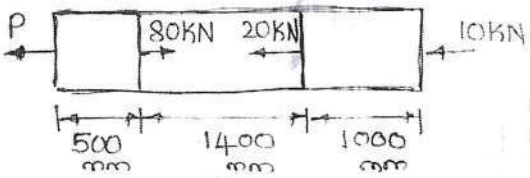
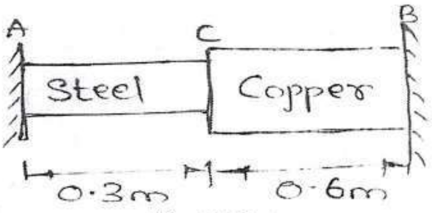
CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME301**

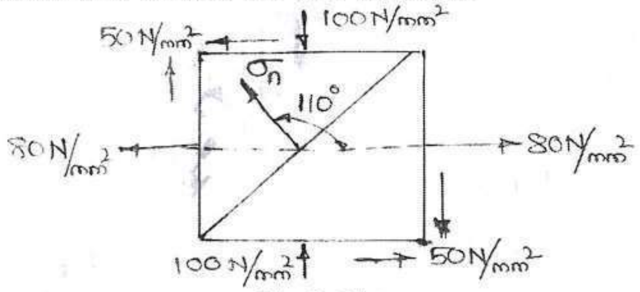
Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	State Hooke's law. Draw a neat diagram of stress-stain curve for mild steel and mark the salient points and zones.	5	L2	CO1
	b.	Derive an expression for elongation in a tapered bar of circular cross section, subjected to an axial tensile load "F".	7	L3	CO1
	c.	A brass bar having uniform cross-section area of 300mm^2 is subjected to a load as shown in Fig.1(c). Find the total elongation of bar and the magnitude of load "P" if, E = 84GPa.  Fig.Q.1(c)	8	L3	CO1
		OR			
Q.2	**a.**	Define the following: i) Poisons ratio ii) Bulk modulus iii) Factor of safety iv) True stress v) Hardness.	5	L2	CO1
	b.	A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G, K.	7	L3	CO1
	c.	A stepped bar is fixed at its two ends rigidly. The bar is free from stresses when its temperature is 30°C. When the temperature is increased to 90°C, determine: i) Stresses induced in copper and steel portions. ii) Displacement at the junction point "C". Take $E_c = 100GPa$, $E_s = 200GPa$, $\alpha_c = 1.8 \times 10^{-5}/°C$ and $\alpha_s = 1.2 \times 10^{-5}/°C$, $A_s = 80mm^2$, $A_c = 120mm^2$.  Fig.Q.2(c)	8	L3	CO1

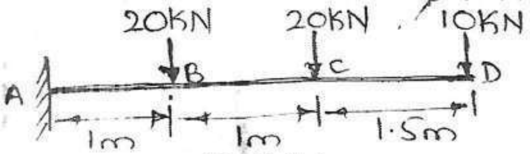
Module – 2

Q.3	a.	Define: i) Principal plane ii) Principal stress iii) Maximum shear stress iv) Plane of maximum shear.	8	L2	CO2
	b.	An element with the stresses acting on it is shown in Fig.Q.3(b), by Mohr's circle method find: i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis ii) Principal stresses and their locations. iii) Maximum shear stresses and their locations.  Fig.Q.3(b)	12	L3	CO2

OR

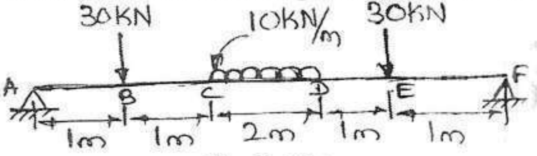
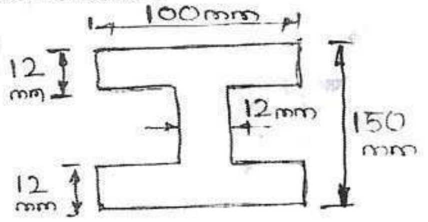
Q.4	a.	Derive expressions for circumferential and longitudinal strains in thin cylinder. Hence show that volumetric strain is $\epsilon = \frac{pd}{4tE}(5-4\gamma)$	8	L3	CO2
	b.	A cast iron pipe has 200mm internal diameter and 50mm metal thickness. It carries water at a pressure of 5N/mm^2. Calculate the intensities of circumferential and radial pressures. Sketch the stress distribution across the section.	12	L3	CO2

Module – 3

Q.5	a.	Discuss about different types of beams and loads.	6	L2	CO3
	b.	Obtain a relation between load intensity, shear force and bending moment.	6	L3	CO3
	c.	Draw the BMD and SFD for cantilever shown in Fig.Q.5(c).  Fig.Q.5(c)	8	L3	CO3

OR

Q.6	a.	Define: i) Point of contraflexure ii) Bending moment iii) Shear force.	6	L2	CO3

	b.	A simply supported beam is shown in Fig.Q.6(b). Draw the SFD and BMD  Fig.Q.6(b)	**14**	L3	**CO3**
		Module – 4			
Q.7	**a.**	List the assumptions made in theory of pure bending. Derive the bending equation with usual notations.	**10**	L3	**CO4**
	b.	A simply supported beam of 5m span has a cross-section 150mm × 250mm. If the permissible stress is 10N/mm^2. Find: i) Maximum UDL intensity ii) Maximum concentrated load "P" at 2m from one end.	**10**	L3	**CO4**
		OR			
Q.8	**a.**	A uniform I-section beam is subjected 100kNm bending moment. Plot the stress variation across the section.  Fig.Q.8(a)	**10**	L3	**CO4**
	b.	A cantilever of square section 200mm × 200mm and length 2m, fails in flexure when 12kN is placed at free end. A rectangular beam of same material and simply supported over length of 3m, 150mm wide and depth 300mm. Calculate minimum central concentrated load required to break the beam.	**10**	L3	**CO4**
		Module – 5			
Q.9	**a.**	Derive torsion equation. Also list the assumptions.	**10**	L3	**CO5**
	b.	Find the shaft diameter required to transmit 60kW at 150rpm, if maximum torque is 25% more than mean torque for a maximum shear stress of 60MPa. Find angle of twist for a 4m length. Take, G = 80GPa.	**10**	L3	**CO5**
		OR			
Q.10	**a.**	Derive an expression for critical load in a column subjected to compressive load, when one end fixed and other free.	**10**	L3	**CO5**
	b.	A 1.5m long column has a circular cross-section of 50mm diameter. One end of column is fixed and other end is free. Taking FOS = 3. Calculate safe load using i) Rankines formula, yield stress 560N/mm^2 and a $\frac{1}{1600}$ ii) Eulers formula, E = 120GPa.	**10**	L3	**CO5**

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CBCS SCHEME

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BME302

Third Semester B.E./B.Tech Degree Examination, Dec.2023/Jan.2024

Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define a gating system. Explain with sketches types of gating system.	10	L1	CO1
	b.	Explain with a neat sketch CO_2 moulding process.	10	L2	CO1
		OR			
Q.2	a.	Define pattern and explain with a neat sketches any four pattern allowances.	10	L1	CO1
	b.	Explain in detail the procedure to determine grain fineness number of greens and in foundry lab.	10	L2	CO1
		Module – 2			
Q.3	a.	Explain with a neat sketch coreless induction furnace.	10	L2	CO2
	b.	Explain with a neat sketch cupola furnace.	10	L2	CO2
		OR			
Q.4	a.	Explain with a neat sketch centrifugal casting process.	10	L2	CO2
	b.	Explain with neat sketches casting defects.	10	L2	CO2
		Module – 3			
Q.5	a.	Illustrate the following metal forming processes with neat sketches : i) Bending ii) Piercing iii) Blanking.	10	L2	CO3
	b.	Explain the following yield criteria : i) Tresca yield criteria ii) Von-Mises yield criteria.	10	L2	CO3
		OR			
Q.6	a.	Describe compound and progressive die processes.	10	L2	CO3
	b.	Explain the importance of temperature in metal forming and write the differences between hot working and cold working.	10	L2,1	CO3
		Module – 4			
Q.7	a.	Explain with neat sketches types of flames produced in OXY-Acetylene welding.	10	L2	CO4
	b.	Explain with a neat sketch OXY-Acetylene gas welding process.	10	L2	CO4
		OR			
Q.8	a.	Explain with a neat sketch MIG welding and mention its advantages, disadvantages and applications.	10	L2	CO4
	b.	Explain with a neat sketch Manual metal arc welding and also mention its advantages, disadvantages and applications.	10	L2	CO4
		Module – 5			
Q.9	a.	Explain with neat sketches welding defects.	10	L2	CO5
	b.	Explain with a neat sketch residual stresses in welded structures.	10	L2	CO5
		OR			
Q.10	a.	Describe the following : i) Soldering ii) Brazing.	10	L2	CO5
	b.	Explain with a neat sketch resistance welding process.	10	L2	CO5

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME303

Third Semester B.E./B.Tech Degree Examination, Dec.2023/Jan.2024

Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Calculate the APF for FCC and BCC unit cell in crystal structure.	**10**	**L3**	**CO1**
	b.	Enumerate the type of crystal imperfections and explain briefly with a suitable sketch grain boundary and twin boundry defects.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain briefly with suitable sketches the plastic deformation by Slip and Twinning.	**10**	**L2**	**CO1**
	b.	Define the following terms : i) Unit cell and space lattice ii) Coordination number.	**5**	**L2**	**CO1**
	c.	Molybdenum has BCC and a density of 10.2×10^3 kg/m^3. Calculate its atomic radius. The atomic weight of molybdenum is 95.94gm/mol. $N_A = 6.023 \times 10^{23}$ atoms/mol.	**5**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Draw neatly the solid solution binary phase diagram of a Ni-Cu system and explain briefly.	**10**	**L2**	**CO2**
	b.	State and explain briefly the Fick's 1st and 2nd law of diffusion.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain briefly with a neat sketch the eutectic system of two components completely soluble in liquid state and partially soluble in solid state.	**08**	**L2**	**CO2**
	b.	Draw a neat sketch of iron-carbon equilibrium diagram and show all phases on the diagram also show the three invariant reactions.	**12**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Explain briefly mechanism of solidification with suitable sketches.	**10**	**L2**	**CO3**
	b.	With a suitable sketch explain normalizing heat treatment process.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Draw a neat labeled Time-Temperature Transformation [TTT] diagram for Eutectoid steel (0.8%C) and explain briefly.	**10**	**L3**	**CO3**
	b.	With a neat sketch briefly explain Aaustemperign and Martempering heat treatment process.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	With a flow chart, explain briefly the powder metallurgy process and its applications.	**10**	**L2**	**CO4**
	b.	Enumerate the different powder production methods, with suitable sketch explain atomization method.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Explain briefly thermal spray coating with suitable sketch. Mention the advantages of surface coatings and treatments.	**10**	**L2**	**CO4**
	b.	Advantages and limitations of powder metallurgy process.	**10**	**L2**	**CO4**

		Module – 5			
Q.9	**a.**	Classify engineering metals. Enumerate the types of cast iron and mention the compositions, properties and applications.	**10**	**L2**	**CO5**
	b.	With a neat sketch, explain the production of composite by : i) Filament winding process ii) Bag molding process.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	With a suitable sketch explain the production of metal metric composite by stir casting process.	**10**	**L2**	**CO5**
	b.	What are the factors affecting the selection of materials explain briefly.	**10**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME304**

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of thermodynamic data handbook and steam tables is permitted.
4. Assume missing data suitably.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	State Zeroth law of thermodynamics and justify how it forms the basis for temperature measurement.	**05**	**L1**	**CO1**
	b.	Derive an expression for P-dV work for a process in which (i) PV = C (ii) $PV^n = C$ where C is a constant.	**05**	**L2**	**CO1**
	c.	The temperature scale by a certain thermometer is given by the relation $t = a \ln x + b$ where 'a' and 'b' are constants and x is the thermometric property of the fluid in the thermometer. If at ice and steam points the thermometric property is found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property 3.5?	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Show that thermodynamics definition for work is superior to mechanics definition.	**05**	**L1**	**CO1**
	b.	With a neat sketch, explain working principle of constant volume gas thermometer.	**05**	**L2**	**CO1**
	c.	A perfect gas is undergoing a process in which $T \alpha V^{2.5}$. Calculate the work done by the gas in going from state 1 in which the pressure is 100 bar and volume is 4 m^3 to the state 2 in which volume is 2 m^3. Also calculate the final pressure.	**10**	**L4**	**CO1**
		Module – 2			
Q.3	**a.**	State the first law of thermodynamics along with the mathematical expression for the following: (i) A closed system undergoing a cycle (ii) A closed system undergoing a change of state.	**05**	**L1**	**CO2**
	b.	With a neat sketch of steady flow device, write the steady flow energy equation with usual notations.	**05**	**L1**	**CO2**
	c.	A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15 m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas change?	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Write the steady flow energy equation for (i) Boiler (ii) Centrifugal pump.	**05**	**L1**	**CO2**
	b.	Show that energy is a property of the system.	**05**	**L2**	**CO2**
	c.	In a certain steady flow process, 12 kg of fluid per minute enters at a pressure of 1.4 bar, density 25 kg/m^3, velocity 120 m/s and internal energy 920 kJ/kg. The fluid properties at exit are 5.6 bar, density 5 kg/m^3, velocity 180 m/s, and internal energy 720 kJ/kg. During the process, the fluid rejects 60 kJ/s of heat and rises through 60 m. Determine work done during the process in KW.	**10**	**L4**	**CO2**

Module – 3					
Q.5	**a.**	Define thermal efficiency of a heat engine and COP of a refrigerator along with mathematical expressions for both. Write their schematic diagram.	**05**	**L1**	**CO3**
	b.	Define entropy and show that it is a property of the system.	**05**	**L2**	**CO3**
	c.	A reversible heat engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. Find the temperature of the source and the sink.	**10**	**L4**	**CO3**
OR					
Q.6	**a.**	State and prove Clausius theorem.	**05**	**L2**	**CO3**
	b.	Give the Kelvin-Plank and Clausius statements of the second law of thermodynamics.	**05**	**L1**	**CO3**
	c.	A lump of steel of mass 10 kg at 627°C is dropped in 100 kg of oil at 30°C. The specific heats of steel and oil are 0.5 kJ/kgK and 3.5 kJ/kgK respectively. Calculate the entropy change of steel, the oil and the universe.	**10**	**L3**	**CO3**
Module – 4					
Q.7	**a.**	Define Available Energy (AE) and Unavailable Energy (UE). Show that unavailable energy is the product of lowest temperature of heat rejection and the change in entropy of the system during the process of supplying heat. Draw the necessary schematics and T-S diagrams.	**10**	**L4**	**CO4**
	b.	With a neat sketch, explain the working principle of separating and throttling calorimeter.	**10**	**L2**	**CO4**
OR					
Q.8	**a.**	In a certain process, a vapor, while condensing at 420°C, transfers heat to water evaporating at 250°C. The resulting steam is used in a power cycle which rejects heat at 35°C. What is the fraction of the available energy in the heat transfer process from the vapour at 420°C that is lost due to the irreversible heat transfer at 250°C?	**10**	**L3**	**CO4**
	b.	Draw the phase equilibrium diagram for a pure substance on P-T coordinates and show the fusion curve, vaporization curve, sublimation curve, triple point and critical point.	**10**	**L2**	**CO4**
Module – 5					
Q.9	**a.**	Write notes on: (i) Daltons law of partial pressure (ii) Amagots law of additive volumes (iii) Compressibility factor (iv) Law of corresponding states (v) Generalized compressibility chart	**10**	**L2**	**CO5**
	b.	One kg of ideal gas is heated from 50°C to 150°C. Determine: (i) Change in internal energy (ii) Change in enthalpy (iii) Change in flow energy (iv) $\overline{C}_V$ and $\overline{C}_P$ Take R = 280 kJ/kgK; $\gamma = 1.32$ for gas.	**10**	**L3**	**CO5**
OR					
Q.10	**a.**	Derive: (i) Maxwell's equations (ii) The first and second Tds equations.	**10**	**L2**	**CO5**
	b.	Find the gas constant and apparent molar mass of a mixture of 2 kg O_2 and 3 kg N_2 given that the universal gas constant is 8314.3 J/kgK, molar mass of O_2 and N_2 are respectively 32 and 28.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN

BME306D

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

Waste Handling and Management

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Waste Management. Explain the importance and objectives of waste management.	**10**	**L2**	**CO1**
	b.	Identify the human and technological components of waste management. Illustrate with an example.	**10**	**L3**	**CO2**
		OR			
Q.2	**a.**	State and explain the environmental aspects of waste collection system.	**10**	**L2**	**CO1**
	b.	How do you create awareness for public about waste management? Analyze with an example.	**10**	**L3**	**CO2**
		Module – 2			
Q.3	**a.**	Explain the different types of solid wastes and compare about their recycling methods.	**10**	**L2**	**CO3**
	b.	What are the primary methods used in the processing and treatment of solid wastes and how do they contribute environmental sustainability? Provide examples to analyze the methods.	**10**	**L3**	**CO4**
		OR			
Q.4	**a.**	Explain the process of composting as a method for managing solid waste. Identify its potential challenges or limitations.	**10**	**L3**	**CO3**
	b.	Discuss the fundamental principles behind gasification process, its advantages in waste treatment compared to traditional methods.	**10**	**L3**	**CO4**
		Module – 3			
Q.5	**a.**	What is Industrial Waste? Explain the different types of industrial waste.	**10**	**L2**	**CO2**
	b.	What is plastic pollution? Enumerate the sources of plastic pollution.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Explain the sources of bio-medical waste and analyze the problems associated with it.	**10**	**L3**	**CO3**
	b.	Write a short note on E-waste collection and its disposal.	**10**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Explain the remedial action for the hazardous waste contaminated sites.	**10**	**L2**	**CO2**
	b.	Briefly discuss about the entrepreneurship activities for waste management.	**10**	**L2**	**CO3**
		OR			
Q.8	**a.**	Waste management and waste handling entrepreneurs in India have important role. Explain with a case study.	**10**	**L3**	**CO3**
	b.	With a case study, compare the domestic composting and centralized composting.	**10**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Briefly explain Environmental Protection Act, Hazardous Waste Rules 2008.	**10**	**L3**	**CO4**
	b.	Explain briefly the Plastic Waste Rules, 2011.	**10**	**L2**	**CO3**
		OR			
Q.10	 **a.** **b.**	Write short notes the following: Biomedical Waste Rule 1998 b. The Batteries Rules 2011 Duties of Constitutional Bodies d. E-Waste Rules 2011	**20**	**L2**	**CO2**

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CBCS SCHEME

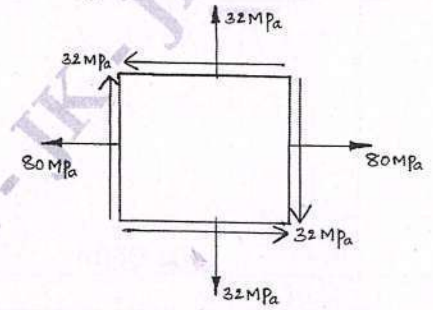
USN ☐☐☐☐☐☐☐☐☐☐ **BME301**

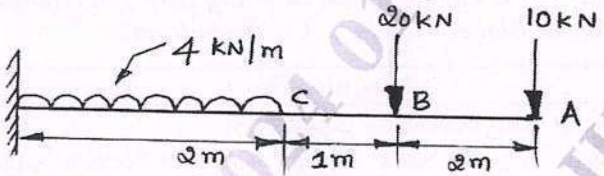
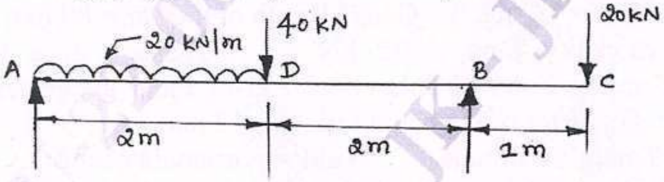
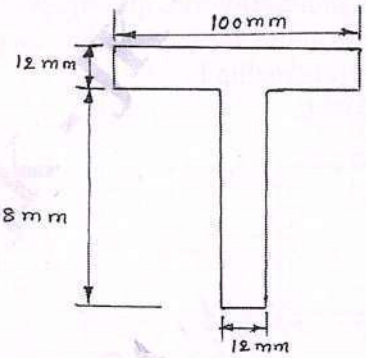
Third Semester B.E./B.Tech. Degree Examination, June/July 2024

Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following with necessary equations: (i) Normal stress (ii) Shear stress (iii) Poisson's ratio (iv) Young's modulus (v) Thermal stress	**10**	**L1**	**CO1**
	b.	The tensile test was conducted on a mild steel bar. The following was obtained from the test: Diameter of steel bar = 16 mm ; Gauge length of the bar = 80 mm ; Load at proportionality limit = 72 kN ; Extension at a load of 60 kN = 0.115 mm ; Load at failure = 80 kN ; Final gauge length of bar = 104 mm ; Diameter of the bar at failure = 12 mm Determine: (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage elongation (v) Percentage decrease in area	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Write the relation between the following with usual notations and meaning: (i) Modulus of elasticity and bulk modulus (ii) Modulus of elasticity and modulus of rigidity (iii) Modulus of elasticity, modulus of rigidity and bulk modulus	**06**	**L1**	**CO1**
	b.	Define the following: (i) Gradual load (ii) Sudden load (iii) Impact load (iv) Shock load	**04**	**L1**	**CO1**
	c.	Rails laid such that there is no stress in them at 24°C. If the rails are 32 m long, determine: (i) The stress in the rails at 80°C, when there is no allowance for expansion. (ii) The stress in the rails at 80°C, when there is an expansion allowance of 8 mm per rail (iii) The expansion allowance for no stress in the rails at 80°C. Take $\alpha = 11 \times 10^{-6}/°C$, E = 205 GPa.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Derive the expression for normal stress and shear stress on a plane inclined at 'θ' angle to the vertical axis in a biaxial stress system with shear stress.	**10**	**L2**	**CO2**
	b.	For the two-dimensional stressed element, shown in Fig.Q3(b), determine the value of: (i) Maximum and minimum principal stress (ii) Principal planes (iii) Maximum shear stress and its plane Verify the answer's by Mohr's circle method  Fig.Q3(b)	**10**	**L3**	**CO2**

		OR			
Q.4	**a.**	Derive an expression for circumferential stress and longitudinal stress for a thin cylinder subjected to an internal pressure 'P'.	**10**	**L2**	**CO2**
	b.	A thick cylinder of internal diameter 160 mm is subjected to an internal fluid pressure of 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2, find the required wall thickness of the cylinder.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Draw the shear force and bending moment diagrams for the cantilever shown in Fig.Q5(a).  Fig.Q5(a)	**10**	**L4**	**CO3**
	b.	Draw the bending moment and shear force diagram for the overhanging beam shown in Fig.Q5(b). Clearly indicate the point of contraflexure.  Fig.Q5(b)	**10**	**L4**	**CO3**
		OR			
Q.6		A simply supported beam of 7m span with overhangs rests on supports which are 4m apart. The left end overhang is 2 m. The beam carries loads of 30 kN and 20 kN on the left and the right ends respectively apart from a uniformly distributed load of 25 kN/m between the supporting points. Draw the shear force and bending moment diagrams. Locate point of contraflexure if any.	**20**	**L4**	**CO3**
		Module – 4			
Q.7	**a.**	Derive the bending equation in the form of $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$.	**10**	**L2**	**CO4**
	b.	A square beam 20 mm × 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3 m long?	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Derive an expression for section modulus of solid rectangular and circular sections.	**10**	**L2**	**CO4**
	b.	Fig.Q8(b) shows the cross-section of a beam which is subjected to a shear force of 20 kN. Draw the shear stress distribution across the depth making values at salient points.  Fig.Q8(b)	**10**	**L3**	**CO4**

		Module – 5			
Q.9	**a.**	Define the following with necessary equations: (i) Torque (ii) Polar modulus (iii) Torsional rigidity	**06**	**L1**	**CO5**
	b.	State the assumptions made in theory of torsion.	**04**	**L1**	**CO5**
	c.	Derive torsion equation in the form of $\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Define the following: (i) Column (ii) Buckling load (iii) Slenderness ratio (iv) Long column (v) Short column	**10**	**L1**	**CO5**
	b.	Derive an expression for Euler buckling load when both ends of the column are fixed.	**10**	**L2**	**CO5**

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CBCS SCHEME

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BME302

Third Semester B.E./B.Tech. Degree Examination, June/July 2024
Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Casting. List the steps involved in making a sand casting.	4	L1	CO1
	b.	Briefly discuss the importance of binders and additives in sand moulding.	8	L2	CO2
	c.	Enlist and explain in detail various allowances given to the pattern and reasons to provide the allowances.	8	L2	CO2
		OR			
Q.2	**a.**	Differentiate between gravity and pressure die casting.	4	L1	CO1
	b.	With a neat sketch, explain the working of the Jolt machine.	8	L2	CO2
	c.	With a neat sketch, explain continuous casting process and mention its merits and demerits.	8	L2	CO2
		Module – 2			
Q.3	**a.**	List and explain in brief the four types of furnaces classification.	6	L2	CO3
	b.	Explain with a neat sketch of working of coreless induction furnace.	6	L2	CO3
	c.	With a neat sketch, explain the different zones present in CUPOLA furnace.	8	L2	CO3
		OR			
Q.4	**a.**	Give the differences between direct arc electric furnace and indirect arc electric furnace.	8	L1	CO3
	b.	With a neat sketch, explain centrifuge casting. State the advantages and disadvantages of centrifugal casting.	12	L2	CO3
		Module – 3			
Q.5	**a.**	Give the detailed relationship between stress strain.	6	L1	CO1
	b.	Enumerate the concept of annealing with sketch.	6	L2	CO3
	c.	Differentiate between soldering and brazing with respect to joint strength and give its applications?	8	L2	CO3

		OR			
Q.6	**a.**	Give the detailed classification of metal forming process.	**4**	**L1**	**CO1**
	b.	With the help of neat sketch explain blanking process.	**6**	**L2**	**CO3**
	c.	With the help of the neat sketch, explain V-bending and edge bending operation.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Sketch and explain tig welding process. Mention its advantages, disadvantages and applications.	**12**	**L2**	**CO3**
	b.	With the help of neat sketch explain oxyacetylene welding.	**8**	**L2**	**CO3**
		OR			
Q.8	**a.**	Explain with neat sketch submerged arc welding process and its applications.	**10**	**L2**	**CO4**
	b.	Explain with neat sketch laser welding and mention its advantages and disadvantages.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following: i) Residual stress in welding ii) Distortion in welding iii) Shrinkage in welding.	**10**	**L2**	**CO4**
	b.	With a neat sketch, explain the friction stir. Discuss the advantages and disadvantages.	**10**	**L2**	**CO4**
		OR			
Q.10	**a.**	List and explain welding defects and remedies.	**10**	**L2**	**CO4**
	b.	Explain the concept of weldability and the thermal effects.	**10**	**L2**	**CO4**

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CBCS SCHEME

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BME303

Third Semester B.E./B.Tech. Degree Examination, June/July 2024

Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	List the three primary classifications of solid materials. Explain briefly the distinctive chemical features of each.	**06**	**L2**	**CO1**
	b.	Classify and briefly explain primary atomic bonds.	**08**	**L2**	**CO1**
	c.	Define unit cell of a crystal lattice. Name and sketch the various crystal structures (unit cells) commonly present in materials. Show the value of edge length (a).	**06**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain the following terms related to crystal structure: (i) Size of unit cell (ii) Coordination number (iii) Atomic packing factors	**06**	**L2**	**CO1**
	b.	Determine the Atomic Packing Factor (APF) for FCC structure (Unit Cell).	**08**	**L2**	**CO1**
	c.	Classify and briefly explain crystal lattice imperfections.	**06**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the term diffusion. State and briefly explain the various types of diffusion mechanisms.	**08**	**L2**	**CO2**
	b.	State and explain Fick's laws of diffusions.	**08**	**L2**	**CO2**
	c.	State and explain any two factors that influence diffusion process.	**04**	**L3**	**CO2**
		OR			
Q.4	**a.**	Define the following : i) Phase ii) Phase diagram iii) Phase equilibrium iv) Solubility limit.	**04**	**L2**	**CO2**
	b.	Explain 'Lever rule' for the construction of phase diagram.	**06**	**L2**	**CO2**
	c.	Name and explain the three invariant reactions that take place in Fe-Fe$_3$C phase diagram.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Name and explain the various mechanisms by which the nucleation of solid particles in liquid metal occurs.	**10**	**L2**	**CO3**
	b.	Explain with suitable diagrams the process of precipitation hardening.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Explain briefly the following heat treatment processes : (i) Annealing (ii) Normalizing (iii) Tempering (iv) Nitriding	**16**	**L2**	**CO3**
	b.	What do you understand by critical radius for nucleation?	**04**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Classify the various surface coating techniques used in surface engineering.	**04**	**L1**	**CO4**
	b.	Briefly explain Chemical Vapour Deposition (CVD).	**10**	**L2**	**CO4**
	c.	Write a note on Lubrication and binders.	**06**	**L1**	**CO4**
		OR			
Q.8	**a.**	Briefly explain the powder-metallurgy process using flow chart.	**08**	**L2**	**CO4**
	b.	State and briefly explain the various methods of atomization processes used for preparing the metallic powder.	**12**	**L2**	**CO4**

		Module – 5			
Q.9	**a.**	What is the Chemical Composition of grey cast iron? Show the microstructure by stating the various properties and uses of grey cast iron.	**06**	**L2**	**CO5**
	b.	Name the various alloying elements and their influence over steel alloys.	**08**	**L2**	**CO5**
	c.	How are copper alloys classified? Designate and state the properties and uses of copper alloys.	**06**	**L2**	**CO5**
		OR			
Q.10	**a.**	How composite materials are classified. State their constituents used.	**06**	**L2**	**CO5**
	b.	Name and briefly explain the various types of fibers and matrix materials used for Fiber Reinforces Plastics (FRP).	**08**	**L2**	**CO5**
	c.	Explain the process of obtaining Material data.	**06**	**L2**	**CO5**

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CBCS SCHEME

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BME304

Third Semester B.E./B.Tech. Degree Examination, June/July 2024

Basic Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of the thermodynamic data book is permitted.

		Module – 1	M	L	C
Q.1	a.	Define Zeroth law of thermodynamics.	2	L1	CO1
	b.	With neat diagram, explain the working of constant volume gas thermometer for measurement of temperature.	8	L1	CO1
	c.	Two Celsius thermometers A and B agree at Ice Point and Steam point and the related equation is $T_A = L + MT_B + NT_B^2$, wehre L, M and N are constants. When both thermometers are immersed in fluid A reads 26°C while B reads 25°C. Determine the reading of A when B reads 37.4°C.	10	L3	CO1
		OR			
Q.2	a.	Distinguish between heat and work in Thermodynamics.	4	L1	CO1
	b.	Derive an expression for the non-flow displacement work done during adiabatic process given by $PV^\gamma = C$. To a closed system 150 kJ of work is done on it.	6	L2	CO1
	c.	If the initial volume is 0.6 m^3 and pressure of system varies as follows $P = (8 - 4V)$ where P is pressure in bar and V is volume in m^3. Determine the final volume and pressure of the system.	10	L3	CO1
		Module – 2			
Q.3	a.	Show that energy is a property of the system. Define the specific heats at constant volume and constant pressure.	10	L2	CO2
	b.	A piston and cylinder machine contains a fluid system, which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is -170kJ. The system completes 100 cycles per min. Complete the following table showing the method for each item, and compute the net rate of work output in KW.	10	L3	CO2

Process	Q (KJ/min)	W(KJ/min)	$\Delta E(KJ/min)$
a – b	0	2,170	-
b – c	21,000	0	-
c – d	-2,100	-	-36,600
d – a	-	-	-

		OR	M	L	C
Q.4	a.	Apply steady flow energy equation to each of the following : (i) Boiler (ii) Nozzle (iii) Centrifugal pump	6	L3	CO2

	b.	Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure and 0.95 m^3/kg volume and leaving at 5 m/s, 700 KPa and 0.19 m^3/kg. The internal energy of the air leaving 93 kJ/kg greater than that of the air entering cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. Compute the rate of shaft work input to the air in kW.	**7**	**L3**	**CO2**
	c.	Steam at rate of 0.42 kg/s and enthalpy of 2785 KJ/kg and a velocity of 33.3 m/s is supplied to a steadily operating turbine. The steam leaves the turbine at 100 m/s and an enthalpy of 2512 kJ/kg. The Inlet pipe is 3 m above the exit pipe. Rate of heat loss from the turbine casing is 0.29 kJ/s. What is the power output of the turbine?	**7**	**L3**	**CO2**
Module – 3					
Q.5	**a.**	State the Kelvin-Planck and Clausius statements of II law of thermodynamics. Show that Kelvin-Planck statement is equivalent to Clausius statement.	**10**	**L1**	**CO3**
	b.	Prove that $COP_{Heat\ pump} = 1 + COP_{Refrigerator}$.	**4**	**L2**	**CO3**
	c.	What is thermal energy reservoir? Explain source and sink.	**6**	**L1**	**CO3**
OR					
Q.6	**a.**	Show that entropy is a property of a system.	**6**	**L1**	**CO3**
	b.	State and prove Clausius inequality.	**7**	**L1**	**CO3**
	c.	A heat engine is supplied with 2512 KJ/min of heat at 650°C and the heat rejections takes place at 100°C. The following results were reported : (i) 867 kJ/min of heat rejected. (ii) 1015 kJ/min of heat rejected. (iii) 1494 kJ/min of heat rejected. Classify which of the results report a reversible cycle. Irreversible cycle or Impossible cycle.	**7**	**L3**	**CO3**
Module – 4					
Q.7	**a.**	Define the following : (i) Available energy (ii) Unavailable energy (iii) Effectiveness (iv) Irreversibility	**8**	**L1**	**CO4**
	b.	Air expands through a turbine from 500 KPa 520°C to 100 KPa, 300°C. During expansion 10 kJ/kg of heat is lost to the surroundings which is at 98 KPa, 20°C. Neglecting the kinetic energy and potential energy changes. Determine per kg of air : (i) The decrease in availability (ii) The maximum work (iii) The Irreversibility. For air take $C_p = 1.005$ kJ/kgK, $h = C_pT$ where C_P is constant and T is in degree Kelvin.	**12**	**L3**	**CO4**
OR					
Q.8	**a.**	Define dryness fraction. With a neat sketch, explain the measurement of dryness fraction of steam by using separating and throttling calorimeter.	**8**	**L1**	**CO4**
	b.	Define the following : (i) Pure substance (ii) Triple point (iii) Critical point	**6**	**L1**	**CO4**

	c.	A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy and the entropy.	6	L3	CO4
		Module – 5			
Q.9	a.	State and explain Dalton's law of partial pressure and Amagat's law of additive volumes.	8	L1	CO5
	b.	A mixture of 0.5 kg of CO_2 and 0.3 kg of N_2 is compressed from $P_1 = 1$ atm, $T_1 = 20^\circ$C to $P_2 = 5$ atm in a polytropic process for which n = 1.3. Find, (i) Final temperature (ii) Work (iii) Heat transfer (iv) Change in entropy. Assume C_P for CO_2 is 0.821 kJ/kgK and C_P for N_2 is 1.017 KJ/kgK.	12	L3	CO5
		OR			
Q.10	a.	Explain the following : (i) Compressibility factor (ii) Reduced properties (iii) Law of corresponding states (iv) Generalized compressibility chart.	12	L1	CO5
	b.	One kg of CO_2 has a volume of 1 m^3 at 100°C. Compute the pressure using, (i) Vander Waal's equation (ii) Ideal gas equation.	8	L3	CO5

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME401**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024

Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Steam tables and Thermodynamic data hand book is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	With usual notations obtain an thermal efficiency of otto cycle.	6	L2	CO1
	b.	Define Explosion ration and cut off ratio.	4	L1	CO1
	c.	In a air standard diesel cycle, the compression ratio is 16. At the beginning of isentropic compression, the temperature is 15°C and pressure 0.1 MPa Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate (i) Cutoff ratio (ii) Heat supplied per kg of air (iii) Cycle efficiency (iv) Mean effective pressure.	10	L3	CO1
		OR			
Q.2	**a.**	How Morse test will be carried on a 3 cylinder IC engine?	4	L1	CO1
	b.	Explain the process of combustion in CI engine.	6	L2	CO1
	c.	The following readings were recorded during a trial on a single cylinder 2 stroke diesel engine, power supplied by electric motor = 1.5 kW, rated speed = 500 rpm; net load on brake drum = 225 N; Diameter of brake wheel = 1000 mm; rate of cooling water = 13.65 kg/min ; Change in temperature of cooling water = 10°C; Fuel consumption = 2 kg / hr ; Calorific value of fuel = 43000 kJ/kg ; AF ratio = 32 : 1; Specific heat of gases = 1.006 kJ/kg K ; Exhaust gas temperature = 345°C; Ambient temperature = 25°C and pressure 1 Bar. Considering a square engine of 30 mm bore and stroke length. Determine : (i) Mechanical efficiency (ii) Brake thermal efficiency (iii) Brake specific fuel consumption (iv) Brake mean effective pressure. Also draw the heat balance sheet on % basis.	10	L3	CO1
		Module – 2			
Q.3	**a.**	Derive an expression of air standard efficiency of Joule cycle.	6	L2	CO2
	b.	Enumerate the differences between open and closed cycle gas turbine.	4	L1	CO2
	c.	For an actual gas turbine cycle, show that the optimum pressure ratio for maximum net work output is given by $R_P = \left(\eta_C \eta_T \frac{T_3}{T_1}\right)^{\frac{\gamma}{(2(\gamma-1)}}$.	10	L3	CO2
		OR			
Q.4	**a.**	Explain the working principle of jet propulsion.	3	L2	CO2
	b.	How turboprop engine works explain clearly?	7	L2	CO2
	c.	A jet propelled engine having 2 jets and working on a turbojet has a velocity of 210 m/s. When flying at an altitude of 12000 m. The density of air at this attitude is 0.172 kg/m^3. The resistance of the plane is 6670.8 N and propulsive efficiency of the jet is 50%. The overall efficiency of the unit is 18%, calorific value of the fuel is 4.895×10^4 kJ/kg. Calculate (i) Absolute velocity of jet (ii) Quantity of air compressed per min (iii) Diameter of jet (iv) Power O/P (v) Specific fuel consumption (vi) A : F ratio.	10	L3	CO2

		Module – 3			
Q.5	**a.**	With the help of neat sketch, explain the working of open feed water heater.	**8**	**L2**	**CO3**
	b.	Steam from a boiler enters a turbine at 25 bar and expands to condenser pressure of 0.2 bar. Determine the rankine cycle efficiency by neglecting pump work: (i) When steam is 80% dry at turbine inlet. (ii) When steam is saturated at turbine inlet. (iii) When steam is superheated at turbine inlet by 76.1 °C (iv) Represent above three processes on same TS diagram.	**12**	**L3**	**CO4**
		OR			
Q.6	**a.**	Enumerate the difference between Carnot cycle and Rankine cycle.	**4**	**L1**	**CO3**
	b.	Obtain an expression for air standard efficiency of Ranking cycle.	**6**	**L2**	**CO3**
	c.	The steam is supplied to the turbine at a pressure of 32 bar and temperature of 410 °C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction of steam at the end of expansion and thermal efficiency of cycle. If the steam is reheated at 5.5 bar temperature of 395 °C and then expand isentropically to 0.08 Bar. What will be the dryness fraction and thermal efficiency of cycle?	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	List out the desirable properties of refrigerant.	**4**	**L1**	**CO4**
	b.	Derive an expression for COP of an refrigeration system.	**6**	**L2**	**CO4**
	c.	Atmospheric air at a pressure of 1 Bar and temperature -5 °C, is drawn in the cylinder of the compressor of Bell-Coleman refrigerating machine. The air is compressed isentropically to a pressure of 5 Bar and cooled to 15 °C in the coder at constant pressure. It is then expanded to a pressure of 1 Bar in an expansion cylinder from where it is passed to cold chamber. Calculate the work done/kg of air and COP of the plant. Assume the cycle with isentropic compression with $\gamma = 1.4$ and polytropic expansion with n = 1.2, C_p of air as 1KJ/kgK.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define (i) Sensible cabling (ii) Sensible heating	**4**	**L1**	**CO4**
	b.	How cooling tower plays an important role in air conditioning system?	**6**	**L2**	**CO4**
	c.	40 m^3 of air per minute at 31 °C DBT and 18.5 °C WBT is passed over the cooling coil whose surface temperature is 4.4 °C. The coil cooling capacity is 3.56 Tonnes of refrigeration under the given condition of air. Determine the DBT and WBT of the air leaving the cooling coil and by pass factor.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Why multistage compressors are preffered over a single stage compressor? Also list the advantages of multistage compressors.	**4**	**L2**	**CO5**
	b.	Define (i) Isothermal efficiency (ii) Adiabatic efficiency (iii) FAD	**6**	**L1**	**CO5**
	c.	A multistage compressor is to be designed to elevate the pressure from 1 Bar to 120 Bar such that the stage pressure ratio will not exceed 4. Determine (i) Number of stages (ii) Exact stage pressure ratio (iii) Intermediate pressure (iv) The minimum power required to compress 15 m^3/min of free air. Take n = 1.2	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Define Critical pressure ratio, also with usual notations derive critical pressure ratio.	**10**	**L2**	**CO5**

	b.	A turbine having a set of 16 nozzles receiver steam at 20 Bar and 400 °C. The pressure of the steam at nozzle exit is 12 Bar. If the discharge rate is 260 kg/min and nozzle efficiency is 90%. Calculate the cross sectional area at the nozzle exit. If the steam has a velocity of 80 m/s at entry to the nozzle, find the % increase in discharge.	**10**	**L4**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME402**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024

Machining Science and Metrology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	With a neat sketch, explain the nomenclature of single point cutting tool.	**07**	**L2**	**CO1**
	b.	Explain briefly mechanics of chip formation process.	**06**	**L1**	**CO1**
	c.	The following data refer to an orthogonal cutting process. Chip thickness 0.62 mm, feed 0.2 mm, rake angle 15°. Calculate chip reduction coefficient and shear angle.	**07**	**L3**	**CO1**
		OR			
Q.2	**a.**	With a neat sketch, explain the main parts of a lathe.	**07**	**L2**	**CO1**
	b.	Briefly explain the major differences between capstan and turret lathe.	**06**	**L1**	**CO1**
	c.	Explain any five operations performed on a lathe.	**07**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain with a neat sketch, up milling and down milling methods.	**07**	**L2**	**CO2**
	b.	Briefly explain the broad classification of milling machines.	**06**	**L1**	**CO2**
	c.	By applying the knowledge of indexing, discuss the different types of indexing that are in practice.	**07**	**L2**	**CO2**
		OR			
Q.4	**a.**	With a neat sketch, explain the radial drilling machine.	**07**	**L2**	**CO2**
	b.	Apply the knowledge of mechanism, explain the quick return mechanism that are used in shaping machine.	**06**	**L3**	**CO2**
	c.	With a neat sketch, explain the centerless grinding machine.	**07**	**L2**	**CO3**
		Module – 3			
Q.5	**a.**	With neat sketches, analyze the different heat zones that are present during metal cutting process.	**07**	**L2**	**CO3**
	b.	Explain the factors that affect the heat generation in metal cutting process.	**06**	**L2**	**CO3**
	c.	Briefly explain the different wear mechanisms of cutting tools.	**07**	**L2**	**CO3**
		OR			
Q.6	**a.**	Briefly explain the different cutting tool materials that are used in practice.	**07**	**L2**	**CO3**
	b.	Analyze the life of tool which is used for rough turning which give a tool life of 1 hrs at a cutting speed of 30 m/min. What will be the life of the tool when it is used at the same cutting speed for finish turning? Take n = 0.125 for rough cut and n = 0.1 for finish cut.	**06**	**L4**	**CO3**
	c.	Briefly discuss the different types of cutting fluids.	**07**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Briefly discuss the major objective of metrology.	**07**	**L2**	**CO4**
	b.	Briefly discuss the following standards of measurement: (i) Line standard (ii) End standard (iii) Wave length standard	**06**	**L2**	**CO4**
	c.	Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with a 300 mm bar. The 300 mm bar has a known error of +40 μm and the three bars together measures 64 μm less than the 300 mm bar. Bar A is 18 μm longer than bar B and 23 μm longer then bar C. Determine the actual length of each bar.	**07**	**L3**	**CO4**
		OR			

Q.8	a.	Briefly explain Inter changeability and selective assembly.	06	L2	CO4
	b.	Define fit. Explain the different types of fits designed for different applications.	06	L2	CO4
	c.	Determine the tolerances on the hole and shaft for a precision running fit designated by 50 H_7g_6. Given: (i) 50 mm lies between 30-50 mm (ii) i(microcs) = $0.45 (D)^{1/3} + 0.001 D$ (iii) Fundamental deviation for 'H' hole = 0 (iv) Fundamental deviation for 'g' shaft = $-2.5 D^{0.34}$ (v) IT7 = 16i (vi) IT6 = 10i State the actual maximum and minimum sizes of the hole and shaft and maximum and minimum clearances.	08	L3	CO4
		Module – 5			
Q.9	a.	Briefly explain with neat sketch, plug and ring gauges.	07	L2	CO5
	b.	With a neat sketch, explain the sigma comparator.	07	L2	CO5
	c.	With a neat sketch, explain the principle of sine bar.	06	L2	CO5
		OR			
Q.10	a.	Discuss the different materials used for the construction of gauges.	07	L2	CO5
	b.	With a neat sketch, explain the Zeiss Ultra Optimeter.	07	L2	CO5
	c.	With a neat sketch, explain the Verneir Bevel Protractor.	06	L2	CO5

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME403**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024

Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Assume missing data suitably.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following properties of fluids and mention their S.I. units: (i) Weight density (ii) Surface tension (iii) Kinematic viscosity (iv) Compressibility	**08**	**L2**	**CO1**
	b.	The space between two square parallel plates is filled with an oil of relative density 0.95. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. It requires a force of 100 N to more the upper plate at a velocity of 2.5 m/s relative to the lower fixed plate. Determine: (i) The dynamic viscosity of oil in Pa-s (ii) Kinematic viscosity of oil	**08**	**L3**	**CO1**
	c.	The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limb is 20 cm.	**04**	**L3**	**CO1**
		OR			
Q.2	**a.**	State and prove Pascal's law.	**05**	**L2**	**CO1**
	b.	Derive an expression for the total pressure and the depth of centre of pressure for a vertical surface submerged in water.	**08**	**L3**	**CO1**
	c.	Find the total pressure and position of centre of pressure on a triangular plate of base 2 m and height of 3m which is immersed in water in such a way that the plan of the plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface.	**07**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Explain different types of fluid flow.	**06**	**L2**	**CO2**
	b.	Derive continuity equation in Cartesian coordinate for a fluid flow in 3 dimensions.	**08**	**L3**	**CO2**
	c.	The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ.	**06**	**L3**	**CO2**
		OR			
Q.4	**a.**	Show that for viscous flow through a circular pipe, the maximum velocity is twice the average velocity.	**08**	**L3**	**CO2**
	b.	A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2, find: (i) The pressure gradient (ii) The average velocity (iii) Reynold number of the flow	**08**	**L3**	**CO2**
	c.	Define Reynolds number. Explain its significance in fluid flow.	**04**	**L2**	**CO2**

		Module – 3			
Q.5	**a.**	Obtain the Euler's equation of motion along a stream line. Obtain Bernoulli's equation. Mention the assumption made.	**08**	**L3**	**CO3**
	b.	Derive an expression for discharge through a rectangular notch.	**06**	**L3**	**CO3**
	c.	An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$.	**06**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive Darcy-Weisbach equation for loss of head due to friction in pipe.	**08**	**L3**	**CO3**
	b.	Derive an expression for the loss of head due to the sudden enlargement in pipe.	**06**	**L3**	**CO3**
	c.	What are the energy losses that occur in pipe? Give the expressions for different minor energy losses.	**06**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Define the drag force and lift force. Also derive their expressions.	**10**	**L3**	**CO4**
	b.	Briefly explain what is meant by boundary layer and hence define the following: (i) Boundary layer thickness (ii) Displacement thickness	**06**	**L2**	**CO4**
	c.	Explain what is stream-lined body and bluff body.	**04**	**L2**	**CO4**
		OR			
Q.8	**a.**	What is dimensional homogeneity? Explain with examples.	**04**	**L2**	**CO4**
	b.	What is similitude? Explain the following : (i) Geometric similarity (ii) Dynamic similarity (iii) Kinematic similarity	**08**	**L2**	**CO4**
	c.	Show by Buckingham's π theorem that the frictional torque 'T' of a disc of diameter 'D' rotating at speed N in a fluid of viscosity 'μ' and density 'ρ' in a flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Show that velocity of propagation of elastic wave in an adiabatic medium is given by $C = \sqrt{KRT}$ starting from fundamentals.	**10**	**L3**	**CO5**
	b.	An air plane is flying at an altitude of 15 km where the temperature is −50°C. The speed of the plane corresponds to Mach number of 1.6. Assume K = 1.4 and R = 287 J/kgK for air, find the plane speed and Mach angle.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Define the following terms: (i) Subsonic flow (ii) Sonic flow (iii) Supersonic flow (iv) Mach number (v) Mach angle	**10**	**L2**	**CO5**
	b.	Explain the necessity of CFD. Mention its advantages, limitations and its applications.	**10**	**L2**	**CO5**

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CBCS SCHEME

USN

BME405A

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024

Non Traditional Machining

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Non-traditional machining process. Write the classification of NTM.	8	L1	CO1
	b.	Justify the need of non-traditional machining process.	6	L2	CO1
	c.	List the applications of NTM.	6	L1	CO1
		OR			
Q.2	**a.**	Differentiate between Traditional and Non-traditional machining processes.	10	L2	CO1
	b.	Explain the physical parameters and process capability of the Non-traditional machining processes.	10	L2	CO1
		Module – 2			
Q.3	**a.**	With a neat sketch, explain the working principle of ultrasonic machining.	10	L2	CO2
	b.	Explain the effector process parameters of Ultrasonic machining.	10	L2	CO2
		OR			
Q.4	**a.**	With a neat sketch, explain the working principle of Abrassive Jet Machining (AJM).	10	L2	CO2
	b.	Explain process parameters on Abrasive Jet Machining.	10	L2	CO2
		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working principle of Electro Chemical Grinding (ECG).	10	L2	CO3
	b.	Explain the following in chemical machining process: (i) Maskants (ii) Etchants	10	L2	CO3
		OR			
Q.6	**a.**	Explain with flow chart the chemical blanking process. Mention its applications.	10	L2	CO3
	b.	Describe the various process parameters affecting ECM.	6	L2	CO3
	c.	List the advantages and disadvantages of ECM.	4	L2	CO3
		Module – 4			
Q.7	**a.**	Explain with a neat sketch, the non-thermal generation of plasma and mechanism of metal removal in PAM.	10	L2	CO4
	b.	With a schematic representation, explain the travelling wire EDM processes.	10	L2	CO4

		OR			
Q.8	**a.**	Differentiate between transferred and non transferred arc plasma torch mode of operation.	**8**	**L2**	**CO4**
	b.	Explain with a neat sketch, the plasma arc machining.	**8**	**L2**	**CO4**
	c.	What are the advantages and disadvantages of EDM?	**4**	**L1**	**CO4**
		Module – 5			
Q.9	**a.**	With a neat sketch, explain Laser Beam Machining (LBM).	**10**	**L2**	**CO5**
	b.	Explain the process parameters of Electron Beam Machining.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	With a neat sketch, explain Electron Beam Machining.	**10**	**L2**	**CO5**
	b.	Explain with a neat sketch, the ND-YAG laser used in the laser beam machining.	**10**	**L2**	**CO5**

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CBCS SCHEME

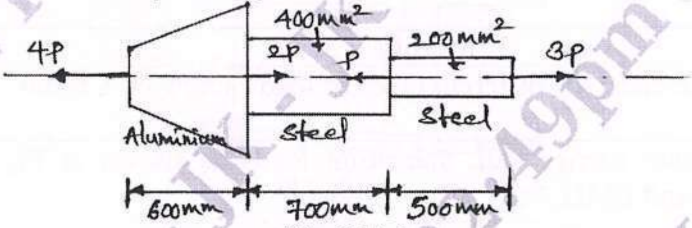
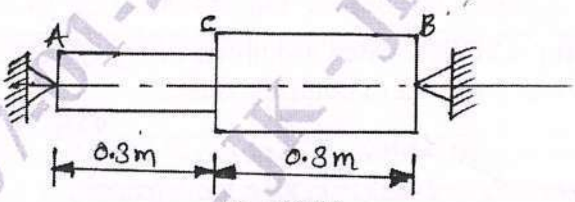
USN ☐☐☐☐☐☐☐☐☐☐ **BME301**

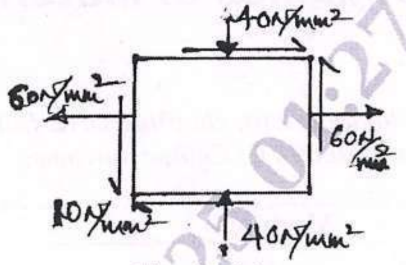
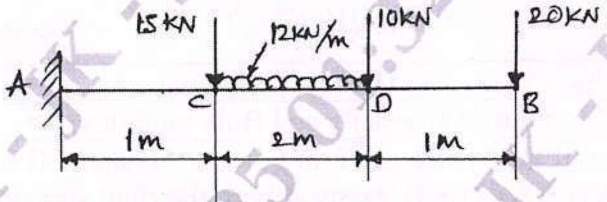
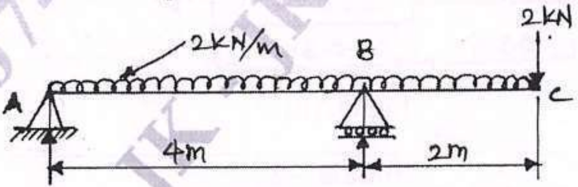
Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

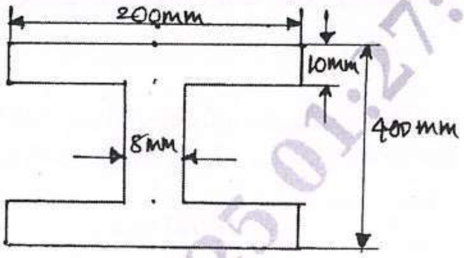
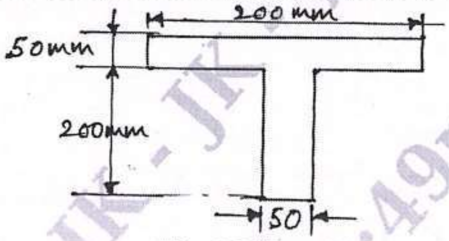
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	**a.**	Define the following terms: (i) Poisson's ratio (ii) Factor of safety	**04**	**L1**	**CO1**
	b.	Show that the expression for the extension of uniformly tapering circular bar subjected to an axial load 'P' is given by, $\delta = 4PL/\pi d_1 d_2 E$	**06**	**L1**	**CO1**
	c.	A bar with stepped portion is subjected to the forces shown in Fig.Q1(c). Solve for the magnitude of force 'P' such that net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa and that of aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively.  Fig.Q1(c)	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	How do you relate Modulus of Elasticity and Bulk modulus?	**10**	**L1**	**CO1**
	b.	Solve for the values of stress and strain in portion AC and CB of the steel bar shown in Fig.Q2(b). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75°C. Take E = 200 GPa and $\alpha = 12 \times 10^{-6}/°C$ for steel. Area of cross-section of AC is 400 mm² and of BC is 800 mm².  Fig.Q2(b)	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	A rectangular bar is subjected to two direct stresses 'σ_x' and 'σ_y' in two mutually perpendicular directions. Show that the normal stress 'σ_n' and shear stress 'τ' on an oblique plane which is inclined at an angle 'θ' with the axis of minor stress are given by $\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta$ and $\tau = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta$	**10**	**L1**	**CO2**

	b.	The state of stress at a point in a stained material is shown in Fig.Q3(b). Identify (i) Direction of principal planes (ii) Magnitude of principal stresses (iii) Magnitude of maximum shear-stress and its direction.  Fig.Q3(b)	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Show that the change in volume of thin cylindrical shell is given by $\delta_V = \frac{Pd}{4tE}(5-4M)v$	**10**	**L1**	**CO2**
	b.	A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Solve for the maximum and minimum hoop stress across the cross-section of the cylinder. Also construct the radial pressure and hoop stress distribution sketch across the section.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Explain with sketches, the different types of loads acting on a beam.	**10**	**L2**	**CO3**
	b.	A cantilever beam carries UdL and point loads as shown in Fig.Q5(b). Construct SFD and BMD.  Fig.Q5(b)	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Explain SFD and BMD for a cantilever beam with a uniformly varying load.	**10**	**L2**	**CO3**
	b.	An overhanging beam ABC is located as shown in Fig.Q6(b). Develop the SFD and BMD. Also locate point of contraflexure.  Fig.Q6(b)	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the assumptions made in simple bending and show that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular section.	**10**	**L2**	**CO4**

	b.	The cross-section of a beam is as shown in Fig.Q7(b). If permissible stress is 150 N/mm^2. Find its moment of resistance and compare it with equivalent section of the same area for a square section.  Fig.Q7(b)	**10**	**L4**	**CO4**
		OR			
Q.8	**a.**	Illustrate an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending.	**10**	**L2**	**CO4**
	b.	A 'T' shaped cross-section of a beam shown in Fig.Q8(b) is subjected to a vertical shear force of 100 KN. Inspect the shear stress at the neutral axis junction and flange. MI about the horizontal neutral axis is 0.0001134 m^4.  Fig.Q8(b)	**10**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the assumptions made in pure torsion-theory and show that $\frac{T}{J_p}=\frac{\tau}{R}=\frac{G\theta}{L}$	**10**	**L2**	**CO5**
	b.	A hallow shaft having internal diameter 40% of its external diameter, transmits 562.5 KW power at 100 rpm. List the internal and external diameters of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5m should not exceed 1.3 degrees. The maximum torque being 25% greater than mean. G = 9×10^4 N/mm^2.	**10**	**L4**	**CO5**
		OR			
Q.10	**a.**	Show the variation of Euler's critical load with slenderness ratio. Explain the limitations of Euler's theory and mention for formulae to overcome these limitations.	**10**	**L2**	**CO5**
	b.	A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, analyze the safe load using (i) Rankine's formula taking yield stress 560 N/mm^2 and α = 1/1600. (ii) Euler's formula, taking E = 1.2×10^5 N/mm^2.	**10**	**L4**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME302

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define manufacturing process. Classify manufacturing process.	8	L1	CO1
	b.	Define pattern and explain with a neat sketches any four pattern allowances.	6	L2	CO1
	c.	With a neat sketch explain Jolt machine.	6	L2	CO1
		OR			
Q.2	a.	Discuss briefly the requirements of base sand in sand mould preparation.	6	L2	CO1
	b.	List the commonly mixed ingredients in moulding sand. Illustrate the properties contribute by each of them to the sand mould.	10	L2	CO1
	c.	What is core? List the different types of cores.	4	L1	CO1
		Module – 2			
Q.3	a.	With a neat sketch explain resistance furnace.	10	L2	CO2
	b.	Explain with a neat sketch CUPOLA furnace.	10	L2	CO2
		OR			
Q.4	a.	With a neat sketches explain casting defects and remedies.	10	L2	CO2
	b.	With a neat sketches explain slush casting.	10	L2	CO2
		Module – 3			
Q.5	a.	Define Forming. With sketches explain the classification of forming process.	10	L2	CO3
	b.	Differentiate between Hot Working and Cold Working.	10	L2	CO3
		OR			
Q.6	a.	Explain the principle of : i) Forging ii) Extrusion.	10	L2	CO3
	b.	Explain : i) Blanking ii) Piercing.	10	L2	CO3
		Module – 4			
Q.7	a.	Define Welding. Explain oxy-acetylene gas welding.	10	L2	CO4
	b.	With a neat sketch explain TIG welding.	10	L2	CO4
		OR			
Q.8	a.	With a neat sketch explain Submerged Arc Welding (SAW).	10	L2	CO4
	b.	With a neat sketches explain types of flames produced in oxy-acetylene gas welding.	10	L2	CO4
		Module – 5			
Q.9	a.	With suitable sketches explain defects in welding and their remedial measures.	10	L2	CO5
	b.	With a neat sketch, explain : i) Soldering ii) Brazing.	10	L2	CO5
		OR			
Q.10	a.	With a neat sketches explain resistance welding process.	10	L2	CO5
	b.	With a neat sketch, explain friction stir welding process.	10	L2	CO5

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME303

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Differentiate between crystalline and non-crystalline solids.	06	L4	CO1
	b.	Explain briefly atomic bonding, ionic bonding and metallic bonding.	08	L2	CO1
	c.	Define (APF) Atomic Packing Factor. Calculate APF for BCC cell.	06	L4,L1	CO1
		OR			
Q.2	a.	Explain slip and twinning.	06	L2	CO1
	b.	Explain point defects and Edge dislocation with necessary diagram.	08	L2	CO1
	c.	With necessary diagram, explain Bragg's law.	06	L3	CO1
		Module – 2			
Q.3	a.	State and explain Hume-Rothery Rule governing the formation of substitutional solid interstitial solid solution with examples.	08	L2	CO2
	b.	Explain with neat sketch, substitutional and interstitial solid solutions with examples.	06	L2	CO2
	c.	State and explain Fick's laws of Diffusion.	06	L3	CO2
		OR			
Q.4	a.	Explain Lever Rule and Gibbs phase rule with an example.	08	L3	CO2
	b.	Draw Fe-Fe$_3$C diagram. Label all phases, temperatures. Explain solidification process for 0.8% C.	12	L2	CO2
		Module – 3			
Q.5	a.	Draw TTT diagram for 0.8% C and superimpose the cooling curves. Explain briefly.	10	L2	CO3
	b.	With neat sketch, explain hardening and tempering heat treatment processes.	10	L3	CO3
		OR			
Q.6	a.	Explain Age hardening of Al – Cu alloys.	06	L2	CO3
	b.	With neat sketches, explain flame hardening.	06	L3	CO3
	c.	Draw the TTT diagram of austenite for eutectoid steel. Explain the various transformations product of austenite.	08	L2	CO3
		Module – 4			
Q.7	a.	Explain briefly common types of coatings.	10	L2	CO4
	b.	With a neat sketch, explain Physical Vapour Deposition (PVD) and Chemical Vapour Deposition (CVD) process.	10	L3	CO4
		OR			
Q.8	a.	Explain briefly about particle shape and particle size.	10	L2	CO4
	b.	Explain any two methods of powder production technique.	10	L2	CO4
		Module – 5			
Q.9	a.	Define composite. Give its classification.	06	L1,L2	CO5
	b.	Explain Metal Matrix Composite and Ceramic Matrix Composites.	08	L2	CO5
	c.	List the advantages and disadvantages of composite materials.	06	L4	CO5
		OR			
Q.10	a.	Explain the evolution of Engineering materials with the help of block diagram.	10	L2	CO5
	b.	With the necessary flowchart, explain the design flow process chart.	10	L3	CO5

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CBCS SCHEME

USN | | | | | | | | | |

BME304

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of steam table and thermodynamics data hand is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	State and explain zeroth law of thermodynamics.	10	L1	CO1
	b.	Two Celsius thermometers 'A' and 'B' agree at ice point and steam point and the related equation is $t_A = L + Mt_B + Nt_B^2$, where L, M and N are constants, when both thermometer are immersed in fluid, 'A' registers 26°C while 'B' registers 25°C. determine the reading of 'A' when 'B' reads 37.4°C	10	L3	CO1
		OR			
Q.2	**a.**	Derive an expression for work done during : i) Isothermal process ii) Adiabatic process.	10	L2	CO1
	b.	A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position, heat is then added reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the network done by the fluid for an initial volume of 0.05 m^3 and draw a neat PV diagram.	10	L3	CO1
		Module – 2			
Q.3	**a.**	Explain Joule's experiment with sketch.	10	L1	CO2
	b.	Air flows steady at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg, The internal energy of the air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas.	10	L3	CO2
		OR			
Q.4	**a.**	Derive Steady Flow Energy Equation (SFEE) with a neat sketch.	10	L2	CO2
	b.	A turbine operates in a steady flow conditions, receiving steam at the following state : pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 34 m/s, and elevation 3 m. The steam leaves the turbine at the following state : pressure 20 KPa, enthalpy 2512 kJ/kg, velocity 100 m/s and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of the steam flow through the turbine is 0.42 kg/s. What is the power output of the turbine in KW?	10	L3	CO2
		Module – 3			
Q.5	**a.**	State and explain Kelvin – Plank and clausius statements of II law of thermodynamics.	10	L2	CO3
	b.	A heat engine receives half of its heat at 1000 K and the rest at 500 K while rejecting heat to a sink at 300 K. What is the maximum possible efficiency of this heat engine?	10	L3	CO3

		OR			
Q.6	**a.**	State and prove clausius inequality.	**10**	**L1**	**CO3**
	b.	A heat engine working on a Carnot cycle absorbs heat from three thermal reservoirs at 1000 K 800 K and 600 K respectively. The engine does 10 KW of net work and rejects 400 kJ/min of heat to the sink at 800 K, if heat supplied by the reservoir at 1000 K 60% heat supplied by reservoir at 600 K. Find the quantifier of heat supplied by each reservoir.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the concept of available and unavailable energy referred to a cycle.	**10**	**L1**	**CO4**
	b.	In a steam generator, water evaporated at 260°C, while the combustion gas (C_P = 1.08 kJ/kg K) is cooled from 13000°C to 320°C. The surrounding are at 30°C. Determine loss in energy available due to the above heat transfer per kg of water evaporated (Latent heat of vaporization of water at 260°C = 1662.5 m^3 kgmole.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Sketch and explain throttling calorimeter.	**10**	**L2**	**CO4**
	b.	A vessel of 0.04 m^3 contains a mixing of saturated water and saturated steam at temperature of 240°C. The mass of the liquid is 8 kg. Find the pressure, specific volume, enthalpy, entropy and internal energy.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain : i) Vander Waal's equation of state ii) Compressibility factor iii) Law of corresponding states.	**10**	**L2**	**CO5**
	b.	1 kg of CO_2 has a volume of 0.86 m^3 at 120°C compute pressure using : i) Ideal gas equation ii) Vander Waal's equation. Take Vander Waal's constants for CO_2 a = 365.6 KNM^4/kg mole and b = 0.0423 m^3/kg mole.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Discuss Maxwell's equations and Tds equation.	**10**	**L2**	**CO5**
	b.	Volumetric analysis of a gaseous mixture yields the following results : CO_2 = 12%, O_2 = 4%, N_2 = 82%, CO = 2%. Determine the analysis on mass basis, molecular weight and gas constant for the mixture, assume ideal gas behavior.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN

BME306D

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Waste Handling and Management

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

			M	L	C
		Module – 1			
Q.1	**a.**	Explain in detail about the importance of Waste Management.	**10**	**L2**	**CO1**
	b.	Write a note on waste handling equipment and technology.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain in detail the role of public authority and private sector in waste collection.	**10**	**L2**	**CO1**
	b.	Explain the different ways of organizing collection of residential waste. And also explain how it impact on waste management.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the different types of solid waste.	**10**	**L2**	**CO1**
	b.	Explain the processing and treatment of solid waste.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain the two methods of composting.	**10**	**L2**	**CO2**
	b.	Explain the dumping of solid waste.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Explain the sources and classification of Hazardous waste.	**10**	**L2**	**CO3**
	b.	What is biomedical waste? Mention the sources of biomedical waste, and also explain the challenges in handling biomedical waste.	**10**	**L3**	**CO3**
		OR			
Q.6		Write a note on the following:	**20**	**L2**	**CO1**
	a. **c.**	Industrial waste b. E-waste Nuclear waste d. Biomedical waste			
		Module – 4			
Q.7	**a.**	Explain the methods of land filling.	**10**	**L2**	**CO4**
	b.	What is recycling and reuse in the waste management? Explain briefly.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Explain the best practices followed in India for waste handling and management.	**10**	**L2**	**CO4**
	b.	What is composting? Explain the methods followed in medium and large scale composting.	**10**	**L2**	**CO4**
		Module – 5			
Q.9		Write a brief note on the following:	**20**	**L3**	**CO5**
	a.	Duties of constitutional bodies and ministries			
	b.	Environmental Protection Act			
	c.	Plastic waste management and handling rules			
	d.	E-waste management and handling rules.			
		OR			
Q.10		Write brief note on the following:	**20**	**L2**	**CO5**
	a.	The batteries waste management and handling rules			
	b.	Biomedical waste management and handling rules			
	c.	Plastic waste handling and management rules			
	d.	E-waste handling and management rules			

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME401**

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Thermodynamics Data hand book and Steam tables are permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Derive an expression for the air standard efficiency of an Otto cycle. Represent the processes of the cycle on P – V and T – S diagrams. List the assumptions.	12	L3	CO1
	b.	The compression ratio of a Diesel cycle is 14 and the cut off ratio is 2.2. At the beginning of the cycle, air is at 0.98 bar and 100°C. Find : i) Temperature and pressure at all the salient points. ii) Air standard efficiency.	8	L3	CO1
		OR			
Q.2	**a.**	Explain the Willan's line method of determining the frictional power of an IC engine.	8	L2	CO1
	b.	In a test on three cylinder, 4 – stroke IC engine with 22cm bore and 26cm stroke, the following were the observations during a trial period of one hour Fuel consumption = 8kg , Calorific value = 45,000 kJ/kg , Total revolutions of the crank shaft = 12,000 , MEP = 6 bar , Net load on brake = 1500N , Brake drum diameter = 1.8m , Rope diameter = 3cm , Mass of cooling water = 550kg , Inlet temperature of water = 27°C , Exit temperature of water = 55°C , Air used = 300kg , Ambient temperature = 30°C , Exhaust gas temperature = 310°C , Specific heat of exhaust gases = 1.1 kJ/kg K , Calculate : i) Mechanical efficiency ii) Indicated thermal efficiency. Also draw a heat balance sheet in kJ/min.	12	L3	CO1
		Module – 2			
Q.3	**a.**	Derive an expression for the optimum pressure ratio for maximum work output in case of an ideal Brayton cycle in terms of maximum and minimum temperature of the cycle.	10	L3	CO2
	b.	In an open cycle gas turbine plant, air enters the compressor at 1 bar and 20°C. The pressure after compression is 4 bar. The isentropic efficiency of turbine and compressor are 85% and 80% respectively. The air – fuel ratio is 90 : 1. Calorific value of fuel used to 42,000 kJ/kg. Mass flow rate of air is 3kg/s. Determine the power output from the plant and the cycle efficiency. Assume that Cp = 1kJ/kg K and r = 1.4 for air and gases.	10	L3	CO2
		OR			

Q.4	a.	With a neat sketch, explain the following methods used to improve the performance of an open cycle gas turbine plant : i) Reheating ii) Inter cooling.	12	L2	CO2
	b.	With a neat sketch, explain the working of a Ramjet and a Turbo propeller engine.	8	L2	CO2
		Module – 3			
Q.5	a.	With a neat schematic diagram and T – S diagram, derive an expression for the thermal efficiency of the Rankine cycle.	8	L3	CO3
	b.	Explain the effect of the following on Rankine cycle efficiency : i) Boiler pressure ii) Condenser pressure.	4	L2	CO3
	c.	A simple ideal Rankine cycle works between the pressure of 30 bar and 0.04 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency and work ratio.	8	L3	CO3
		OR			
Q.6	a.	With a neat schematic diagram and T – S diagram, briefly explain the regenerative vapour power cycle with single open feed water heater. Derive and expression for its thermal efficiency.	10	L3	CO3
	b.	A steam power plant operates on a reheat cycle. Steam in boiler at 150 bar , 550°C expands through high pressure turbine. It is reheated at constant pressure of 40 bat to 550°C and expands through low pressure turbine to a condenser at 0.1 bar. Find i) Quality of steam at turbine exist ii) Cycle efficiency iii) Steam rate in kg/Kw hr.	10	L3	CO3
		Module – 4			
Q.7	a.	With a neat sketch, explain the working principle of an Ammonia vapour absorption refrigeration system.	8	L2	CO4
	b.	A 10 ton Ammonia ice plant operates between an evaporator temperature of -15°C and condenser temperature of 35°C. The Ammonia enters the compressor as dry saturated vapour. Assuming isentropic compression, determine i) mass flow rate or Ammonia ii) COP iii) Power input in KW iv) Tons of ice at -10°C produced from water at 25°C in a day. Enthalpy of fusion of ice = 334 kJ/kg , Cp = 4.187 kJ/kg K for water and Cp = 2.1 kJ/kg K for ice.	12	L3	CO4
		OR			
Q.8	a.	With a neat sketch, explain the working principle of a winter air conditioning system. Represent the processes of the system on a psychrometric chart.	10	L2	CO4

	b.	It is required to design an air conditioning plant for an office room with the following conditions : Outdoor conditions = 14ºC DBT , 10ºC WDT , Required conditions = 20ºC DBT , 60% RH , Amount of air circulation = 0.3m^3/min/person , Seating capacity of office = 60. The required condition is achieved first by heating and then by adiabatic humidifying. Determine : i) heating capacity of the coil in kW and the surface temperature required if the bypass factor of the coil is 0.4 ii) Capacity of the humidifier.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Derive an expression for the volumetric efficiency of a reciprocating air compressor.	**10**	**L3**	**CO5**
	b.	Air at 1 bar and 27ºC is compressed to 7 bar by a single stage reciprocating compressor according to the law PV$^{1.3}$ = C. The free air delivered was 1m3/min. Speed of the compressor is 300rpm , Stroke to bore ratio is 1.5:1. Mechanical efficiency is 85% and motor transmission efficiency is 90%. Determine i) Indicated power and Isothermal efficiency. ii) Cylinder dimensions and power of the motor required to drive the compressor.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive an expression for condition of maximum discharge through a nozzle.	**10**	**L3**	**CO5**
	b.	A convergent – divergent nozzle is required to discharge 360 kg/hr of steam. The nozzle is supplied with steam and 10 bar and 0.97 dry and discharges against a back pressure of 0.5 bar. Neglecting the effect of friction, find the throat and exit diameters. Assume the condition for maximum discharge.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME403

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following properties of fluids and write their SI units. i) Density ii) Specific weight iii) Specific volume iv) Kinematic viscosity.	8	L1	CO1
	b.	If the velocity distribution over a plate is given by $u = \frac{2}{3}y - y^2$ in which 'u' is the velocity in meter per second at a distance 'y' meter above the plate, Determine the shear stress at y = 0 and y = 0.15m. Take dynamic viscosity of fluid as 8.63 poises.	6	L3	CO1
	c.	Define capillarity. Derive an expression for capillary rise.	6	L2	CO1
		OR			
Q.2	a.	State and prove Pascal's law.	6	L2	CO2
	b.	Define the following and indicate their relative position on a chart: i) Absolute pressure ii) Gauge pressure iii) Vacuum pressure iv) Atmospheric pressure.	6	L1	CO2
	c.	The right limb of a simple u-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.	8	L3	CO2
		Module – 2			
Q.3	a.	Define the following types of fluid flows: i) Steady and unsteady flow ii) Uniform and non-uniform flow iii) Compressible and incompressible flow.	6	L1	CO2
	b.	Derive the continuity equation in three dimensional Cartesian co-ordinates for a steady, incompressible fluid flow.	8	L2	CO2
	c.	Explain stream function and velocity potential function.	6	L2	CO2

		OR			
Q.4	**a.**	Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe.	10	L2	CO2
	b.	A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow.	6	L3	CO2
	c.	Define Reynolds number. Explain its significance in fluid flow.	4	L2	CO2
		Module – 3			
Q.5	**a.**	Derive Euler's equation of motion along a stream line. Deduce Bernoulli's equation from Euler's equation. State the assumptions made.	10	L2	CO3
	b.	A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position 'A' to 500 mm diameter at a position 'B' which is 4 m at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 lit/s, determine the loss of head and direction of flow.	10	L3	CO3
		OR			
Q.6	**a.**	Derive Darcy – Weisbach equation for loss of head due to friction in pipe.	10	L2	CO3
	b.	A horizontal pipe line 40 m long is connected to a water tank at one end and discharge freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe.	10	L3	CO3
		Module – 4			
Q.7	**a.**	Explain the following terms: i) Drag ii) Lift iii) Friction drag iv) Pressure drag.	8	L2	CO4
	b.	Briefly explain what is meant by boundary layer and hence define the following: i) Boundary layer thickness ii) Displacement thickness.	6	L2	CO4
	c.	State and explain Buckingham's π theorem.	6	L2	CO4
		OR			
Q.8	**a.**	What is similitude? Explain the different types of similitude.	7	L2	CO4
	b.	Explain the dimentional homogeneity with examples.	3	L2	CO4

	c.	The frictional torque (T) of a disc of diameter (D) rotating at a speed (N) in a fluid of viscosity (μ) and density (ρ) in a turbulent flow is given by $T = D5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by Buckingham's - π theorem.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Define Mach number. Explain the significance of Mach number in compressible fluid flow.	**6**	**L2**	**CO5**
	b.	Derive an expression for velocity of sound wave in a fluid.	**8**	**L2**	**CO5**
	c.	Find the velocity of bullet fired in standard air if Mach angle is 30°. Take R = 287.14 J/kg K and $\gamma = 1.4$ for air and temperature of air is 15°C.	**6**	**L3**	**CO5**
		OR			
Q.10	**a.**	An air plane is flying at an altitude of 15 km where the temperature is -50°C. The speed of plane corresponds to Mach number 1.6. Assume $\gamma = 1.4$ and R = 287 J/kg K for air. Find speed of plane and Mach angle.	**8**	**L3**	**CO5**
	b.	Define: i) Mach Number ii) Sub-Sonic flow iii) Sonic flow iv) Super-Sonic flow	**4**	**L1**	**CO5**
	c.	Mention the advantages and disadvantages of CFD.	**8**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME502**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	**a.**	Define Turbo machine and explain parts of turbomachine with neat sketch.	7	L1	CO1
	b.	What is specific speed of a pump? Derive an expression for the same?	6	L2	CO1
	c.	Tests on a turbine runner 1.25 m in diameter at 30 m head gave the following results : Power developed 736 kW, Speed 180 rpm, Discharge 2.7 m^3/s. Find the diameter, speed and discharge of a runner to operate at 45 m head and gave 1472 kW power at the same efficiency. What is the specific speed of both the turbines?	7	L3	CO1
		OR			
Q.2	**a.**	With reference to expansion process, define the following and write the corresponding relations: (i) Total-to-Total efficiency. (ii) Static-to-Static efficiency.	4	L1	CO1
	b.	Show that for a compressor polytropic efficiency is given by, $\eta_P = \dfrac{\frac{x-1}{x}\ln\left[\frac{P_2}{P_1}\right]}{\ln\left[\frac{T_2}{T_1}\right]}$ Where P_1 and P_2 are pressure at inlet and outlet of compressor respectively. Where as T_1, T_2 are temperatures at inlet and outlet of compressor respectively.	8	L2	CO1
	c.	A 9 stage centrifugal compressor has overall stage pressure ratio 2.82. Air enters the compressor at 1 bar and 15°C. The efficiency of the compressor is 88%. Determine the following : (i) Pressure ratio of each stage (ii) Polytropic efficiency (iii) Preheat factor	8	L3	CO1
		Module – 2			
Q.3	**a.**	Derive an alternate form of Euler's turbine equation and explain the significance of each energy components.	8	L2	CO2
	b.	For an axial flow compressor, show that $R = \dfrac{V_f}{2U}\left[\dfrac{\tan\beta_1 + \tan\beta_2}{\tan\beta_1 \times \tan\beta_2}\right]$ Where V_f velocity of flow, U-blade speed β_1, β_2 are blade angles at inlet and outlet respectively.	7	L2	CO2
	c.	The velocity of steam in a Delavar turbine at the inlet is 1200 m/s. The nozzle angle at the inlet is 22° and rotor blades are equiangular. Assume relative velocities of the steam at inlet and outlet to be equal and tangential speed of the rotor is 400 m/s. Determine (i) Blade angles at inlet and outlet. (ii) Power developed if mass flow rate is 1 kg/s.	5	L3	CO2

		OR			
Q.4	a.	Show that maximum utilization factor, where ϕ is the speed ratio, α_1 is Guide angle at inlet. $\in_{\max} = \frac{2\phi\cos\alpha_1}{1+2R\phi\cos\alpha_1}$.	8	L2	CO2
	b.	Define utilization factor and degree of reaction also show that utilization factor, $\in = \frac{V_1^2 - V_2^2}{V_1^2 - RV_2^2}$?	7	L2	CO2
	c.	The impeller of a centrifugal pump has an outer diameter of 1.5 m. It lifty water at a rate of 2000 kg/s. The blade is making an angle of 145° with the direction of motion at outlet and the speed being 300 rpm. Radial velocity of flow is 3 m/s. Find the power required to drive the impeller.	5	L3	CO2
		Module – 3			
Q.5	a.	What is compounding? Name different methods of compounding and explain with neat sketch any one of the method of compounding.	6	L1	CO3
	b.	Prove that in 50% reaction turbine maximum blade efficiency, $\eta_{b\max} = \frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}$ Where α_1 is nozzle exit angle.	7	L2	CO3
	c.	A signle stage impulse turbine has diameter of 1.5 m and running at 3000 rpm. The nozzle angle is 20°. Speed ratio is 0.45. Ratio of relative velocity at the outlet to that at inlet is 0.9. The outlet angle of blade is 3° less than inlet angle. Steam flow rate is 6 kg/s. Draw the velocity diagrams and find the following : (i) Blade angle (ii) Power developed (iii) Axial thrust	7	L3	CO3
		OR			
Q.6	a.	In a Curtis stage with two rows of moving blades, the rotors are equiangular. The first rotor has an angle of 29° each while second rotor has an angle of 32° each. The velocity of steam at the exit of nozzle is 530 m/s and blade coefficients are 0.9 in the first, 0.95 in the stator and in the second rotor. If the absolute velocity at the stage exit should be axial, find (i) Mean blade speed (ii) The rotor efficiency (iii) Power output for a flow rate of 32 kg/s.	9	L3	CO3
	b.	Define the following terms related to reaction steam turbine and write their relations : (i) Blade efficiency (ii) Stage efficiency	4	L1	CO3
	c.	The following data refers to a stage of reaction turbine: Rotor diameter = 1.5 m, Speed ratio = 0.72, Outlet blade angle 20°, Rotor speed = 3000 rpm, Determine (i) Blade efficiency (ii) Percentage increase in blade efficiency and the rotor speed, if the rotor is designed to run at the best theoretical speed.	7	L3	CO3
		Module – 4			
Q.7	a.	With reference to Hydraulic turbines, define (i) Hydraulic efficiency (ii) Mechanical efficiency (iii) Overall efficiency (iv) Volumetric efficiency.	4	L1	CO4

	b.	Show that maximum hydraulic efficiency in a Pelton wheel $\eta_{H\max} = \dfrac{1 + C_b \cos\beta_2}{2}$. Where C_b – blade velocity coefficient and β_2 is blade angle at exist.	7	L2	CO4
	c.	A Pelton turbine has a water supply of 5 m^3/s at a head of 256 m and runs at 500 rpm. Assume a turbine efficiency of 0.85, a coefficient of velocity for nozzle as 0.985 and a speed ratio of 0.46. Calculate (i) Power output (ii) Specific speed (iii) Number of Jets (iv) Jet diameter (v) Diameter of wheel (vi) Number of cups (vii) Cup dimensions.	9	L3	CO4
		OR			
Q.8	a.	Explain the construction and working of Kaplan turbine with neat sketch.	6	L1	CO4
	b.	The following data is given for a Francis turbine. Net head = 70 m, Speed – 600 rpm, Shaft power = 370 kW, $\eta_C = 0.80$, $\eta_H = 0.95$, flow ratio = 0.25, Breadth ratio = 0.1, Outer diameter of the runner is = 2 times inner diameter of runner. The thickness of vanes occupy 10% of circumferential area of the runner. Velocity of flow is constant and discharge is radial at outlet? Determine (i) Guide blade angle. (ii) Runner angle at inlet and outlet. (iii) Diameter of the runner at inlet and outlet. (iv) Width of the wheel at inlet.	7	L3	CO4
	c.	Define draft tube efficiency. Derive an expression for inlet pressure head of draft tube and its efficiency.	7	L2	CO4
		Module – 5			
Q.9	a.	Define the following terminologies related to centrifugal pump : (i) Suction head (ii) Delivery head (iii) Static head (iv) Manometric head (v) Manometric efficiency (vi) Mechanical efficiency. (vii) Overall efficiency.	7	L1	CO5
	b.	Derive an expression for H-Q characteristic curve for a centrifugal pump. Discuss the H-Q curve for forward, radial and backward curved vanes.	8	L2	CO5
	c.	A single stage centrifugal pump with a impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3/s water to a height of 30 m with a manometric efficiency of 75%. Find the number of stages and diameter of each impeller of a multistage pump to lift 5 m^3/s of water to a height of 200 m when rotating at 1500 rpm.	5	L3	CO5
		OR			
Q.10	a.	With neat sketch, explain slip, slip coefficient and slip factor.	6	L1	CO5
	b.	Explain the phenomenon of surging and stalling.	4	L1	CO5

	c.	A single sided centrifugal air compressor running at a speed of 16500 rpm produced a pressure ratio of 4 : 1. The hub diameter at the eye of the compressor is 16 cm. Inlet of air to the rotor is axial and equal to 120 m/s. The stagnation temperature and pressure at inlet are 25 °C and 1 bar. The mass flow rate is 8.3 kg/s and the total head isentropic efficiency is 78%. The pressure coefficient is 0.7. Determine (i) Eye tip diameter (ii) Blade angle at eye root and eye tip. (iii) Impeller tip diameter. (iv) Shaft power input to the compressor if the mechanical efficiency is 97%.	10	L3	CO5

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CBCS SCHEME

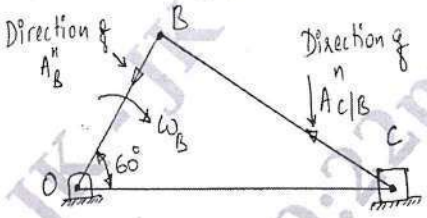
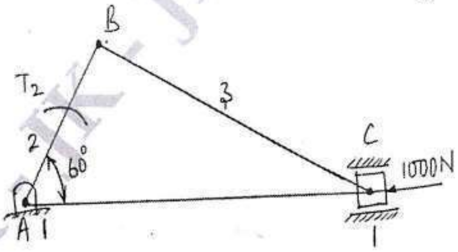
USN ☐☐☐☐☐☐☐☐☐☐ **BME503**

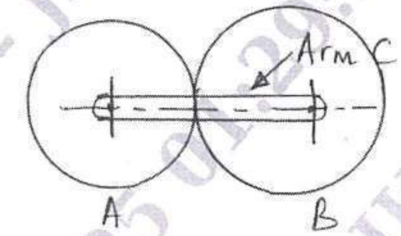
Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

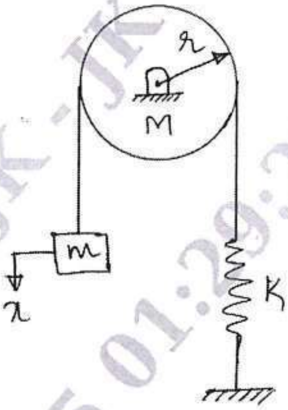
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define : (i) Kinematic link (ii) Kinematic pair (iii) Kinematic chain (iv) Mechanism (v) Machine.	**10**	**L1**	**CO1**
	b.	Briefly explain the following inversions : (i) Beam engine (ii) Watt's straight line mechanism	**10**	**L1**	**CO1**
		OR			
Q.2	**a.**	In a slider crank mechanism, the crank OB = 30 mm and connecting rod BC = 120 mm. The crank rotates at a uniform speed of 300 rpm clockwise. For the crank position as shown in Fig. Q2 (a) ; find (i) Velocity of Piston C and angular velocity of connecting rod BC (ii) Acceleeration of piston C and angular acceleration of connecting rod BC.  Fig. Q2 (a)	**10**	**L3**	**CO1**
	b.	If the crank and connecting rod are 150 mm and 600 mm long respectively and the crank rotates at a uniform speed of 100 rpm closckwise; determine the angular velocity and angular acceleration of connecting rod and velocity of the piston by using Raven's approach. The angle which the crank makes with the inner dead center is 30°.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	With a neat sketch, explain the following : (i) Equillibrium of Three force members (ii) Equillibrium of Four force members.	**10**	**L1**	**CO2**
	b.	For a slider crank mechanism as shown in Fig. Q3 (b), the force applied to the piston is 1000 N when the crank is at 60° from IDC. Given AB = 100 mm and BC = 300 mm. Calculate the driving torque T_2.  Fig. Q3 (b)	**10**	**L3**	**CO2**

		OR			
Q.4	**a.**	Explain : (i) Dynamic force analysis. (ii) D'Alembert's principle.	**10**	**L1**	**CO2**
	b.	A punching machine punches 38 mm holes in 32 mm thick plate requires 7 N-m/mm^2 of sheared area and punches one hole in every 10 sec. The mean speed is of the flywheel given is 25 m/sec. The punch has a stroke of 100 mm. Find : (i) Power required to drive the machine. (ii) Mass of the flywheel, if total fluctuation of speed is not to exceed 3%.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Define the following gear terminologies : (i) Pitch circle. (ii) Pitch circle diameter. (iii) Addendum (iv) Dedendum (v) Module.	**10**	**L1**	**CO3**
	b.	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact and length of arc of contact.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive with usual notations ; an expression for velocity ratio of compound gear trains.	**10**	**L2**	**CO3**
	b.	In an Epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in anticlockwise direction about centre of gear A which is fixed as shown in Fig. Q6 (b); then determine speed of gear B. If the gear A instead of being fixed makes 300 rpm in clockwise direction, what will be the speed of gear B? Use Tabular method.  Fig. Q6 (b)	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	A shaft carries 4 masses A, B, C, D in parallel planes in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively. Each of B and C has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between B and C is 100° and in between B and A is 190°, both being measured in same direction. The axial distance between A and B is 100 mm and in between B and C is 200 mm. For the shaft to be in complete balance, determine magnitude of masses at A and D as well as the angular position of mass at D.	**10**	**L3**	**CO4**
	b.	A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the 1st, 2nd and 4th cranks are 400 mm, 200 mm and 200 mm respectively from 3rd crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts of 3rd cylinder and relative angular positions of the cranks in order that the engine may be in complete primary balance.	**10**	**L3**	**CO4**

		OR			
Q.8	**a.**	Define the following terminologies : (i) Sensitiveness (ii) Stability (iii) Hunting (iv) Effort (v) Power.	**10**	**L1**	**CO4**
	b.	A Porter governor has equal arms each of 250 mm long and pivoted on the axis of rotation. Each flyball has a mass of 5 kg and the mass of central sleeve is 15 kg. The radius of rotation of the flyball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum, maximum speeds and the range of speed of the governor.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Define the following types of vibrations : (i) Free vibration. (ii) Forced vibration (iii) Damped vibration. (iv) Undamped vibration (v) Longitudinal vibration.	**10**	**L1**	**CO5**
	b.	Determine the natural frequency of the spring mass pulley system as shown in Fig. Q9 (b).  Fig. Q9 (b)	**10**	**L3**	**CO5**
		OR			
Q.10		Explain the following : **a.** Rotating unbalance. **b.** Reciprocating unbalance. **c.** Vibration isolation **d.** Critical speed.	**20**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME515D**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Energy Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Briefly explain the various steps involved in coal handling.	**10**	**L3**	**CO1**
	b.	Explain the working principle of Benson boiler with a neat sketch.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Draw the layout of a diesel power plant.	**10**	**L3**	**CO1**
	b.	List and explain the different methods of starting a diesel engine.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the solar radiation incident on the earth's surface.	**10**	**L3**	**CO2**
	b.	With the help of neat sketch, explain the method of extraction of solar energy from solar ponds.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Explain the working of floating drum biogas plant with a neat sketch.	**10**	**L3**	**CO3**
	b.	Explain the working of down draft gasifier with a neat sketch.	**10**	**L3**	**CO3**
		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of Hot dry rock geothermal plant.	**10**	**L3**	**CO3**
	b.	With a neat sketch, explain double basin arrangement of harnessing of tidal energy.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a block diagram, explain the basic components of wind energy conversion system.	**10**	**L3**	**CO3**
	b.	With a neat sketch, explain horizontal axis and vertical axis wind machines.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch, explain pumped storage hydroelectric power plant.	**10**	**L3**	**CO3**
	b.	The runoff data of a river at a particular site is tabulated below :	**10**	**L4**	**CO3**

Month	Mean discharge per month (millions of m^3)
January	40
February	25
March	20
April	10
May	0
June	50
July	75
August	100
September	110
October	60
November	50
December	40

(i) Draw a hydrograph and find the mean flow.
(ii) Also draw the flow duration curve.
(iii) Find the power in MW available at mean flow if the head available is 80 m and overall efficiency of generation is 85%. Take each month of 30 days.

OR					
Q.8	a.	With a neat sketch, explain closed Rankine cycle OTEC system.	10	L3	CO2
	b.	List the problems associated with Ocean Thermal Energy Conversion (OTEC).	4	L2	CO2
	c.	Explain the following terms related to hydroelectric power plant: (i) Pen stock (ii) Draft tube	6	L3	CO3
Module – 5					
Q.9	a.	Explain the principle of release of nuclear energy by fusion and fission reactions.	10	L3	CO3
	b.	Explain with a neat sketch, the general components of a nuclear reactor.	10	L3	CO3
OR					
Q.10	a.	With a neat sketch, explain the working of Pressurized Water Reactor (PWR).	10	L3	CO3
	b.	Explain the following : (i) Reactor shielding (ii) Radio active waste disposal.	10	L3	CO3

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CBCS SCHEME

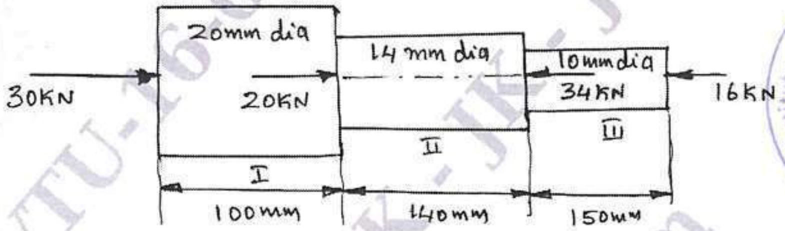
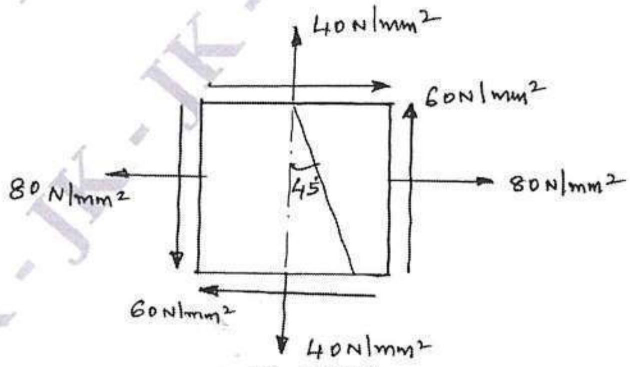
USN ☐☐☐☐☐☐☐☐☐☐ **BME301**

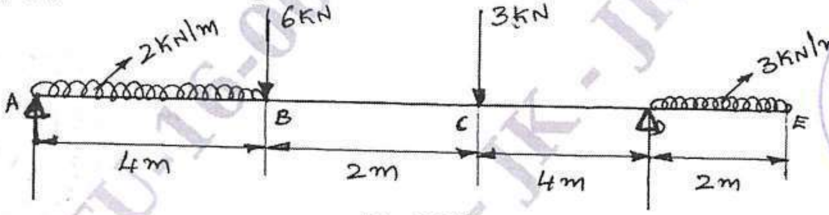
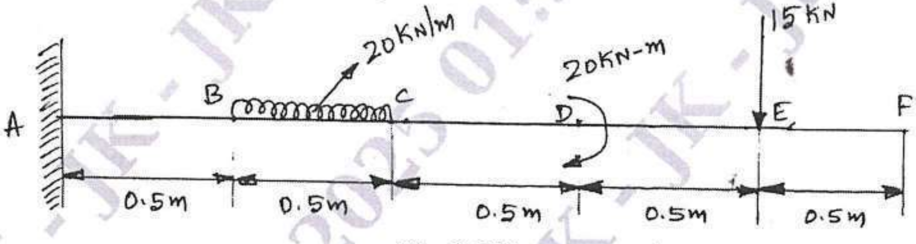
Third Semester B.E./B.Tech. Degree Examination, June/July 2025

Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following with necessary equations: (i) Stress (ii) Strain (iii) Young's modulus (iv) Poisson's ratio	**04**	**L1**	**CO1**
	b.	Explain with a neat sketch the stress-strain diagram for mild steel.	**06**	**L2**	**CO1**
	c.	Determine the overall change in length of the bar shown in the Fig.Q1(c) with following data : E = 100000 N/mm^2.  Fig.Q1(c)	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Derive the relationship among Young's modulus, Bulk modulus and Poisson's ratio.	**08**	**L2**	**CO1**
	b.	An aluminium bar of 50 mm diameter is stressed in a testing machine, at certain instant the applied force is 100 KN while measured elongation of rod is 0.219 mm in a 300 mm gauge length and decrease in diameter is 0.01215 mm. Calculate elastic constants of the material.	**12**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Define Principal planes and principal stresses.	**04**	**L1**	**CO2**
	b.	A point in a strained material, the stresses on two planes at right angles to each other are 80 N/mm^2 (tensile) and 40 N/mm^2 (tensile) each of the above stresses is accompanied by a shear stress of 60 N/mm^2 as shown in Fig.Q3(b). Determine normal stress, shear stress and resultant stress on an oblique plane inclined at angle of 45° to the axis of minor tensile stress. Also find the major principal stress minor principal stress and their location, maximum shear stress and its location. Sketch the major and minor principal stress and also maximum shear stress planes with respect to x-axis.  Fig.Q3(b)	**16**	**L3**	**CO2**

		OR			
Q.4	**a.**	What are the differences between thin and thick cylinder.	**04**	**L1**	**CO2**
	b.	Derive an equation for longitudinal stress for thin cylinder.	**06**	**L2**	**CO2**
	c.	Find the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal fluid pressure of 8 N/mm^2. The maximum allowance or permissible or hoop stress in the section is not to exceed 35 N/mm^2.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Define a beam. What are the different types of beams?	**06**	**L1**	**CO3**
	b.	Draw the shear force and bending moment diagrams for the beam shown in Fig.Q5(b). Also find the point of contraflexture.  Fig.Q5(b)	**14**	**L3**	**CO3**
		OR			
Q.6	**a.**	Define the following : (i) Sagging bending moment (ii) Hogging bending moment (iii) Point of contraflexture	**06**	**L1**	**CO3**
	b.	Draw the bending moment and shear force diagram for the beam shown in Fig.Q6(b).  Fig.Q6(b)	**14**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Derive the bending equation in the form of $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$	**10**	**L2**	**CO4**
	b.	A simply supported beam of span 5 m has a cross section of 150 mm × 250 mm if the permissible stress is 10 N/mm^2, find (i) Max intensity of uniformly distributed load it can carry. (ii) Max concentrated load 'P' applied at 2 m from one end it can carry.	**10**	**L3**	**CO4**
		OR			
Q.8		A cast iron beam of I-section shown in Fig.Q8, is simply supported over a span of 6 m. If the limiting bending stress under tension and compression for the material are 32.5 MPa and 65 MPa respectively. Determine uniformly distributed load inclusive of self weight that the beam can carry.	**20**	**L4**	**CO4**

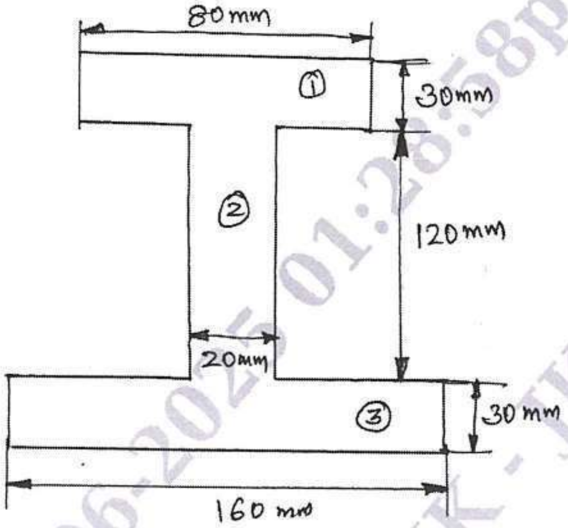


Fig.Q8

Module – 5

Q.9	**a.**	Derive torsion equation in the form of $\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$	**10**	**L2**	**CO5**
	b.	A solid shaft rotating at 1000 rpm transmits 50 KW. Maximum torque is 20% more than the mean torque. Material of the shaft has the allowable shear stress of 50 MPa and modulus of rigidity 80 GPa. Angle of twist in the shaft should not exceed 1° in one meter length. Determine the diameter of the shaft.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Define the following : (i) Column (ii) Buckling load (iii) Slenderness ratio (iv) Radius of gyration	**08**	**L1**	**CO5**
	b.	Derive an expression for Euler buckling load when both ends of the column are fixed.	**12**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME302

Third Semester B.E./B.Tech. Degree Examination, June/July 2025

Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	What is Pattern? Explain the following patterns used in sand casting. i) Split pattern ii) Match plate pattern iii) Sweep pattern	**10**	**L2**	**CO1**
	b.	Sketch and Explain Jolt type moulding machine.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Illustrate the different steps involved in shell moulding process.	**10**	**L2**	**CO1**
	b.	Explain how to determine the amount of clay present in the foundry sand.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain with neat sketch the construction and working of direct arc electric furnace.	**10**	**L2**	**CO2**
	b.	With a neat sketch, explain resistance furnace.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	What is die casting? With a neat sketch explain hot chamber die casting process.	**10**	**L2**	**CO2**
	b.	With a neat sketch explain semi-centrifugal casting process.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Distinguish between hot working and cold working process.	**10**	**L4**	**CO3**
	b.	Derive an expression for wire drawing load by slab analysis.	**10**	**L3**	**CO1**
		OR			
Q.6	**a.**	Explain bending operations with suitable sketches.	**10**	**L2**	**CO3**
	b.	With neat sketches, explain combination die and progressive die.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch, Explain Gas Tungsten Arc Welding (GTAW) Process.	**10**	**L2**	**CO4**
	b.	Distinguish between GAS Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW).	**10**	**L1**	**CO4**
		OR			
Q.8	**a.**	Explain submerged Arc Welding (SAW) process with a neat sketch.	**10**	**L2**	**CO4**
	b.	Analyze the types of flames that can be obtained during oxy-acetalene welding process.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following weld defects with neat sketches. i) Inclusion ii) Over penetration iii) Porosity iv) Undercut v) Spatter	**10**	**L2**	**CO5**
	b.	Write a note on Heat Affected Zone (HAZ) in welding with neat sketch.	**10**	**L1**	**CO5**
		OR			
Q.10	**a.**	Define soldering. Explain soldering iron process with a neat sketch.	**10**	**L2**	**CO5**
	b.	With a neat sketch. Explain friction stir welding process.	**10**	**L2**	**CO1**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME303**

Third Semester B.E./B.Tech. Degree Examination, June/July 2025

Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: Bloom's level, C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain classification of materials. Compare crystalline solids and non crystalline solids.	**10**	**L2**	**CO1**
	b.	Define (i) Crystal lattice (ii) Unit cell (iii) Planar atomic density (iv) Coordination number (v) Atomic packing factor.	**10**	**L1**	**CO1**
		OR			
Q.2	**a.**	Derive atomic packing factor for simple cubic structure.	**10**	**L2**	**CO1**
	b.	Explain edge and screw dislocations.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	State and explain HumeRothery rules.	**10**	**L1**	**CO2**
	b.	Explain Fick's laws of diffusion.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain iron-carbon diagram with a sketch.	**10**	**L2**	**CO2**
	b.	Two metals A and B are used to form an alloy containing 75% A and 25% B. A melts at 650°c and B at 450°c. The solid solubility of metal A is B and of B is A are negligible. The metal pair forms an eutectic at 40% A and 60% B which solidifies at 300°c. Assume liquids and solidus lines are straight draw phase diagram for the alloy series.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Explain (i) Annealing (ii) Normalizing (iii) Hardening (iv) Tempering (v) Nitriding.	**10**	**L1**	**CO3**
	b.	Explain with sketch Joming End Quench test.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Explain with a neat sketch flame hardening.	**10**	**L2**	**CO3**
	b.	Explain with a graph T-T-T diagram.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch explain physical vapours deposition.	**10**	**L2**	**CO4**
	b.	Write advantages and disadvantages of surface coating.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Explain different powder production techniques in mechanical methods.	**10**	**L2**	**CO4**
	b.	Explain the functions of lubricants and binders in powder metallurgy.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	State properties, composition and uses of low, medium and high carbon steels.	**10**	**L2**	**CO5**
	b.	Explain with sketch hand-layup process.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Briefly explain the selection criteria for selection of materials.	**10**	**L2**	**CO5**
	b.	With a sketch explain filament winding process.	**10**	**L2**	**CO5**

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CBCS SCHEME

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BME304

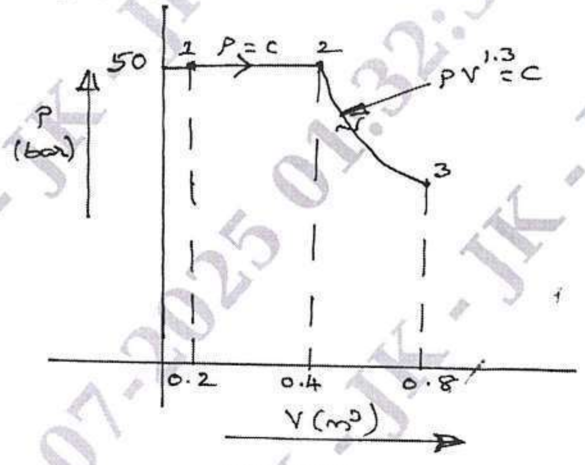
Third Semester B.E./B.Tech. Degree Examination, June/July 2025

Basic Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of thermodynamics data hand book and steam tables is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	State Zeroth Law of thermodynamics. Explain its significance in the measurement of temperature.	**6**	**L2**	**CO1**
	b.	Prove that work is a path function.	**4**	**L2**	**CO1**
	c.	The temperature 't' on a thermometric scale is defined in terms of property P by the relation t = a ℓnp + b, where a and b are constants. Experiments give values of P as 1.86 and 6.81 at the ice point and the steam point respectively. Evaluate the temperature 't' on the Celsius scale corresponding to a reading of P = 2.5 on the thermometer.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Define work from mechanics point of view and thermodynamics point of view. Explain the sign convention of work.	**6**	**L2**	**CO1**
	b.	Derive an expression for P-dV work for a polytropic process.	**6**	**L3**	**CO1**
	c.	Determine the total work done in a gas system following the expression process shown in Fig.Q2(c).  Fig.Q2(c)	**8**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	State and explain the first law of thermodynamics for closed system undergoing a cycle process.	**4**	**L2**	**CO2**
	b.	Prove that internal energy is a property of the system.	**6**	**L3**	**CO2**
	c.	The work and Heat are taken with several processes as a result of which the final state is identical with the initial state. The work transfer and the heat transfer are given in the Table Q3(c). Complete the cycle.	**10**	**L3**	**CO2**

Process	Q(kJ)	W(kJ)	du(kJ)
1 – 2	200	500	- - - - -
2 – 3	- - - - -	300	400
3 – 4	- - - - -	–200	- - - - -
4 – 1	50	0	- - - - -

Table Q3(c)

		OR			
Q.4	**a.**	Write a note on Perpetual Motion Machine of Kind I (PMMK I)	**4**	**L2**	**CO2**
	b.	With a neat sketch of steady flow device, write the steady flow energy equation with usual notations.	**6**	**L2**	**CO2**
	c.	The working fluid in a steady flow process flows at the rate of 220kg/min. The fluid rejects 100 kJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure 6 bar, internal energy 2000 kJ/kg, specific volume 0.36 m^3/kg and leaves the system at a velocity of 140 m/s, pressure 1.2 bar, internal energy 1400 kJ/kg, specific volume 1.3 m^3/kg. Determine the power output in KW. The change in potential energy is neglected.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Explain the limitations of first law of thermodynamics.	**4**	**L2**	**CO3**
	b.	Give the Kelvin-Plands statement and Clausicus statement of second law of thermodynamics.	**4**	**L2**	**CO3**
	c.	Define a heat engine, a heat pump and a refrigerator. Write the mathematical expressions for the efficiency of a heat engine, COP of a heat pump and a refrigerator. Prove that $(COP)_{\text{Heat pump}} = 1 + (COP)_{\text{Refrigerator}}$.	**12**	**L2**	**CO3**
		OR			
Q.6	**a.**	State and prove Clausius inequality.	**6**	**L3**	**CO3**
	b.	Explain the principle of increase of entropy.	**6**	**L2**	**CO3**
	c.	A heat engine receives 300 kJ/min of heat from a source at 327°C and rejects heat to a sink at 27°C. The hypothetical amounts of heat rejection are : i) 200 kJ/min ii) 150 kJ/min iii) 100 kJ/min. From these results, state which of these cores is a reversible cycle, irreversible cycle and impossible one.	**8**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch, explain how the dryness fraction of steam is determined using a combined separating and throttling calorimeter.	**10**	**L2**	**CO4**
	b.	Superheated steam from an initial condition of 5 bar and 300°C is expended isentropically to a pressure of 0.5 bars. Calculate : i) Find condition of steam after expansion ii) Change in enthalpy/kg of steam iii) Change in internal energy /kg of steam.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Explain the following terms : i) Triple point ii) Critical point iii) Sub cooled liquid iv) Quality of steam v) P – V – T surfaces.	**10**	**L2**	**CO4**
	b.	Derive an expression for the available energy from C_1 finite energy source at temperature T_1 when the surrounding temperature is T_0.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following : i) Maxwell's relations ii) Clausius Clapeyron equation.	**8**	**L2**	**CO5**
	b.	State and explain Dalton's law of partial pressure and Anagat's law of additive volumes.	**6**	**L2**	**CO5**
	c.	Define the following terms : i) Mass fraction ii) Mole fraction iii) Volume fraction.	**6**	**L2**	**CO5**
		OR			
Q.10	**a.**	Write a note on compressibility factor and generalized compressibility chart.	**10**	**L2**	**CO5**
	b.	Determine the pressure exerted by CO_2 in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C using : i) Ideal gas equation ii) Vander Waal's equation . Find the compressibility factor using the value of pressure obtained from Vanderwaal's equation.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME306D

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Waste Handling and Management

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Describe the various steps involved in waste management logistics.	**10**	**L2**	**CO1**
	b.	Illustrate the fees schemes in waste management.	**10**	**L3**	**CO2**
		OR			
Q.2	**a.**	Identify the human and technological components of waste management. Illustrate with an example.	**10**	**L3**	**CO1**
	b.	Provide an overview of programs that promote public awareness of waste management.	**10**	**L2**	**CO2**
		Module – 2			
Q.3	**a.**	Explain the characteristics and types of solid waste with relevant examples.	**10**	**L2**	**CO1**
	b.	Compare biomethanation and biohydrogen production for solid waste processing, highlighting their processes, advantages and limitations.	**10**	**L3**	**CO3**
		OR			
Q.4	**a.**	Analyze the role of material recovery facilities in the mechanical treatment of solid waste.	**10**	**L3**	**CO2**
	b.	Discuss the following thermal treatment techniques in the solid waste management: (i) Co-combustion (ii) Pyrolysis	**10**	**L2**	**CO4**
		Module – 3			
Q.5	**a.**	Define hazardous waste and explain its classification based on its characteristics.	**10**	**L2**	**CO1**
	b.	Propose a systematic plan for the collection, segregation, treatment and disposal of biomedical waste.	**10**	**L3**	**CO2**
		OR			
Q.6	**a.**	Explain the environmental and societal impacts of improper e-waste disposal along with possible recycling and reuse strategies.	**10**	**L2**	**CO4**
	b.	Outline the health and environmental effects of nuclear waste and the key steps in decommissioning nuclear power reactors.	**10**	**L3**	**CO4**

		Module – 4			
Q.7	**a.**	Provide a brief review of entrepreneurship activities in waste management.	**10**	**L3**	**CO3**
	b.	Explain in detail the how remediation of hazardous waste contaminated sites is carried out.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Explain with a case study, how effective waste management and handling practices are implemented in India and other countries.	**10**	**L2**	**CO4**
	b.	Analyze case studies of different municipalities waste handling techniques focusing on domestic, medium and large scale and centralized composting.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the objectives and key provisions of the Environmental Protection Act.	**10**	**L2**	**CO5**
	b.	Discuss the objectives and main features of the Plastic Waste Rule 2011 and E-waste Rules, 2011.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Discuss the main features of the Hazardous Waste Rules, 2008 and Batteries Rules 2011.	**10**	**L2**	**CO5**
	b.	Explain the duties of constitutional bodies and Ministers in waste management rules of India.	**10**	**L2**	**CO5**

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CBCS SCHEME

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BME401

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Thermodynamic data handbook is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	With P-V and T-S diagrams, derive air standard efficiency of diesel cycle. State the assumptions made.	**10**	**L3**	**CO1**
	b.	The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process, the pressure is 1 bar and the temperature is 300K. The heat transfer to the cycle is 1900 kJ/kg of air. Calculate i) pressure and temperature at the end of each process of the cycle ii) Thermal efficiency iii) Mean effective pressure.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	With a p – θ diagram, explain the stages of combustion in SI engine.	**10**	**L2**	**CO1**
	b.	In a test on three cylinder four stroke IC engine, with 22 cm bore and 26 cm stroke, the following observations were made during a trail period of 1 hour. Fuel consumption = 8 kg ; Air comsumption = 300 kg ; Ambient temperature = 30° C ; Calorific value of fuel = 45000 kJ/kg ; Net load on the brake = 1500 N ; Brake drum diameter = 1.8 m ; Rope diameter = 3 cm ; Mass of cooling water circulated = 550 kg ; Inlet and exit temperature of cooling water = 27 °C and 55 °C. Total revolutions of the cycle = 12000 m.e.p = 6 bar. Exhaust gas temperature = 310 °C ; C_p for exhaust gases = 1.1 kJ/kg K. Calculate IP , BP , Mechanical efficiency and indicated thermal efficiency. Draw up heat balance sheet on minute basic.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	With a block diagram and T – S diagram, explain , how intercooling , reheating and regenerating improves thermal efficiency of gas turbine plant.	**10**	**L2**	**CO2**
	b.	In a regenerative gas turbine cycle, air enters the compressor at 1 bar, 15°C. The pressure ratio is 6. The isentropic efficiency of compressor and turbine is 0.8 and 0.85 respectively. The maximum temperature in the cycle is 800 °C. The effectiveness of regenerator is 0.78. Assume C_p = 1.005 kJ/kg K, γ = 1.4 for air and C_p = 1.4 kJ/kg K , γ = 1.32 for combustion products. Find the cycle efficiency.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	With a neat diagram, explain the working of Turbo prop. Also draw T – S diagram.	**10**	**L2**	**CO2**
	b.	With a neat sketch, explain the working of Rocket engine.	**10**	**L2**	**CO2**

		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of Reheat Rankine cycle. Show the processes on P – V and T – S diagrams.	**10**	**L2**	**CO3**
	b.	A simple Rankine cycle works between the pressures of 30 bar and 0.04 bar. The initial condition of steam being dry saturated. Calculate the cycle efficiency , work ratio and specific steam consumption.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a T – S diagram, explain the effect of following parameters on Ranking cycle efficiency. i) Pressure of steam at inlet to turbine. ii) Pressure of steam at the end of expansion.	**10**	**L2**	**CO3**
	b.	A regenerative cycle operated with steam supplied at 30 bar and 300 °C and condenser pressure of 0.08 bar. The extraction points for two open type feed water heaters are at 3.5 bar and 0.7 bar. Calculate thermal efficiency of the plant neglecting pump work.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a schematic diagram, explain the working of vapour absorption refrigeration system. Show the processes on T – S diagram.	**10**	**L2**	**CO4**
	b.	An ammonia vapour compression refrigeration system operates between evaporator pressure of 1.9 bar and condenser pressure of 15.6 bar. The vapour has a dryness fraction of 0.864 at entry to the compressor. Determine COP and refrigeration effect produced for a work input of 1 kW.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	With a neat schematic diagram, explain the working of summer air conditioning for hot and dry weather. Show the processes on psychrometric chart.	**10**	**L2**	**CO4**
	b.	Following data refers to an air conditioning system to be designed for an industrial process for hot and wet climate. Outside conditions : 30°C DBT , 75% RH Required inside conditions : 20°C DBT , 60% RH. The required condition is achieved first by cooling and dehumidifying and then by heating. Find i) Capacity of cooling coil in TOR ii) Capacity of heating coil in kW iii) Amount of water vapour removed per hour.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	For a single acting reciprocating air compressor, show that the clearance volume do not effect the work of compression.	**10**	**L4**	**CO5**

	b.	Air at 1 bar and 27°C is compressed to 7 bar by a single stage reciprocating compressor according to the law $PV^{1.3} = C$. The free air delivered was 1 m^3/min. Speed of compressor = 300 rpm , Stroke to bore ratio = 1.5 , Mechanical efficiency = 85% and motor transmission efficiency = 90%. Determine i) IP and Isothermal efficiency ii) Cylinder dimensions iii) Power of the motor.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive Critical pressure ratio expression for a flow through steam nozzle.	**10**	**L4**	**CO5**
	b.	Dry saturated steam at a pressure of 11 bar enters a C – D nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic frictionless, determine i) exit velocity of steam ii) Ratio of cross – sectional area at exit to throat. Assume condition for maximum discharge.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME402**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Machining Science and Metrology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Distinguish between orthogonal cutting and oblique cutting with neat sketches. Also justify which type of cutting method is preferred, why?	**06**	**L2**	**CO1**
	b.	With a neat sketch, explain single point cutting tool nomenclature.	**06**	**L2**	**CO1**
	c.	The following data are obtained during a turning operation on a Lathe, cutting Force = 120 kg, Feed force = 30 kg, Rake angle = 15°, Feed rate = 0.2 mm/rev, chip thickness = 0.3 mm, cutting speed = 100 m/min, work piece diameter = 120 mm, Depth of cut = 0.4 mm. calculate, a) Chip thickness ratio b) Shear angle c) Co-efficient of friction d) Friction angle e) Shear stress	**08**	**L3**	**CO1**
		OR			
Q.2	**a.**	Mention the assumption of merchant circle model, draw the neat sketch of merchant circle with all the notation.	**06**	**L2**	**CO1**
	b.	Derive the relation between Rake angle, shear angle and Frictional angle.	**08**	**L2**	**CO1**
	c.	With a neat sketch explain the principle of Lathe machine. Also distinguish between Turret Lathe and Capstan Lathe.	**06**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the constructional feature of column and knee type milling machine with a neat sketch.	**06**	**L2**	**CO2**
	b.	What is Indexing? Mention the different method, also write the steps for Indexing 69 divisions.	**08**	**L3**	**CO2**
	c.	Distinguish between Up milling and Down milling with sketches.	**06**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain the constructional feature of radial drilling machine with a neat sketch.	**06**	**L2**	**CO2**
	b.	A 12 mm hole is to be drilled through a 20 mm thick plate. The cutting speed is 12 m/min and the feed rate is 0.12 mm/rev. Estimate the machining time. Take the over travel plus the clearance of the tool as 5 mm.	**08**	**L3**	**CO2**
	c.	Distinguish between shaping and planning machine.	**06**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	With a neat sketch Explain the different temperature zones during metal cutting process.	**06**	**L2**	**CO3**
	b.	Determine the percentage change in the cutting speed required to give 60% reduction in tool life. The speed /life of the tool relationship is given by $VT^n = G$. Take n = 0.2.	**08**	**L3**	**CO3**
	c.	What are the functions of coolants in metal cutting process. Mention some of the coolants used during metal cutting.	**06**	**L2**	**CO3**

		OR			
Q.6	**a.**	What do you mean by tool life? Mention the tool life equation with usual notation, also mention the parameters on which tool life is depending.	**06**	**L2**	**CO1**
	b.	Explain with a neat sketch, Flank and creator wear.	**06**	**L2**	**CO3**
	c.	A lathe turning at a particular speed is cutting a mild steel work piece with H.S.S tool. The speed – life relationship for the tool is given by $VT^{0.4} = 400$. Determine the percentage increase in the tool life of the cutting speed is reduced by 20%	**08**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	What are the difference between line standards and end standards. Also mention the characteristics of Line standards.	**08**	**L2**	**CO1**
	b.	Explain the wringing phenomenon with a neat sketch.	**06**	**L2**	**CO1**
	c.	List the slips to be wrung together to produce on overall dimension of 92.357 mm using two protection slips of 2.500 mm size. Show the slip gauge combination.	**06**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define Fit. Explain the types of fit and their designation. With sketches. (any 2)	**06**	**L2**	**CO4**
	b.	With a neat sketch, Explain Hole basis system and shaft basis system.	**06**	**L2**	**CO4**
	c.	Determine the dimension of the shaft and hole for a fit 30 H_8/d_{10} and sketch the fit for the following. i) Diameter 30 falls in the dia range 18-30, upper deviation for "d" shaft is $-16\,D^{0.44}$ ii) $i=0.45\,D^{1/3} + 0.001\,D$. Tolerance for IT 8 = 25i, Tolerance for IT10 = 64i	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following with neat sketches. i) Plug gauges ii) Ring gauges iii) Snap gauge iv) Concept of limits of size and Tolerance	**12**	**L2**	**CO5**
	b.	Determine the type of fit after deciding the fundamental deviation and tolerance in the following. Also sketch the fit : i) Fit $\phi 70\ H_9\ e_7$ Diameter step (50-80) ii) Fundamental deviation for e shaft $= -11D^{0.41}$ Take, IT7 = 16i and IT9 = 40i, $i = 0.45\sqrt[3]{D} + 0.001D$	**08**	**L3**	**CO5**
		OR			
Q.10	**a.**	Describe with a neat sketch, the construction and working of L.V.D.T.	**10**	**L2**	**CO5**
	b.	Explain the principle of sine – bar with sketch. Also build the angle $37°\ 9^1\ 18^{11}$ using angle gauges with sketch.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME403**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025

Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following properties of fluids and mention their SI units: (i) Mass Density (ii) Specific weight (iii) Kinematic viscosity	**06**	**L1**	**CO1**
	b.	Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with an angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of the oil film is 1.5 mm.	**08**	**L3**	**CO1**
	c.	Calculate the capillary rise in a glass tube of 3.0 mm diameter when immersed vertically in (i) water and (ii) mercury. Take surface tensions for mercury and water as 0.0725 N/m and 0.52 N/m respectively in contact with air. Specific gravity for mercury is given as 13.6.	**06**	**L3**	**CO1**
		OR			
Q.2	**a.**	Distinguish between (i) Absolute pressure (ii) Gauge pressure (iii) Gauge vacuum (iv) Atmospheric pressure. Indicate their relative position on a chart.	**06**	**L2**	**CO1**
	b.	Derive an expression for the total pressure and the depth of centre of pressure for a inclined surface submerged in water.	**08**	**L3**	**CO1**
	c.	A square plate of 1.5 m side is immersed in water vertically. Find the hydrostatic force on the plate and the depth of centre of pressure from free surface of water. When its upper side is 0.5 m below the free surface of water.	**06**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Define the following : (i) Steady and Unsteady flow (ii) Compressible and Incompressible flow (iii) Laminar and Turbulent flow	**06**	**L2**	**CO2**
	b.	Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional flow.	**08**	**L3**	**CO2**
	c.	The velocity components in a two-dimensional flow are : $u = 8x^2y - \frac{8}{3}y^3$ and $v = -8xy^2 + \frac{8}{3}x^3$ Show that these velocity component represent a possible case of an irrotational flow.	**06**	**L3**	**CO2**

		OR			
Q.4	**a.**	Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow.	**08**	**L3**	**CO2**
	b.	A fluid of viscosity 0.5 poise and specific gravity 1.20 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 147.15 N/m^2. Find (i) The pressure gradient (ii) The average velocity (iii) The Reynolds number of the flow.	**08**	**L3**	**CO2**
	c.	Define Reynolds number. Explain its significance in fluid flow.	**04**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Derive Euler's equation of motion along a stream line. Obtain Bernoulli's equation from Euler's equation. Mention the assumptions made.	**08**	**L3**	**CO3**
	b.	Derive the expression for the rate of flow of fluid through a horizontal venturimeter.	**06**	**L3**	**CO3**
	c.	A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 14.715 N/cm^2 and vacuum pressure at the throat is 40 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$.	**06**	**L3**	**CO3**
		OR			
Q.6	**a.**	Explain the procedure to find the loss of head due to friction in pipes using (i) Darcy formula and (ii) Chezy's formula.	**06**	**L2**	**CO3**
	b.	Obtain expression for head loss in a sudden expansion in the pipe. List all the assumptions made in the derivation.	**08**	**L3**	**CO3**
	c.	Calculate the rate of flow of water through a pipe of diameter 300 mm. When the difference of pressure head between the two ends of a pipe 400 m apart is 5 m of water. Take value of f = 0.009 in the formula. $h_f = \frac{4 f l V^2}{d \times 2g}$	**06**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	What do you understand by the terms boundary layer and boundary layer theory?	**04**	**L1**	**CO4**
	b.	Define displacement thickness. Derive an expression for the displacement thickness.	**08**	**L3**	**CO4**
	c.	Oil with a free-stream velocity of 2 m/s flow over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and the shear stress at the trailing end point and determine the total surface resistance of the plate. Take specific gravity as 0.86 and kinematic viscosity as 10^{-5} m^2/s.	**08**	**L3**	**CO4**

		OR			
Q.8	**a.**	Explain the following terms: (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity	**06**	**L2**	**CO4**
	b.	State Buckingham's π - theorem. What do you mean by repeating variables?	**06**	**L2**	**CO4**
	c.	The frictional torque 'T' of a disc of diameter 'D' rotating at a speed 'N' in a fluid of viscosity 'μ' and density 'ρ' in a turbulent flow is given by 'T'. Show that $T = D^5N^2\rho\phi\left[\frac{\mu}{\rho ND^2}\right]$	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	State the Bernoulli's theorem for compressible flow. Derive an expression for Bernoulli's equation when the process is (i) Isothermal (ii) Adiabatic.	**10**	**L3**	**CO5**
	b.	Define Mach number. Explain its importance in compressible fluid flow.	**05**	**L2**	**CO5**
	c.	Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg °K, take K for air 1.4. Assume temperature as 15°C.	**05**	**L3**	**CO5**
		OR			
Q.10	**a.**	What is CFD? Mention the advantages and disadvantages of CFD.	**08**	**L1**	**CO5**
	b.	What are the steps involved in solving a CFD problem? Explain.	**06**	**L2**	**CO5**
	c.	An aeroplane is flying at an height of 15 km, where the temperature is – 50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg °K. Find the speed of the plane.	**06**	**L3**	**CO5**

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CBCS SCHEME

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BME405A

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025

Non Traditional Machining

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Non-traditional Machining process. Also give the classification of non-traditional machining process based on different energy sources.	**10**	**L1**	**CO1**
	b.	Explain the need for non-traditional machining process.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain the selection of non-traditional machining process.	**08**	**L2**	**CO2**
	b.	What are the specific advantages , disadvantages and applications of non-traditional machining process.	**12**	**L2**	**CO2**
		Module – 2			
Q.3	**a.**	Write a neat sketch of Ultrasonic Machining (USM) process and label the important parts. Also explain principle of working.	**12**	**L2**	**CO2**
	b.	Discuss the process characteristics like material removal rate, tool wear, accuracy and surface finish of USM.	**08**	**L2**	**CO3**
		OR			
Q.4	**a.**	With a neat sketch explain working principle of Abrasive Jet Machining process.	**12**	**L2**	**CO2**
	b.	Explain the process variables in Abrasive Jet Machining process.	**08**	**L1**	**CO2**
		Module – 3			
Q.5	**a.**	With a neat sketch explain principle of working of Electro Chemical Machining process (ECM).	**12**	**L2**	**CO2**
	b.	Explain the process parameters of ECM like current density, tool feed rate, gap between tool and workpiece, flow rate of electrolyte.	**08**	**L1**	**CO2**
		OR			
Q.6	**a.**	With a neat sketch explain electrochemical honing process, also write advantages and limitations of the process.	**08**	**L2**	**CO2**
	b.	Explain the following with respect to chemical machining process: i) Chemical blanking process ii) Chemical Milling process	**12**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	With a neat sketch explain mechanism of metal removal in EDM process.	**12**	**L1**	**CO4**
	b.	What is Dielectric Fluid? Explain the desirable properties of a dielectric fluid medium used in EDM process. Also list the different dielectric fluids.	**08**	**L2**	**CO4**
		OR			
Q.8	**a.**	With a sketch explain working of Plasma Arc Machining process (PAM).	**10**	**L2**	**CO4**
	b.	Explain the safety precaution in PAM.	**06**	**L2**	**CO4**
	c.	Write the applications of EDM process.	**04**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	With a help of neat sketch explain working principle of Laser Beam Machining process (LBM).	**12**	**L2**	**CO2**
	b.	What are the advantages , limitations and applications of LBM.	**08**	**L1**	**CO2**
		OR			
Q.10	**a.**	With a neat sketch explain Electron Beam Machining process (EBM).	**12**	**L2**	**CO2**
	b.	What are the advantages , limitations and applications of EBM.	**08**	**L1**	**CO2**

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CBCS SCHEME

USN

BME/BSA/BAG/BMT501

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Industrial Management and Entrepreneurship

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain in detail the nature and characteristics of management process.	**10**	**L2**	**CO1**
	b.	Discuss the functional areas of management.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain in detail the steps involved in planning.	**10**	**L2**	**CO1**
	b.	Explain in detail the decision making process.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the important principles of organization structure.	**10**	**L2**	**CO2**
	b.	Explain the process of selection and recruitment.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain the basic styles of leadership.	**10**	**L2**	**CO2**
	b.	Explain theories of motivation.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Write a note on different types of entrepreneurs.	**10**	**L1**	**CO2**
	b.	Explain in detail the barriers to entrepreneurship.	**10**	**L2**	**CO2**
		OR			
Q.6	**a.**	Explain the stages in entrepreneurial process.	**10**	**L2**	**CO2**
	b.	Write a note on role of entrepreneurs in economic development.	**10**	**L1**	**CO2**
		Module – 4			
Q.7	**a.**	Explain the main objectives of developing small scale industries.	**10**	**L2**	**CO3**
	b.	Write a note on role of SSI in economic development.	**10**	**L1**	**CO3**
		OR			
Q.8	**a.**	Explain the steps to start a small scale industry.	**10**	**L2**	**CO3**
	b.	Write a note on government policy towards SSI.	**10**	**L1**	**CO3**

		Module – 5			
Q.9	**a.**	Write a note on: i) KIADB ii) KSSIDC	**10**	**L1**	**CO3**
	b.	Explain the guidelines issued by planning commission for preparation of project report.	**10**	**L2**	**CO3**
		OR			
Q.10	**a.**	Write a note on: i) NSIC ii) KSFC.	**10**	**L1**	**CO3**
	b.	Explain the different studies to be carried out for appraisal of a project.	**10**	**L2**	**CO3**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME502**

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Steam table is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Draw and explain the parts of general turbomachines.	**6**	**L2**	**CO1**
	b.	Distinguish between turbomachines and positive displacement machines.	**6**	**L2**	**CO1**
	c.	1/5 scale model of a pump was tested in a laboratory at 1000 rpm. The head developed and power input at the best efficiency point were found to be 8 m and 30 KW. If the prototype pump has to work against a head of 25 m, determine its working speed, power required to drive it and the ratio of flow rates handled by the two pumps.	**8**	**L3**	**CO1**
		OR			
Q.2	**a.**	Define the static and stagnation state of fluid.	**4**	**L2**	**CO1**
	b.	Define the following with the help of h-s diagram for power absorbing and power generating machine. i) Total to total efficiency ii) Total to static efficiency iii) Static to total efficiency iv) Static to static efficiency.	**8**	**L2**	**CO1**
	c.	Show that the polytrophic efficiency during expansion process is given by $\eta_p = \dfrac{\ln(T_2/T_1)}{\left(\dfrac{\gamma-1}{\gamma}\right)\ln(P_1/P_2)}$	**8**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Define degree of reaction and utilization factor. Establish relation between them.	**10**	**L2**	**CO2**
	b.	Draw the velocity triangle at inlet and outlet of turbo machines and derive the Euler turbine equation with usual notations.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Derive head-capacity relationship for centrifugal pump and explain the effect of discharge angle on it.	**10**	**L2**	**CO2**

	b.	An inward flow radial vane turbine has the following data, power = 150 kW, speed = 32000 rpm, out diameter of the impeller = 20 cm, inner diameter of the impeller 8 cm, absolute velocity of gas at entry = 387 m/sec. Absolute velocity of gas at exit = 193 m/sec and radial in direction. Construct the velocity triangles at entry and exit of the impeller and determine: i) Mass flow rate ii) Percentage energy transfer due to change of radius.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Prove that maximum blade efficiency of a single impulse turbine is given by $\eta_b = \cos^2\alpha_1$ with combined velocity diagram.	**10**	**L2**	**CO3**
	b.	The nozzle of a D-laval turbine delivers 2 kg /sec of steam at a speed of 2400 m/sec. The nozzle are inclined at an angle of 16 degree to the plane of the wheel. The blade velocity is 600 m/sec. Allowing a blade velocity coefficient of 0.72, calculate: i) Blade efficiency ii) Power developed by the blades iii) Energy lost in the blades. The blade angle at outlet may be taken as 25°.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Prove the condition for maximum efficiency of a reaction turbine using a combined velocity diagram.	**10**	**L2**	**CO3**
	b.	The following particulars refer to a stage of an impulse reaction turbine. Outlet angel of fixed blade = 20°, outlet angle of moving blades = 30°, radial height of fixed and moving blades = 10 cm, mean blade velocity = 138 m/sec, blade speed ratio = 0.625, specific volume of steam at fixed blade outlet = 1.235 m^3/kg, specific volume of steam at moving blade out = 1.305 m^3/kg, speed of the rotor = 3000 rpm, calculate the degree of reaction, the adiabatic heat drop in pair of blade rings and gross stage efficiency, Given the following coefficient which are same for both fixed and moving blades, $\eta = 0.9$, carry over coefficient = 0.86.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Define and write mathematical equation. i) Hydraulic efficiency ii) Mechanical efficiency iii) Overall efficiency iv) Volumetric efficiency.	**10**	**L2**	**CO4**
	b.	In a power station, a pelton wheel produce 15000 KW under a head of 350 m, while running at 500 rpm. Assume a turbine efficiency of 0.84, coefficient of velocity for Nozzle as 0.98, speed ratio 0.46 and bucket velocity coefficient 0.86. Calculate: i) Number of jet ii) Diameter of each jet iii) Tangential force exerted on the buckets if the bucket deflect the jet through 165°.	**10**	**L3**	**CO4**

		OR			
Q.8	**a.**	Explain with a next sketch working of hydro electric power plant.	**6**	**L1**	**CO4**
	b.	With a neat sketch. Explain the working of draft tube and list out the application.	**4**	**L2**	**CO4**
	c.	The following data is given for a Francis turbine. Net head = 70 m, speed = 600 rpm, power at the shaft = 367.5 kW, overall efficiency = 85%, hydraulic efficiency = 95%, flow ratio = 0.25, width ratio = 0.1, outer diameter to inner diameter ratio = 2.0. The thickness of vanes occupies 10% of the circumferential area of runner, velocity of flow is constant at inlet and discharge is radial at outlet. Determine: i) Guide blade angle ii) Runner vane angle at inlet and outlet iii) Width of the wheel at inlet iv) Diameter of runner at inlet and outlet.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Derive an expression for a minimum starting speed of a centrifugal pump.	**5**	**L2**	**CO5**
	b.	Derive an expression for the static pressure rise in the impeller of a centrifugal pump with inlet and outlet velocity diagram.	**5**	**L2**	**CO5**
	c.	A centrifugal pump running at 1000 rpm. The outlet angle of vane is 45° and the velocity of flow at outer let is 2.5 m/sec, the discharge through the pump is 200 lit/sec, when the pump is working against the total head of 20 m, if the nanometric efficiency of the pump is 80%, determine : i) Diameter of the impeller ii) Width of the impeller at outlet.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Explain with a neat sketch working of centrifugal compressor.	**5**	**L2**	**CO5**
	b.	Explain the surging and choking in centrifugal compressor.	**5**	**L2**	**CO5**
	c.	An axial flow compressor stage draws air from with the stagnation conditions 1.013 bar and 308 K. Assuming 50% reaction stage with a flow coefficient of 0.52 and the ratio $\Delta V_{w/h} = 0.25$, find the rotor blade angle at the inlet and exit as well as the mean rotor speed. The total to total efficiency of the stage is 0.87 when the stage produces a total to total pressure ratio of 1.23. Find also pressure coefficient and the power input to the system, assuming the work input factor to be 0.86. The mass flow rate is 12 kg/sec.	**10**	**L3**	**CO5**

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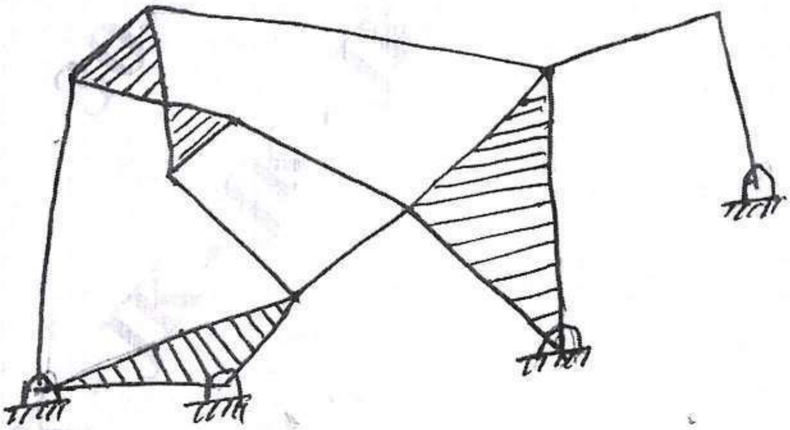
CBCS SCHEME

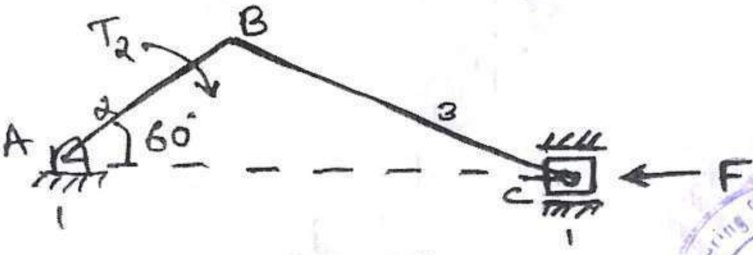
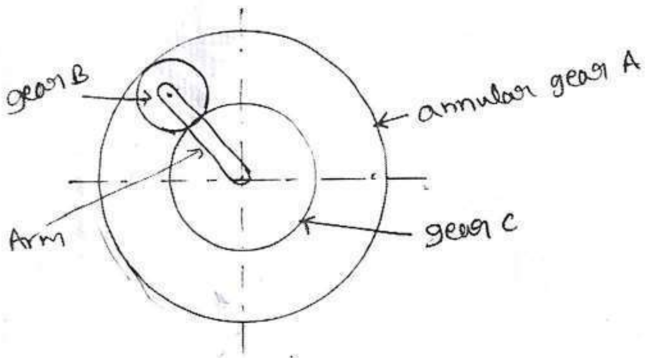
USN ☐☐☐☐☐☐☐☐☐☐ **BME503/BMR503**

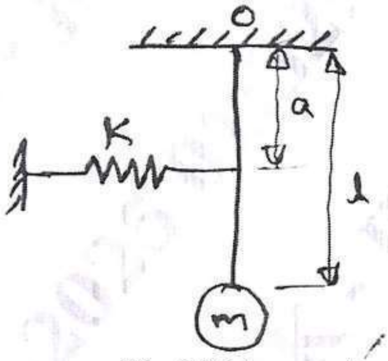
Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define : i) Kinematic link ii) Kinematic pair iii) Kinematic joint iv) Kinematic mechanism v) Machine.	5	L1	CO1
	b.	Applying the knowledge of inversion of mechanisms, illustrate with a neat sketch a mechanism to, i) Draw an ellips ii) Draw a straight line.	7	L3	CO1
	c.	Apply the concept of complex algebra method to find the angular velocity of connecting rod and linear velocity of piston in a slider crank machinasnim. The crank radius in 100 mm and length of connecting rod is 500 mm. The crank is rotating in CCW at an angular velocity of 15 rad/s. When crank is at 60°.	8	L3	CO1
		OR			
Q.2	**a.**	Classify kinematic pair based on relative motion.	10	L2	CO1
	b.	Define degrees of freedom and mobility of mechanism.	4	L1	CO1
	c.	Calculate the mobility (Dof) of the following mechanism.  Fig.Q2(c)	6	L3	CO1

		Module – 2			
Q.3	**a.**	Analyze the static equilibrium of a member subjected to two force system, three force system and two force and a torque.	8	L3	CO1
	b.	Analysis the driving torque T_2 on the crank of a mechanism shown in Fig.Q3(b) for static equilibrium. Given, F = 2500N, AB = 100 mm, BC = 400 mm.  Fig.Q3(b)	12	L3	CO1
		OR			
Q.4	**a.**	Analyse D'Alembert's principle for dynamic force analysis.	5	L3	CO2
	b.	Apply the concepts of dynamic force analysis to determine the inertia forces of the 4-link mechanism. AB = 500 mm, BC = 660 mm, CD = 560 mm, and AD = 1000 mm, the link AB has an angular velocity of 10.5 rad/s CCW and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD are 4.2 kg/m length. The link AB has a mass of 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertia of 88500 kg.mm^2.	15	L3	CO2
		Module – 3			
Q.5	**a.**	Explain with a neat sketch law of gearing.	8	L2	CO3
	b.	Two gear wheels of module pitch 4.5 mm have 24 and 33 teeth respectively. Pressure angle 20°, each wheels has a standard addendum of 1 module. Find the length of arc of contact and velocity of sliding if the speed of smaller wheel is 120 rpm.	12	L3	CO3
		OR			
Q.6	**a.**	What is a gear train? Explain with a neat sketch any 3 types of gear train.	7	L2	CO3
	b.	An epicyclic gear train consists of three gears A, B and C and shown in Fig.Q6(b). The number of teeth on annular gear A is 74 and on gear C is 34. The gear B meshes with both gears A and C and is carried on an arm F which rotates about the centre A at 25 rpm. If the gear A is fixed, find the speed of gear B and C.  Fig.Q6(b)	8	L3	CO3
	c.	With a neat sketch, explain spur gear terminology.	5	L2	CO3

		Module – 4			
Q.7	**a.**	What is static and dynamic balancing?	**5**	**L1**	**CO4**
	b.	Four masses, $m_1 = 100$ kg, $m_2 = 175$ kg, $m_3 = 200$ kg and $m_4 = m_4 = 125$ kg are fixed to the crank of 200 mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3 and 4 with respect to 1 are 75°, 135° and 240° taken in the same sense. Distances of the planes 2, 3, and 4 from 1 are 600 mm, 1800 mm and 2400 mm. Determine the magnitude and position of balancing masses at radius 600 mm in planes ℓ and m located in the middle of 1 and 2 and in the middle of 3 and 4 respectively.	**15**	**L3**	**CO4**
		OR			
Q.8	**a.**	What is a governor? Derive an expression for the equilibrium speed of a porter governor.	**8**	**L2**	**CO5**
	b.	The arms of a porter governor are each 250 mm long and pivoted on governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radii of rotation of balls at minimum and maximum speed are 150 mm and 200 mm respectively. Find the speed range of governor.	**12**	**L3**	**CO5**
		Module – 5			
Q.9	**a.**	With usual notations, determine the natural frequency of a simple pendulum by neglecting the mass of the rod.	**7**	**L2**	**CO6**
	b.	Find the natural frequency of the system shown in Fig.Q9(b) by neglecting the mass of the rod.  Fig.Q9(b)	**13**	**L3**	**CO6**
		OR			
Q.10	**a.**	Write a note on : i) Vibration isolation ii) Critical speed.	**8**	**L1**	**CO6**
	b.	An electric motor is supported on a spring and dash pot. The spring has the stiffness 6400 N/m and the dashpot offers resistance of 500 N at 4 m/s. The unbalanced mass 0.5 kg rotates at 5 cm radius and the total mass of vibratory system is 20 kg. The motor runs at 400 rpm. Determine : i) Damping factor ii) Amplitude of vibration and phase angle iii) Resonant speed and resonant amplitude iv) Forces exerted by the spring and dashpot on the motor.	**12**	**L3**	**CO6**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME515D

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Energy Engineering

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	With a neat sketch, explain the working of Benson boiler.	10	L2	CO1
	b.	Why cooling towers and ponds are used in thermal power stations?	2	L1	CO1
	c.	Explain the importance of accessories of boiler.	8	L2	CO1
		OR			
Q.2	a.	Explain the applications of diesel engines in power field.	10	L2	CO1
	b.	With a neat sketch, explain the layout of diesel power plant.	10	L2	CO1
		Module – 2			
Q.3	a.	Explain the working principle of pyranometer and pyrhaliometer with a neat sketch.	10	L2	CO2
	b.	With a neat sketch, explain the solar pond electric power generation.	10	L2	CO2
		OR			
Q.4	a.	With a neat sketch, explain the working of floating drum biogas plant.	10	L2	CO3
	b.	Explain the factors affecting biogas generation.	10	L2	CO3
		Module – 3			
Q.5	a.	With a neat sketch, explain the working of dry steam geothermal power plant.	10	L2	CO3
	b.	With a neat sketch, explain the working of double basin tidal power plant.	10	L2	CO3
		OR			
Q.6	a.	What are the advantages and limitations and applications of wind energy?	10	L2	CO3
	b.	With a neat sketch, explain the working principle of horizontal axis wind turbine.	10	L2	CO3
		Module – 4			
Q.7		Write a short note of the following : i) Hydrographs and flow duration curves. ii) Storage and pondage. iii) Penstock and surge tank. iv) Draft tube and their applications. v) Pumped storage plants.	20	L2	CO3

OR					
Q.8	**a.**	With a neat sketch, explain Open cycle and Closed cycle OTEC system.	**14**	**L2**	**CO3**
	b.	Explain the problems associated with OTEC system.	**6**	**L2**	**CO3**
Module – 5					
Q.9	**a.**	Explain the principles of release of nuclear energy – Fusion and Fission reactions.	**8**	**L2**	**CO3**
	b.	With a neat sketch, explain the working principle of Pressurized water reactor.	**12**	**L2**	**CO3**
OR					
Q.10		Write a short note of the following : i) Nuclear fuels. ii) Nuclear Fusion and Fission. iii) Chain reaction. iv) Radiation hazards. v) Radioactive waste disposal.	**20**	**L2**	**CO3**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME601**

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025

Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: Bloom's level, C: Course outcomes.
3. Use of Heat Transfer data Hand Book is permitted

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Derive on expression for temperature distribution and heat transfer in 1-D conduction heat transfer through SLAB.	**10**	**L3**	**CO1**
	b.	An exterior wall of a house may be approximated by a 10 cms layer of common brick (K=0.7w/m°c) followed by 4cms layer of gypsum plaster (K = 0.48w/m°c) Find thickness of loosely packed rock wool insulation (K =0.065 w/m°c) that should be added to reduce the heat loss (or gain) through the wall by 80%.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Explain basic laws of heat transfer.	**6**	**L2**	**CO1**
	b.	Discuss the expression for temperature distribution and the rate of heat transfer for an one dimensional hollow sphere.	**4**	**L2**	**CO1**
	c.	A 600 mm outer diameter sphere storing a liquid is provided with two insulating layers, a high temperature insulation of conductivity 0.35 w/m°c and a low temperature insulation of thermal conductivity 0.07w/m°c. The thickness of the former is 100mm. The temperature drop across high temperature insulation is required to be 2 ½ times that across the low temperature insulation, calculate the thickness of the latter.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Derive the 1 D fin equation for a fin of uniform cross section. By integrating the fin equation, obtain the expression for the temperature variation in a long fin.	**10**	**L3**	**CO2**
	b.	A 1m long, 5cm diameter cylinder placed in an atmosphere of 40°c is provided with 12 longitudinal straight fins (K = 75W/mk) 0.75mm thick. The fin protrudes 2.5cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m^2 K. Calculate the rate of heat transfer if the surface temperature of the cylinder is 150°c.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Obtain an expression for temperature distribution and total heat transfer for lumped heat analysis treatment of transient heat conduction.	**10**	**L3**	**CO2**
	b.	A 10cm diameter apple, approximately spherical in shape, is taken from a 20°c environment and placed in a refrigerator whose temperature is 5°c and average convective heat transfer coefficient over the surface of apple is $6w/m^2$ °c. Calculate the temperature at the center of the apple after a period of 1 hour. Thermo physical properties of apple are ρ =998 kg/m^3, C = 4180J/Kg K, K = 0.6W/m-K.	**10**	**L3**	**CO2**

		Module – 3			
Q.5	**a.**	Explain explicit scheme of solution to the one dimensional transient heat conduction problem without heat generation.	**10**	**L2**	**CO3**
	b.	Derive the relation between radiation intensity and emissive power.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Explain (i) Stefan Boltzmann law (ii) Kirchhoff's law (iii) Plancks law (iv) Wien's displacement law (v) Block body.	**10**	**L2**	**CO3**
	b.	Thin polished copper plate with an emissivity of 0.04 is inserted as radiation shield between two dull steel plates with emissivity of 0.8. Determine the percentage decrease in radiant energy transfer due to the presence of shield. Find percentage reduction if the copper plate gets oxidised with an emissivity of 0.6.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With reference to fluid flow over a flat plate, discuss the concept of velocity boundary layer and thermal boundary layer.	**10**	**L2**	**CO4**
	b.	Air at 0°c and 20m/s flows over a flat plate of length 1.5m that is maintained at 50°c. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the overage heat transfer coefficient and the heat loss for the entire plates per unit width.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Explain the significance of the following i. Grashof Number ii. Nusselt Number iii. Stanton Number iv. Prandtt Number v. Reynolds Number	**10**	**L2**	**CO4**
	b.	The water is heated in a tank by dipping vertically a plate (30cm × 30cm) size. The temperature of plate surface is maintained at 140°c. Assuming the temperature of surrounding water at 20°c. Find out the heat lost from the plate per hour.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain in detail the regimes of pool boiling.	**10**	**L2**	**CO5**
	b.	One hundred tubes of 12mm in diameter are arranged in a square array and are exposed to steam at atmospheric pressure. Calculate the mass of steam condensed per unit length of the tube if the tube wall temperature is maintained at 98°c. The properties of water at mean temperature density = 960 Kg/m^3. Absolute viscosity = 282×10^{-6} Kg/m-s, Thermal conductivity = 0.61W/m–Kg, h_{fg} = 2255 KJ/Kg.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive an expression for LMTD for a counter flow heat exchanger.	**10**	**L3**	**CO5**
	b.	Water (C_p=4200 J/Kg °c) enters a counter flow double pipe heat exchanger at 38°C flowing at 0.076 kg/S. It is heated by oil (C_p=1880 J/Kg°C) flowing at the rate of 0.152 Kg/S from an inlet temperature of 116°C. For an area of $1m^2$ and U = 340 W/m^2 °C, determine the total heat transfer rate.	**10**	**L3**	**CO5**

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CBCS SCHEME

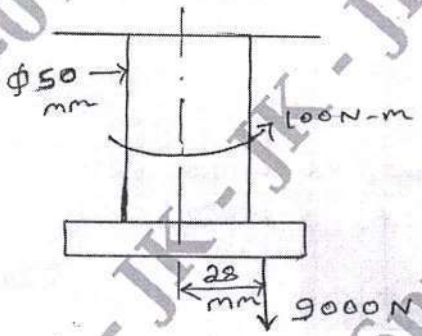
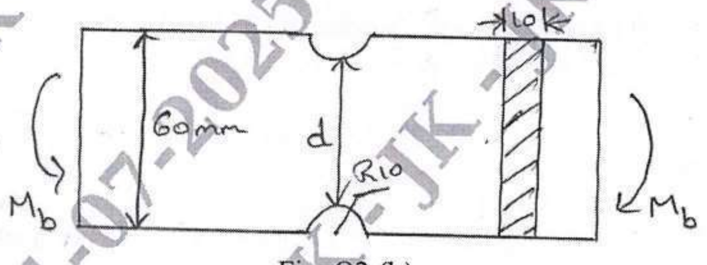
USN ☐☐☐☐☐☐☐☐☐☐ **BME602**

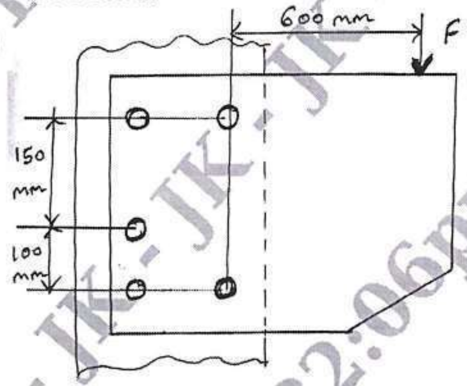
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025

Machine Design

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design data hand book is permitted.
3. Missing data can be assumed.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	List and explain theories of material failure.	**10**	**L2**	**CO2**
	b.	A 50 mm diameter steel rod supports 9 KN load and in addition it is subjected to a torsion moment of 100 N-m as shown in Fig. Q1 (b). Identify maximum tensile and maximum shear stress.  Fig. Q1 (b)	**10**	**L2**	**CO2**
		OR			
Q.2	**a.**	Derive Soderberg's and Goodman equation for designing member subjected to fatigue loading.	**10**	**L2**	**CO2**
	b.	A notched flat plate shown in Fig. Q2 (b) is subjected to bending moment of 10 N-m. Identify the maximum stress induced in the member by taking the stress concentration into account.  Fig. Q2 (b)	**10**	**L3**	**CO1**
		Module – 2			
Q.3		Design the shaft of armature of a motor. If the magnetic poll on the shaft is equivalent to a uniformly distributed load of 10 N per mm length over the middle one third of 600 mm length of shaft between bearings. The motor transmits a power of 15 kW @ 1200 rpm. The allowable shear stress is 50 MPa. Take $C_m = 1.5$ and $C_t = 1.25$.	**20**	**L3**	**CO3**

		OR			
Q.4	**a.**	Show that the squeeze key is equally strong in shear and compression.	**4**	**L4**	**CO3**
	b.	A rectangular C/S key 8*7*36 is used to transmit 6 kW @ 1200 rpm. The shaft diameter is 30 mm. If the allowable shear and crushing stress for key material are 60 MPa and 135 MPa respectively and find whether key is safe or not.	**6**	**L4**	**CO3**
	c.	Design a rigid flange coupling to transmit 18 kW @ 1440 rpm. The allowable shear stress for CI flange is 4 MPa. The shafts, keys and bolts are made of annealed steel having allowable shear stress of 93 MPa. Allowable crushing stress for key is 186 MPa. Assume key way factor as 0.75.	**10**	**L4**	**CO3**
		Module – 3			
Q.5	**a.**	A double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a pressure of 0.95 MPa. Assume an efficiency of 75%, allowable tensile strength in the plate 90 MPa, allowable crushing stress 140 MPa and allowable shear stress 56 MPa. Design and interpret efficiency of the joint.	**10**	**L4**	**CO3**
	b.	Calculate the safe load that can be applied to an eccentrically loaded riveted bracket as shown in Fig. Q5 (b). The allowable shear stress for 25 mm diameter rivets used is 90 MPa.  Fig. Q5 (b)	**10**	**L3**	**CO3**
		OR			
Q.6		Investigate the design requirements for a pair of spur gears to transmit a power of 18 kW from a shaft running @ 1000 rpm to a parallel shaft running @ 250 rpm, maintaining a centre distance of 160 mm between the shaft centres. Suggest suitable surface hardness for the gear pair.	**20**	**L4**	**CO4**
		Module – 4			
Q.7		Analyze the requirements for designing a pair of helical gears to transmit power of 15 kW @ 3200 rpm with a speed ratio of 4 : 1. Given that the pinion is made of cast steel with 0.4 % carbon content untreated and gear is made of high grade cast iron, with a helix angle of 26° and a minimum of 20 teeth on each gear. Suggest suitable surface hardness for gear and pinion.	**20**	**L4**	**CO4**
		OR			
Q.8		A pair of 20° FDI gear are to be designed to connect two shafts @ right angles having a velocity ratio 4:1, the gear is made of cast steel 0.2% untreated and the pinion is made up of C30 steel heat treated, the pinion has 20 teeth and transmit power of 40 kW @ 720 rpm. Design the bevel gears completely.	**20**	**L4**	**CO4**

Module – 5					
Q.9	**a.**	Derive Petrofit equation for Journal bearing.	**10**	**L3**	**CO5**
	b.	A simple band brake of drum diameter 600 mm has a band passing over it with an angle of contact of 225°, while one end is connected to fulcrum, the other end is connected to the brake lever at a distance of 400 mm from the fulcrum. The brake lever is 1 m long. The brake is to absorb a power of 15 kW @ 720 rpm. Design the brake lever of rectangular C/S, assuming depth to be thrice the width. Take allowable stress 80 MPa.	**10**	**L4**	**CO3**
OR					
Q.10	**a.**	Write a short note on Hydrodynamic theory of lubrication, showing pressure distribution and a graph of friction (Vs) speed.	**10**	**L3**	**CO5**
	b.	A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at the shaft speed of 1800 rpm. Assume the ratio of diameter to the radial clearance as 1000. The viscosity of oil 0.01 PaS at the operating temperature. Determine the following : (i) Sommerfeld number. (ii) The coefficient of friction based on Mckee's equation. (iii) Amount of heat generated.	**10**	**L4**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME654B**

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025

Renewable Energy Power Plants

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain briefly different renewable and non-renewable energy sources.	**10**	**L2**	**CO1**
	b.	Explain environmental benefits and challenges of renewable energy sources.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain extra-terrestrial radiation and special distribution of extra terrestrial radiation.	**10**	**L2**	**CO1**
	b.	Explain solar radiation at the earth's surface.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain pyranometer with neat sketch.	**10**	**L2**	**CO2**
	b.	Explain pyrheliometer with neat sketch.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain PV system components and their functionalities.	**10**	**L2**	**CO2**
	b.	What are the design considerations for solar power plants.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Explain horizontal wind energy power plant with diagram.	**10**	**L3**	**CO3**
	b.	Explain the parameters effecting the energy extraction through wind.	**10**	**L2**	**CO1**
		OR			
Q.6	**a.**	Explain with schematic diagram the working of a dry steam geothermal power plant.	**10**	**L3**	**CO3**
	b.	What are the problems associated with geothermal conversion.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Explain different ways to extract energy through tides with neat diagram.	**10**	**L3**	**CO4**
	b.	Explain different ways to extract energy through waves with neat diagram.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Describe OTEC and working principle with neat sketch.	**10**	**L2**	**CO4**
	b.	What are the problems associated with OTEC.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Explain fixed dome biogas power plant with diagram.	**10**	**L2**	**CO5**
	b.	Explain gasification with diagram.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Explain Hydrogen Production Technology (Electrolysis method).	**10**	**L2**	**CO5**
	b.	Describe advantages of hydrogen energy.	**10**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME302**

Third Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain various pattern allowances and their importance.	**10**	**L2**	**CO1**
	b.	Sketch and explain Jolt type moulding machine.	**06**	**L1**	**CO1**
	c.	Define the following terms with reference to the moulding sand: (i) Permeability (ii) Green Strength (iii) Dry Strength (iv) Hot Strength	**04**	**L1**	**CO1**
		OR			
Q.2	**a.**	Sketch and explain Shell moulding process.	**10**	**L2**	**CO1**
	b.	Give the functions of a riser in a casting. Also, differentiate between open and blind risers.	**06**	**L1**	**CO1**
	c.	Explain the terms 'Core' and 'Chaplet'.	**04**	**L1**	**CO1**
		Module – 2			
Q.3	**a.**	With a neat sketch explain the constructional features of a Cupola.	**10**	**L2**	**CO2**
	b.	Sketch and explain resistance furnace.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	With a neat labelled diagram explain continuous casting process.	**10**	**L2**	**CO2**
	b.	Explain with neat sketches following casting defects: (i) Hot tears (ii) Cold shut and Misrun	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Explain the following yield criteria : (i) Tresca Criterion (ii) Von Mises Criterion	**10**	**L2**	**CO3**
	b.	Sketch and explain wire drawing. Also list the characteristics of cold working process.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	With a neat sketch explain explosive forming process.	**10**	**L2**	**CO3**
	b.	With a neat sketch explain die-punch assembly used in sheet metal work. Also explain blanking and punching operations.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Sketch and explain the types of oxy-acetylene welding flames.	**10**	**L2**	**CO4**
	b.	Explain briefly the principle of gas welding. Also list its advantages, disadvantages and applications.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Sketch and explain submerged arc welding process.	**10**	**L2**	**CO4**
	b.	With a neat sketch explain Tungsten Inert Gas welding process. Mention its advantages and disadvantages.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	With a neat sketch explain various zones in welded structure.	**10**	**L2**	**CO5**
	b.	With neat sketches explain welding defects.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Write short notes on : (i) Soldering (ii) Brazing	**10**	**L2**	**CO5**
	b.	Explain the following resistance welding processes: (i) Butt Welding (ii) Seam welding	**10**	**L2**	**CO5**

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BME303

Third Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following terms : (i) Unit Cell (ii) Space Lattice (iii) Crystal Structure (iv) Coordination Number	**08**	**L1**	**CO1**
	b.	Define APF. Calculate the APF for simple cube and HCP crystal structures.	**12**	**L3**	**CO1**
		OR			
Q.2	**a.**	Classify the Crystal imperfection. With neat sketch explain point defects.	**10**	**L1**	**CO1**
	b.	Explain these concepts of materials : (i) Slip (ii) Twining (iii) Ionic and Metallic Bonding	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Define Diffusion. List the factors affecting diffusion. Explain diffusion laws for both steady and non-steady state.	**10**	**L1**	**CO2**
	b.	Explain eutectic phase diagram where 2 metals completely soluble in liquid state and insoluble in solid state. Draw neat phase diagram and label all phases.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain Gibb's phase rule.	**05**	**L1**	**CO2**
	b.	A binary alloy system contains two solid phases α and β. The composition of α and β are A = 5% B and A = 95% B respectively. Calculate (i) A = 40% B alloy (ii) A = 70% B alloy composition by Lever rule.	**06**	**L3**	**CO2**
	c.	Draw a neat sketch of Iron-Carbon diagram and label all the phases. Quote three important critical temperature lines.	**09**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Define Heat Treatment. Describe with a neat sketch TTT diagram.	**10**	**L1**	**CO3**
	b.	Explain with neat diagram, Austempering and Martempering process for steel.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Describe with neat sketch, flame hardening process.	**08**	**L2**	**CO3**
	b.	Explain these heat treatment techniques: (i) Age hardening (ii) Grain Growth in steel specimen (iii) Recrystallization technique	**12**	**L1**	**CO3**

		Module – 4			
Q.7	**a.**	Explain thermal spray coating with neat diagram. Discuss the advantages of the coating methods.	**10**	**L1**	**CO4**
	b.	With a flow chart, explain in detail the steps of powder metallurgy process.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	With a neat sketch explain atomization and roll crushing methods of powder production.	**10**	**L2**	**CO4**
	b.	Discuss the advantages , disadvantages and applications of powder metallurgy.	**10**	**L1**	**CO4**
		Module – 5			
Q.9	**a.**	Define Composite Materials. Describe the classification, advantages and applications of composite materials.	**10**	**L1**	**CO5**
	b.	With neat sketch explain wet lay up and filament winding process.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Classify Engineering Materials. Discuss types, composition and applications of cast iron.	**10**	**L2**	**CO5**
	b.	Describe factors affecting material selection chart.	**10**	**L1**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME304**

Third Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Thermodynamics data hand book is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	State and explain the Zeroth Law of thermodynamics.	**10**	**L1**	**CO1**
	b.	The temperature 't' on a thermometric scale is defined interms of a property 'P' by the relation t = a lnp + b, where 'a' and 'b' are constants. The temperature of the ice point and steam point are assigned numbers as '0' and 100 respectively. Experiment gives values of 'P' of 1.86 and 6.81 at ice and steam point respectively. Evaluate the temperature corresponding to a reading of P = 2.5 on thermometer.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Draw the following process on P-V plane and write the expression for work in each case : i) Isothermal process ii) Polyntropic – process.	**10**	**L1**	**CO1**
	b.	Unit mass of a certain fluid is contained in a cylinder at an initial pressure of 20 bar. The fluid allowed to expand reversibly behind a piston according to the law $PV^2 = C$ until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position : heat is then supplied reversibly with the piston firmly locked in position until pressure rises to original value of 20 bar. Calculate network done by the fluid for an initial volume of 0.05 m^3. Show the process on PV diagram.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	With a neat diagram, explain the Joule's experiment. Also state the first law of thermodynamics.	**10**	**L1**	**CO2**
	b.	0.5 m^3 of air initially at a temperature of 210°C and a pressure of 40×10^4 N/m^2 are compressed according to the law $PV^{1.2} = C$ to a final volume of 0.05 m^3. Calculate : i) Mass ii) Final pressure iii) Work iv) Heat transfer v) Change in enthalpy Take : R = 0.287 KJ/kg °K ; √ = 1.4, Cp = 1.005 KJ/kg °K.	**10**	**L2**	**CO2**

		OR			
Q.4	**a.**	Derive the steady flow energy equation for a single stream of fluid entering and leaving the control volume.	**10**	**L2**	**CO2**
	b.	A turbine operates under steady flow conditions receiving steam at the following state : pressure is 1.2 MPa, temperature is 188°C. Enthalpy is 2785 KJ/kg, velocity is 34 m/s elevation is 3 m. The steam leaves the turbine at the following state : pressure is 200 MPa, Enthalpy is 2512 KJ/kg, velocity is 100 m/s and elevation is zero (0) meter. Heat is lost to the surroundings at a rate of 0.29 KJ/s. If the steam flow rate is 0.42 kg/s. determine the power–output from the turbine.	**10**	**L5**	**CO2**
		Module – 3			
Q.5	**a.**	Establish the equivalence of Kelvin-Planck and Clausius statement.	**10**	**L2**	**CO3**
	b.	In a heat engine the temperature of the source and sink are 700°C and 50°C respectively. The heat supplied is 83.3 KJ/s. Find the power developed by the engine.	**10**	**L5**	**CO3**
		OR			
Q.6	**a.**	State and explain Clausius in equality.	**10**	**L3**	**CO3**
	b.	2.5 kg of air at a pressure of 2 bar and 26°C forms a closed system, which undergoes a constant pressure process with a neat addition of 650 KJ, Calculate : i. Find temperature ii. Chang enthalpy iii. Change in internal energy iv. Work transfer v. Change in entropy Take : $C_p = 1.005$ KJ/kg°K, $C_V = 0.714$ KJ/kg°K.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the concept of available and unavailable energy.	**10**	**L3**	**CO4**
	b.	A fluid at 1 MPa and 250°C contained in a vessel having 0.28 m^3 volume is cooled until its pressure drops to 0.35 MPa. Determine the final temperature heat transferred and change in entropy of the fluid. Assume fluid to be air. Take : R = 0.287 KJ/kg°K, $C_V = 0.7165$ KJ/kg°K.	**10**	**L4**	**CO4**
		OR			
Q.8	**a.**	With neat sketch, explain the method of measurement of dryness fraction of steam using separating throttling colorimeter.	**10**	**L2**	**CO4**
	b.	Steam at 5 bar having a dryness fraction of 0.9 expands adiabatically and reversibly to a final pressure of 1 bar. Determine the final condition of steam.	**10**	**L5**	**CO4**

Module – 5

Q.9	**a.**	State the i. Gibb's Dolton's law of partial pressure ii. Amagot's law.	**10**	**L2**	**CO5**
	b.	If a gas has C_p = 1.97 KJ/kg°K and C_V = 1.5 KJ/kg°K. Determine its molecular mass and characteristics gas constant.	**10**	**L4**	**CO5**
		OR			
Q.10		Define the following : i) Ideal and real gas ii) State the Vander-Waal's equation iii) Compressibility factor iv) Law of corresponding states v) Beattie – Bridgeman equation.	**20**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME306D

Third Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Waste Handling and Management

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	With a flowchart, explain the steps involved in waste management.	**10**	**L2**	**CO1**
	b.	Discuss briefly about the factors influencing waste collection systems.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Briefly explain hauled container system and stationary container system used for collection of solid waste.	**10**	**L2**	**CO1**
	b.	Discuss about waste handling equipments.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain physical and chemical characteristics of solid waste.	**10**	**L2**	**CO2**
	b.	Discuss abut factors affecting site selection for land fill.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Define compositing. Explain the different methods used.	**10**	**L2**	**CO2**
	b.	Explain the different thermal treatments used in waste management.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Define E-Waste. Explain the different treatment methods used in managing E-Waste.	**10**	**L2**	**CO3**
	b.	Explain briefly about identification and classification of hazardous waste.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Discuss the classification of Biomedical waste. Explain the different treatment methods used for managing the waste.	**10**	**L2**	**CO3**
	b.	Explain types and characteristics of Nuclear waste.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Discuss the different methods of landfilling used in India.	**10**	**L3**	**CO4**
	b.	Explain with a case study about waste management system used in India.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Discuss briefly about medium and large scale composting.	**10**	**L3**	**CO4**
	b.	With a case study explain the waste handling techniques used in India.	**10**	**L3**	**CO4**

Module – 5

Q.9		Write short notes on :	20	L2	CO5
	a.	The Environmental Protection Act			
	b.	The Hazardous Waste Rules, 2008			
	c.	The Plastic Waste Rule, 2011			
	d.	Biomedical Waste Rule, 1998.			
		OR			
Q.10	**a.**	Write short notes on : i. The E-waste Rules, 2011 ii. The Batteries Rules, 2001.	10	L2	CO5
	b.	Discuss briefly the duties of constitutional bodies and Ministries in managing waste.	10	L2	CO5

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME401**

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Steam Tables and Thermodynamic Data hand book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define cut off ratio and Air standard efficiency.	**04**	**L1**	**CO1**
	b.	With usual notations obtain Air Standard efficiency of otto cycle.	**06**	**L2**	**CO1**
	c.	The compression ratio of Diesel cycle is 14, and cut-off ratio is 2.2. At the beginning of the cycle, air is at 0.98 bar and 100° C. Find : i) Temperature and pressure at salient points. ii) Air standard efficiency.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Define the following : i) Indicated power ii) Brake power iii) Friction power iv) Mechanical efficiency	**04**	**L1**	**CO1**
	b.	Explain the process of combustion in SI engine.	**06**	**L2**	**CO1**
	c.	The following data were obtained from a Morse test on a 4 – cylinder, 4 – stroke, S.I engine, coupled to a hydraulic dynamometers operating at constant speed of 1500 rpm. Brake load with all the four cylinders firing = 296 N. Brake load with cylinder No. 1 not firing = 201 N. Brake load with cylinder No. 2 not firing = 206 N. Brake load with cylinder No. 3 not firing = 192 N. Brake load with cylinder No. 4 not firing = 200 N. The brake power in 'KW' is calculated using BP = $\frac{WN}{42300}$ Where, W = Brake load in Newtone. N = Engine speed in rpm. Calculate : i) Brake power ii) Indicated power iii) Friction power iv) Mechanical efficiency	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Derive an expression for the efficiency of a Brayton cycle.	**06**	**L2**	**CO2**
	b.	Explain the difference between open cycle and closed cycle gas turbine.	**04**	**L1**	**CO2**
	c.	Air enters the compressor of an ideal air standard Brayton cycle at 100 kpa, 300 k with a volumetric flow rate of 6 m^3/s. The compressor work ratio is 10. The turbine inlet temperature is 1500 k. Determine: i) The thermal efficiency ii) Work ratio iii) Power. Take $\gamma = 1.4$ $C_p = 1.005$ KJ/KgK	**10**	**L3**	**CO2**

		OR			
Q.4	**a.**	With a neat sketch explain the working of Ram jet.	**10**	**L2**	**CO2**
	b.	Discuss the working principle of Rocket propulsion with neat sketch.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	List the drawbacks of Carnot vapour power cycle.	**04**	**L1**	**CO3**
	b.	Discuss the effect of i) Boiler pressure ii) Condenser pressure on the performance of a Rankine cycle.	**06**	**L2**	**CO3**
	c.	In a steam power cycle, the steam supply is at 15 bar, and dry saturated. The condenser pressure is 0.4 bar. Calculate the thermal efficiency for i) Carnot vapour power cycle ii) Rankine vapour power cycle Neglect pump work.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With help of neat sketch, explain the working of Reheat Rankine cycle.	**08**	**L2**	**CO3**
	b.	A turbine is supplied with steam at a pressure of 20 bar and Temperature 350° C. The steam is then expands to a condenser pressure of 0.04 bar. Calculate its thermal efficiency. It is desired to improve the efficiency by regenerative feed heating by bleeding steam at 2 bar and heating in an open feed heater. Calculate the percentage improvement in thermal efficiency. Neglect pump work in the above calculation.	**12**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	List out the desirable properties of refrigerant.	**04**	**L1**	**CO4**
	b.	With help of neat sketch, explain the working principle of vapour compression Refrigeration System.	**06**	**L2**	**CO4**
	c.	A simple vapour compression refrigeration plant produces 5 Tonnes of refrigeration. The enthalpies of the working fluid at inlet to the compressor = 183.19 kJ/kg at exit of compressor = 209.41 kJ/Kg , at exit of the condenser = 74.59 kJ/kg. Estimate : i) The refrigerant flow rate ii) COP of the plant iii)Power required to drive the compressor iv) The rate of heat rejection in the condenser	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define : i) Sensible heating ii) Sensible coding	**04**	**L1**	**CO4**
	b.	With a neat sketch, explain a summer air conditioning system.	**06**	**L2**	**CO4**
	c.	An air conditioning system is designed under the following conditions. Out door conditions: 30° C DBT, 75% RH Required indoor conditions: 22°C DBT, 70% RH. Amount of free air circulated 3.33 m^3 / s. Coil dew point temperature (DPT) = 14°C. The required conditions is achieved first by cooling and dehumidification and then by heating. Estimate : i) The capacity of the cooling coil in Tonnes of refrigeration ii) The capacity of heating coil in KW iii) The amount of water vapour removed in kg /hr.	**10**	**L3**	**CO4**

		Module – 5			
Q.9	**a.**	Define the following with respect to a reciprocating air compressor. i) Volumetric efficiency ii) Adibatic efficiency iii) Isothermal efficiency iv) Mechanical efficiency	**06**	**L1**	**CO5**
	b.	Explain the advantages of multistage compression.	**04**	**L2**	**CO5**
	c.	A 2 – stage air compressor with complete inter cooling delivers air to the mains at a pressure of 30 bar suction conditions are 1 bar of 15°C. If both cylinders have same stroke. Find the ration of cylinder diameter for maximum efficiency. The index of compression is 1.3.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	With usual notations derive the expression for critical pressure ratio.	**10**	**L2**	**CO5**
	b.	A turbine having a set of 16 nozzles receives steam at 20bar and 400°C. The pressure of steam at the nozzle exit is 12 bar. If the discharge rate is 260 kg/mm and nozzle efficiency is 90%. Calculate the cross – sectional area at the nozzle exit. If the steam has a velocity of 80 m/s at entry to the nozzle. Fine the percentage increase in discharge.	**10**	**L4**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME402**

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Machining Science and Metrology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain the different types of chips produced during metal cutting with neat sketches.	7	L1	CO1
	b.	Explain the difference between orthogonal cutting and oblique cutting with atleast two examples for each.	7	L1	CO1
	c.	Derive an expression for shear plane angle in terms of rake angle and chip thickness ratio.	6	L3	CO1
		OR			
Q.2	**a.**	With a neat sketch, explain the various parts of a lathe machine.	6	L2	CO1
	b.	Explain how does a capstan lathe differ from turret lathe.	6	L1	CO1
	c.	Explain any four operations performed on a lathe machine.	8	L2	CO1
		Module – 2			
Q.3	**a.**	Explain with a sketch the constructional features of column and knee type milling machine.	6	L2	CO2
	b.	Explain any four operations performed on milling machine.	8	L2	CO2
	c.	Index 87 divisions by compound indexing method having a index plate with circle of holes – 21, 23, 27, 29, 31, 33	6	L3	CO2
		OR			
Q.4	**a.**	With a neat sketch, explain the construction and operation of bench drilling machine.	7	L2	CO2
	b.	Briefly explain the differences between shaper and planer machine.	6	L1	CO2
	c.	With a neat sketch, explain grinding process and the components of a grinding wheel.	7	L2	CO2
		Module – 3			
Q.5	**a.**	Explain the different types of tool wear with relevant sketches.	7	L2	CO3
	b.	A cast iron bar stock was turned at 50 m/min, for which the tool life was 3 hours. For the same material, at 40m/min, the tool life was 5 hours. Find the value of constant 'C' and 'n' in the Taylor's tool life equation.	6	L3	CO3
	c.	What is tool life? Explain the factors which affect the tool life.	7	L2	CO3

		OR			
Q.6	**a.**	Briefly explain the desirable properties of cutting tool materials.	**6**	**L2**	**CO3**
	b.	Explain Taylors tool life equation.	**6**	**L2**	**CO3**
	c.	Explain the salient features of HSS and coated carbides.	**8**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Define Metrology. Explain the objectives of metrology.	**7**	**L2**	**CO4**
	b.	Explain with neat sketches wringing phenomenon of step gauges.	**7**	**L2**	**CO4**
	c.	Four length bars A, B, C and D each having a basic length 125 mm are to be calibrated using a calibrated length bar of 500 mm basic length. The 500 mm bar has an actual length of 499.999/mm. Also, $L_B = L_A + 0.0001$ mm, $L_C = L_A + 0.0005$ mm, $L_D = L_A - 0.0002$ mm and $L_A + L_B + L_C + L_D = L + 0.0003$ mm. Determine L_A, L_B, L_C and L_D.	**6**	**L3**	**CO4**
		OR			
Q.8	**a.**	Explain the following terms: i) Tolerance ii) Interchangeability iii) Selective assembly	**6**	**L2**	**CO4**
	b.	Define fit. Explain the different types of fit with neat sketches.	**7**	**L2**	**CO4**
	c.	Determine the tolerances on the hole and the shaft for a precision running fit designated by 50 $H_7$96. Given : i) 50 mm lies between 30-50 mm ii) $i = 0.45\sqrt[3]{D} + 0.001D$ microns iii) Fundamental deviation for 'H' hole = 0 iv) Fundamental deviation for 'g' shaft = $-2.5D^{0.3/-}$ v) IT7 = 16i vi) IT6 = 10i State the actual maximum and minimum sizes of the hole and shaft, and maximum and minimum clearances.	**7**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	What are gauges? How are they classified?	**6**	**L3**	**CO5**
	b.	Explain with neat sketches, any two types of gauges.	**7**	**L2**	**CO5**
	c.	With a neat sketch, explain reed type mechanical comparator.	**7**	**L2**	**CO5**
		OR			
Q.10	**a.**	With neat sketch, explain working of LVDT.	**7**	**L2**	**CO5**
	b.	With neat sketch, explain the principle of sine bar.	**7**	**L2**	**CO5**
	c.	Select the sizes of angle gauges required to built the following angles, also show the arrangement of gauges: i) 57° 34′ 9″ ii) 102° 8′ 42″	**6**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME405A**

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Non - Traditional Machining

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Differentiate between traditional and non – traditional machining processes.	**8**	**L2**	**CO1**
	b.	Describe the need for non – traditional machining processes.	**6**	**L2**	**CO1**
	c.	Explain the factors to be considered in selection of non – traditional machining processes.	**6**	**L2**	**CO1**
		OR			
Q.2	**a.**	List the advantages and limitations of non – traditional machining processes.	**6**	**L1**	**CO1**
	b.	Classify NTM processes based on source of energy used.	**8**	**L1**	**CO1**
	c.	List the application of NTM processes.	**6**	**L1**	**CO1**
		Module – 2			
Q.3	**a.**	Illustrate the working principle of AJM with a neat sketch.	**10**	**L3**	**CO2**
	b.	Describe the process characteristics involved in AJM.	**6**	**L2**	**CO2**
	c.	List the advantages and limitations of AJM.	**4**	**L1**	**CO2**
		OR			
Q.4	**a.**	Illustrate the working principle of USM with a neat sketch.	**8**	**L3**	**CO2**
	b.	Explain the effect of process parameters involved in USM.	**8**	**L2**	**CO2**
	c.	List the advantages and limitations of USM.	**4**	**L1**	**CO2**
		Module – 3			
Q.5	**a.**	Illustrate the working principle of ECM with a sketch.	**10**	**L3**	**CO3**
	b.	Explain chemical machines (CHM) process characteristics.	**6**	**L2**	**CO3**
	c.	List the advantages and limitations of Chemical Machining process.	**4**	**L1**	**CO3**
		OR			
Q.6	**a.**	Illustrate the working of chemical blanking process with a sketch.	**10**	**L1**	**CO2**
	b.	Explain the process characteristics of ECM	**6**	**L2**	**CO2**
	c.	Differentiate between Electro Chemical Machining and Chemical Machining.	**4**	**L1**	**CO2**

		Module – 4			
Q.7	**a.**	Illustrate the working principle of PAM process with a neat sketch.	**10**	**L3**	**CO4**
	b.	Explain the process parameters of PAM.	**6**	**L2**	**CO4**
	c.	List the advantages and limitations of PAM.	**4**	**L1**	**CO4**
		OR			
Q.8	**a.**	Explain the working principle of EDM with a neat sketch.	**10**	**L2**	**CO4**
	b.	Explain EDM process parameters.	**6**	**L2**	**CO4**
	c.	List the desirable properties of dielectric fluids used in EDM.	**4**	**L1**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the working of EBM with a neat sketch.	**10**	**L2**	**CO5**
	b.	List the applications of EBM.	**4**	**L1**	**CO5**
	c.	Differentiate between LBM and EBM.	**6**	**L1**	**CO5**
		OR			
Q.10	**a.**	Illustrate the working of LBM with a neat sketch.	**10**	**L2**	**CO5**
	b.	Explain process parameters of LBM.	**6**	**L2**	**CO5**
	c.	Explain process characteristics of LBM.	**4**	**L2**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME501/BMT501/BSA501/BAG501

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Industrial Management and Entrepreneurship

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain the meaning and characteristics of management.	**10**	**L2**	**CO1**
	b.	List and explain the functions of management.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain the steps involved in planning process.	**10**	**L2**	**CO1**
	b.	Discuss the nature and importance of planning process.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the nature and purpose of organization and list the principles of organization.	**10**	**L2**	**CO2**
	b.	Explain the process of selection and recruitment in staffing.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain the meaning and nature of directing and explain any two motivational theories.	**10**	**L2**	**CO2**
	b.	Explain the meaning and steps in controlling.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Explain the functions of an Entrepreneur.	**10**	**L2**	**CO2**
	b.	Define the meaning of Entrepreneur and explain the types of Entrepreneur.	**10**	**L2**	**CO2**
		OR			
Q.6	**a.**	Explain the stages in entrepreneurial process.	**10**	**L2**	**CO2**
	b.	Explain the role of entrepreneurs in the Economic Development and list the barriers of Entrepreneurship.	**10**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Explain the characteristics and role of small scale industries in Economic development.	**10**	**L2**	**CO3**
	b.	Explain the different policies of Small Scale Industries (SSI) and government policy towards SSI.	**10**	**L2**	**CO3**
		OR			
Q.8	**a.**	Explain the impact of privatization and globalization on SSI.	**10**	**L2**	**CO3**
	b.	Briefly explain Ancillary and Tiny Industries.	**10**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Briefly explain TECKSOK and KIADB schemes.	**10**	**L2**	**CO3**
	b.	Explain the steps involved in preparation of project.	**10**	**L2**	**CO3**
		OR			
Q.10	**a.**	Explain Market and Technical Feasibility Study.	**10**	**L2**	**CO3**
	b.	Explain Financial and Social Feasibility Study.	**10**	**L2**	**CO3**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME502**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *M : Marks , L: Bloom's level , C: Course outcomes.*
3. *Use of steam table and Mollies chart is permitted.*

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define a Turbo Machine. List any six differences between a Turbo machine and a positive displacement machine.	**8**	**L2**	**CO1**
	b.	Design specific speed of a turbine. Explain its significance.	**4**	**L2**	**CO1**
	c.	A 1/4th scale turbine model is tested under a head of 10 m. The full scale turbine is required to work under a head of 28.5 m and runs at 415 rpm. At what speed must the model be run if it develops 94 kW and uses 0.96 m^3/s of discharge at this speed? What power will be developed from the full scale turbine? Name the type of the turbine.	**8**	**L3**	**CO1**
		OR			
Q.2	**a.**	With h-s diagram, define : i) total-to-total efficiency ii) total-to-static efficiency for a power generating turbo machine.	**8**	**L3**	**CO1**
	b.	Show that the polytropic efficiency for a compression process is given by $\eta_p = \left(\frac{n}{n-1}\right)\left(\frac{\gamma-1}{\gamma}\right)$ where γ = ratio of specific heats, n = polytropic index.	**4**	**L1**	**CO1**
	c.	Air flows through an air turbine where its stagnation pressure is decreased in the ratio 5 : 1. Total-to-total efficiency is 0.8. The air flow rate is 5 Kg/s. If the total power output is 500 kW, Find : i) inlet total temperature ii) actual exist total temperature iii) actual exist static temperature iv) total-to-static efficiency. Take the flow velocity as 100m/s.	**8**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	With usual notations and velocity triangles, derive alternate form of Euler-turbine equation and identify the components of energy transfer.	**10**	**L3**	**CO2**
	b.	At a stage in a 50% degree of reaction axial flow turbine running at 3000 rpm, the blade mean diameter is 68.5 cm. The maximum utilization factor for the stage is 0.915. Calculate the inlet and exit absolute velocities for the rotor assuming the velocity triangles at inlet and outlet to be symmetric. Find also the power output for a flow rate of 15 Kg/s.	**10**	**L3**	**CO2**

		OR			
Q.4	**a.**	Draw the velocity triangles for an axial flow compressor and show that for an axial flow compressor having no axial thrust, the degree of reaction is given by $R=\frac{V_a}{2u}\left[\frac{\tan\beta_1+\tan\beta_2}{\tan\beta_1\ \tan\beta_2}\right]$ Where V_a = Axial flow velocity, β_1 and β_2 = Inlet and outlet blade angles with respect to tangential direction.	**10**	**L3**	**CO2**
	b.	An inward flow reaction turbine has inlet and outlet diameter as 1m and 0.5m respectively. The vanes are radial at inlet and the discharge is radial at outlet. The water enters the vanes at an angle of 10°. Assume the velocity of flow to be constant and equal to 3 m/s. Find : i) speed of the runner ii) vane angle at outlet.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	What do you mean by compounding of steam turbine? Explain with the help of a schematic diagram, a two row velocity compounded turbine stage.	**8**	**L2**	**CO3**
	b.	A single stage impulse turbine rotor has a diameter of 1.2m running at 3000 rpm. The nozzle angle is 18°. The blade speed ratio is 0.42. The blade friction coefficient is 0.9. The outlet angle of the blade is 3° less than the inlet angle. Steam flow rate is 5 Kg/s. Draw the velocity triangles and find : i) Axial thrust on bearing ii) Blade angles iii) Power developed iv) Blade efficiency.	**12**	**L3**	**CO3**
		OR			
Q.6	**a.**	With the help of inlet and outlet velocity triangles. Show that the maximum blade efficiency of a Parson's reaction turbine is $\frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}$ where α_1 = Nozzle angle at inlet.	**8**	**L3**	**CO3**
	b.	Dry saturated steam at 10 bars is supplied to a single rotor axial flow impulse turbine, the condenser pressure being 0.5 bar. The nozzle efficiency is 94% and the nozzle angle at the rotor inlet is 18° to the wheel plane. The rotor blades are equiangular and move at a speed of 450 m/s. If the blade velocity coefficient for the moving blades is 0.92, determine : i) Power output for a mass flow rate of 1 Kg/s ii) Rotor efficiency iii) Stage efficiency iv) Axial thrust v) Direction of exist steam velocity	**12**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Show that for Pelton wheel, the maximum hydraulic efficiency is given by $\eta_{h(max)}=\frac{1+K\cos\beta_2}{2}$ where K = blade velocity coefficient, β_2 = blade exist angle.	**10**	**L3**	**CO4**

	b.	A three jet Pelton wheel is required to generate 10,000 kW under a head of 400 m. The blade angle at outlet is 15° and the reduction in the relative velocity over the blades is 5%. If the overall efficiency = 80%, $C_v = 0.98$ and speed ratio = 0.46, find : i) diameter of jet ii) total flow rate iii) tangential force exerted on the buckets	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define the following efficiencies of a hydraulic turbine i) Hydraulic efficiency ii) Mechanical efficiency iii) Overall efficiency	**6**	**L2**	**CO4**
	b.	Explain the function of a draft tube in a reaction hydraulic turbine.	**4**	**L2**	**CO4**
	c.	A Kaplan turbine working under a head of 20 m develops 11,772 kW. The outer diameter of the runner is 3.5m and hub diameter is 1.75 m. The guide blade angle at the extreme edge of the runner is 35°. The hydraulic and overall efficiencies of the turbines are 0.88 and 0.84 respectively. If the velocity of whirl at outlet is zero, determine : i) Runner vane angles at inlet and outlet ii) Speed of the turbine	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	What is cavitation in centrifugal pumps? What are the effects of cavitations? What are the steps to be taken to reduce the effects of cavitations?	**4**	**L2**	**CO5**
	b.	Derive an expression for the static pressure rise in the impeller of centrifugal pumps with velocity triangles.	**8**	**L3**	**CO5**
	c.	A centrifugal pump discharges $0.15 m^3/s$ of water against a head of 12.5 m. The speed of the impeller is 600 rpm. The outer and inner diameters of the impeller are 50 cm and 20 cm respectively. The vanes are bent back at 35° to the tangent at the exit. If the area of flow remains $0.07 m^2$ from inlet to outlet, calculate : i) Manometric efficiency of the pump ii) Vane angle at inlet	**8**	**L3**	**CO5**
		OR			
Q.10	**a.**	Define the following with respect to centrifugal compressors : i) Power input factor ii) Pressure coefficient iii) Compressor efficiency	**6**	**L1**	**CO5**
	b.	Explain the phenomenon of surging as applied to a centrifugal compressor	**6**	**L2**	**CO5**
	c.	Derive an expression for pressure ratio in terms of impeller tip speed for a centrifugal compressor.	**8**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

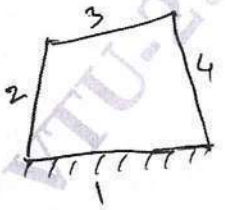
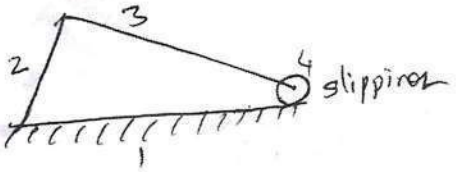
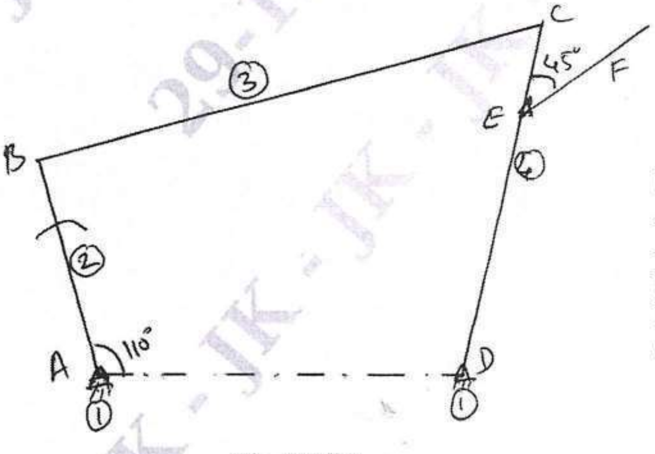
BME503/BMR503

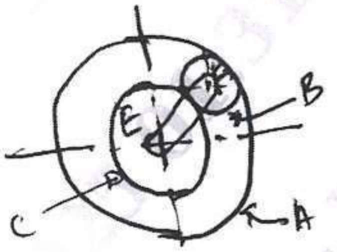
Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

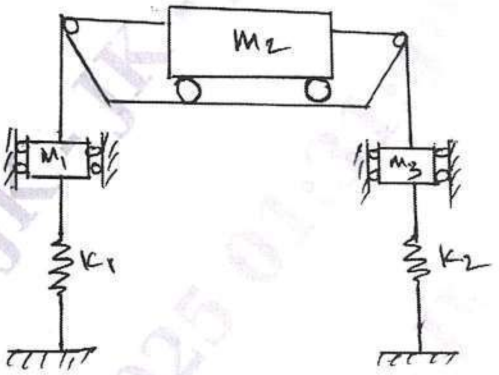
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define the following : i) Kinematic pair ii) Mechanism iii) Machine iv) Structure v) Degrees of freedom	**10**	**L1**	**CO1**
	b.	Explain the following with neat sketch : i) Beam Engine ii) Elliptical Trammel	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Determine the degrees of freedom for the following : i)  Fig.Q2(a)(i) ii)  Fig.Q2(a)(ii)	**04**	**L3**	**CO1**
	b.	In a slider crank mechanism, the crank OB is 30 mm long and the connecting rod BC is 120 mm long. The crank rotates at a uniform speed of 300 rpm clockwise about centre 'O' for a crank position ∠BOC equal to 60° , draw the configuration and find i) Velocity of piston 'C' and angular velocity of connecting rod BC. ii) Acceleration of piston 'C' and angular acceleration of connecting rod BC.	**16**	**L3**	**CO2**
		Module – 2			
Q.3	**a.**	Discuss the static equilibrium of i) Two forces ii) Three forces iii) Two forces with torque member	**06**	**L2**	**CO3**
	b.	In the Fig.Q3(b), a four-bar mechanism is shown. Calculate the required value of T_2 and various forces on links for the equilibrium of the system.  F = 2000 N AD = 215 mm AB = 200 mm BC = 370 mm DC = 350 mm CE = 100 mm Fig.Q3(b)	**14**	**L3**	**CO3**

		OR			
Q.4	**a.**	State and explain D'Alembert's Principle.	**04**	**L1**	**CO3**
	b.	When the crank is 45° from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.75 m, Stroke of the piston = 0.5 m and length of connecting rod = 1 m. Determine the torque on the crank shaft, if the engine runs at 350 rpm and the mass of the reciprocating parts is 200 kg.	**16**	**L3**	**CO3**
		Module – 3			
Q.5	**a.**	What is interference and explain the methods to avoid interference.	**06**	**L1**	**CO1**
	b.	Two spur gears have 24 and 30 teeth of module = 10 mm Standard addendum = 1 module, Pressure angle = 20°. Find i) Length of path of contact ii) Length of arc of contact iii) Contact ratio	**14**	**L3**	**CO1**
		OR			
Q.6		An epicyclic gear consists of three gears A, B and C as shown in Fig.Q6. The gear 'A' has 72 internal teeth and gear 'C' has 32 external teeth. The gear 'B' meshes with both 'A' and 'C' and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear 'A' is fixed, determine the speed of gears 'B' and 'C'.  Fig.Q6	**20**	**L3**	**CO1**
		Module – 4			
Q.7	**a.**	Explain briefly static and dynamic balancing as applied to revolving masses in different planes.	**04**	**L2**	**CO4**
	b.	A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise as A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 10 mm, find their magnitude and angular positions.	**16**	**L4**	**CO4**

		OR			
Q.8	**a.**	With usual notations, explain the primary and secondary unbalanced forces of reciprocating masses.	**06**	**L2**	**CO4**
	b.	Explain the following : i) Sensitiveness of the governor ii) Isochronous governor	**04**	**L2**	**CO5**
	c.	The arms of a porter governor are 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified.	**10**	**L3**	**CO5**
		Module – 5			
Q.9	**a.**	Define Logarithmic Decrement. Show that logarithmic decrement 'δ' is given by $\frac{2\pi\xi}{\sqrt{1-\xi^2}}$ for underdamped system.	**08**	**L2**	**CO6**
	b.	Determine the natural frequency of the system shown in Fig.Q9(b). Assume that the wires connecting the masses are stiff and in tension.  Fig.Q9(b)	**12**	**L3**	**CO6**
		OR			
Q.10	**a.**	Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account.	**10**	**L2**	**CO6**
	b.	A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19600 N/m and damping co-efficient of 100 N-s/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine i) Amplitude of vibration of the mass ii) Phase difference between the force and displacement iii) Force transmissibility ratio	**10**	**L3**	**CO6**

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USN ☐☐☐☐☐☐☐☐☐☐ **BME515A**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Mechatronics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define Mechatronics. Explain briefly Mechatronics design process with a neat block diagram.	10	L2	CO1
	b.	Explain with a block diagram the working of a Automated Washing Machine.	10	L2	CO1
		OR			
Q.2	a.	Define Sensor. Explain with a neat diagram, the working of a hall effect sensor.	10	L2	CO1
	b.	Define Transducer. Explain with a neat diagram the working principle of, (i) Photo diode (ii) Photo resistor (iii) Photo transistor	10	L2	CO1
		Module – 2			
Q.3	a.	Define Solenoid. Explain the working of data loggers with a neat diagram.	10	L2	CO2
	b.	Define Relay. Explain the working of 4 quadrant servo drives with a neat diagram.	10	L2	CO2
		OR			
Q.4	a.	With a neat sketch, explain the working principle of permanent magnet DC motor.	10	L2	CO2
	b.	Explain with a neat diagram the working principle of, (i) Digital to Analog conversion (ii) Analog to Digital conversion	10	L2	CO2
		Module – 3			
Q.5	a.	What is Microprocessor? Explain the different types of registers.	10	L2	CO3
	b.	Explain with a neat layout the Internal Architecture of INTEL 8085A Microprocessor.	10	L2	CO3

		OR			
Q.6	**a.**	What is Microcontroller? Explain with a block diagram the basic elements of microcontroller.	**10**	**L2**	**CO3**
	b.	Explain briefly the following forms of memory units : ROM, PROM, EPROM, EEPROM, RAM	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Define Programmable Logic Controller (PLC). Explain with a block diagram the working of extending and retracting a single acting Pneumatic Piston using latches.	**10**	**L2**	**CO4**
	b.	Explain with a neat diagram the basic structure of Programmable Logic Controller (PLC).	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	Explain briefly the basic structure of ladder logic diagram.	**10**	**L2**	**CO4**
	b.	Explain with a ladder diagram the working control of a process tank.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the elements of open loop and closed loop control system with a neat block diagram.	**10**	**L2**	**CO5**
	b.	Design a Mechatronic system for Pick and Place Robot.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Explain with a neat diagram : (i) Hydro Dynamic Bearing (ii) Hydro Static Bearing	**10**	**L2**	**CO5**
	b.	Design a Mechatronic system for automatic car parking barrier.	**10**	**L2**	**CO5**

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CBCS SCHEME

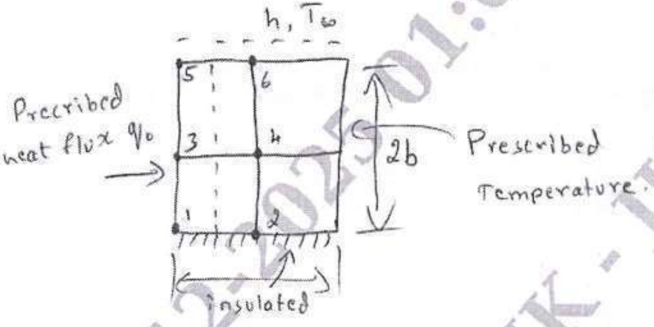
USN ☐☐☐☐☐☐☐☐☐☐ **BME601**

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Heat and Mass transfer Data book are permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Derive an expression for Temperature distribution and rate of heat transfer through plane wall.	**10**	**L3**	**CO1**
	b.	Explain different boundary conditions as applicable to heat transfer analysis.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain the experimental method of determining the thermal conductivity of a metal rod.	**10**	**L2**	**CO1**
	b.	The wall of a house in cold region consists of three layers, an outer brick work 15 cm thick, the inner wooden panel 1.2 cm thick, the intermediate layer is insulator of 7 cm thick. The K for brick and wood are 0.7 and 0.18 W/mK. The inside and outside temperature of wall are 21 and $-15^{\circ}C$. If insulation layer offer twice the thermal resistance of the brick wall, calculate, (i) Heat loss per unit area. (ii) 'K' of insulator.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Derive an expression for the temperature distribution for a long fin of uniform cross section with insulated tip.	**10**	**L3**	**CO3**
	b.	A rod (K = 200 W/mK) 5 mm in diameter and 5 cm long has its one end maintained at 100°C. The surface of the rod is exposed to ambient air at 25°C with convection heat transfer co-efficient of 100 W/m^{2}K. Assuming the other end is insulated. Determine (i) the temperature of rod at 20 mm distance from the end at 100°C (ii) Heat dissipation rate from the surface of rod (iii) Effectiveness.	**10**	**L3**	**CO3**
		OR			
Q.4	**a.**	Obtain an expression for temperature distribution of solid in lumped heat transfer analysis in dimensional numbers.	**10**	**L3**	**CO3**
	b.	A 15 mm diameter mild steel sphere of K = 42 W/m°C is exposed to cooling air flow at 20°C with h = 120 W/m^2°C. Determine the following : (i) Time required to cool from 550°C to 90°C. (ii) Instantaneous heat transfer rate 2 minutes after start of cooling.	**10**	**L3**	**CO3**

		Module – 3			
Q.5	**a.**	Explain the formulation of differential equation 1-D steady state heat conduction.	**10**	**L2**	**CO3**
	b.	Consider steady state heat conduction in a square region of side 2b, in which energy is generated at a constant rate of g w/m^3. The boundary conditions for the problem are shown in Fig. Q5 (b). Write the finite difference equations for nodes 1, 3 and 5 in this Fig. Q5 (b).  Fig. Q5 (b)	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	State and explain the following laws of radiation : (i) Steafan Boltzman law (ii) Kirchoff's law (iii) Planck's law (iv) Wein's displacement law (v) Lambert's cosine law	**10**	**L2**	**CO3**
	b.	Calculate the net radiant heat exchange per unit area for two large parallel plates at a temperature of 427°C and 27°C respectively. $\epsilon_{hot\ plate} = 0.9$, $\epsilon_{cold\ plate} = 0.6$. If a polished alluminium shield is placed between them. Find the percentage reduction in the heat transfer $\epsilon_{shield} = 0.04$.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain with sketch : (i) Velocity Boundary layer (ii) Thermal Boundary layer	**10**	**L2**	**CO2**
	b.	Air at a temperature of 20°C flows through a rectangular duct with a velocity of 10 m/s. The duct is $30cm \times 20cm$ in size and air leaves at 34°C. Find the heat gain by air when it is passed through 10 m long.	**10**	**L3**	**CO2**
		OR			
Q.8	**a.**	Explain the physical significance of, (i) Reynolds number (ii) Prandtl number (iii) Nusselt number (iv) Grashoff's number (v) Stanton number	**10**	**L2**	**CO2**
	b.	Considering the body of a man as a vertical cylinder of 300 mm diameter and 170 cm height. Calculate the heat generated by the body in one day. Take the body temperature as 36°C and ambient temperature as 14°C.	**10**	**L3**	**CO2**

Module – 5					
Q.9	**a.**	Derive an expression for LMTD for a parallel flow heat exchanger.	**10**	**L3**	**CO4**
	b.	An oil cooler for a large diesel engine is to cool engine oil from 60°C to 45°C using sea water at an inlet temperature of 20°C with a temperature raise of 15°C. The design heat load is 140 kW and the mean overall heat transfer coefficient based on the outer surface area of the tube is 70 W/m^2°C. Calculate the heat transfer surface area for single pass counter flow and parallel flow arrangements.	**10**	**L3**	**CO4**
OR					
Q.10	**a.**	Explain with a neat sketch the Regimes of pool Boiling process.	**10**	**L2**	**CO4**
	b.	A vertical plate 30 cm × 30 cm is exposed to steam at atmospheric pressure. The plate temperature is 98°C. Calculate the heat transfer and the mass of steam condensed per hour.	**10**	**L2**	**CO4**

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CBCS SCHEME

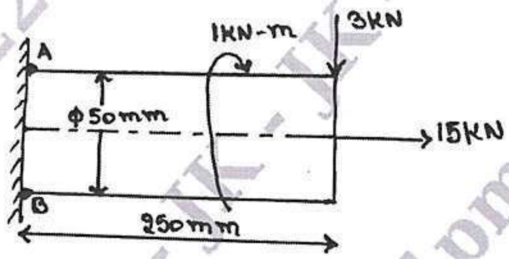
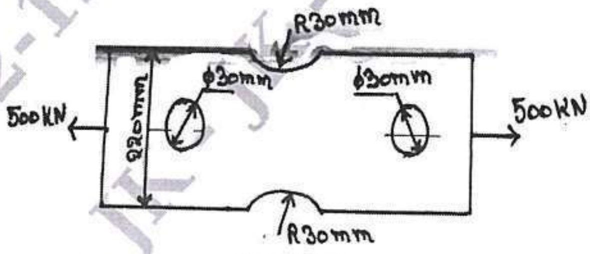
USN ☐☐☐☐☐☐☐☐☐☐ **BME602**

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Machine Design

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Design Data Hand Book is permitted.

		Module – 1	M	L	C
Q.1	a.	Explain the factors which influence the selection of engineering materials?	5	L2	CO1
	b.	Explain Codes and Standards.	5	L2	CO1
	c.	A circular rod of diameter 50 mm is subjected to an axial, bending and torsional loads as shown in Fig Q1(c). Determine the nature and magnitude of stresses at the critical points.  Fig Q1(c)	10	L3	CO1
		OR			
Q.2	a.	Define Stress concentration and discuss any two methods of reducing stress concentration.	6	L1	CO1
	b.	Explain the following theories of failure i) Maximum Normal Stress Theory ii) Maximum Shear Stress Theory iii) Distortion Energy Theory	6	L2	CO1
	c.	A bar of rectangular section is subjected to an axial pull of 500 kN as shown in Fig Q2(c). Determine the thickness of the plate, if the allowable tensile stress is 200 MPa.  Fig Q2(c)	8	L3	CO1

		Module – 2			
Q.3	**a.**	A shaft is supported by two bearings placed in apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000N. The pulley weight 1000N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weight 500N. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine suitable diameter of solid shaft, assuming torque on one pulley is equal to torque on other pulley. Choose C15 steel ($\sigma_y = 235.4$ MPa, $\sigma_u = 425$ MPa) as the shaft material and use ASME code for the design of shaft. Assume minor shock condition.	**20**	**L3**	**CO3**
		OR			
Q.4	**a.**	Prove that a square key is equally strong in shear and compression.	**5**	**L3**	**CO3**
	b.	Design a flange coupling to connect the shafts of a motor and centrifugal pump for the following specification pump output = 3000 liters/minute, Total head = 20 m, Pump speed = 600 rpm, Pump efficiency = 70%, Select C-40 steel ($\sigma_y = 328.6$ MPa) for shaft and C-35 steel ($\sigma_y = 304$ MPa) for bolts with factor of safely 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2.	**15**	**L3**	**CO3**
		Module – 3			
Q.5	**a.**	Design a triple riveted Lap Joint with zig-zag riveting, for a pressure vessel of 1.5 m diameter. The maximum pressure inside vessel is 1.5 MPa. The allowable stresses in tension, crushing and shear are 100 MPa, 125 MPa and 75 MPa respectively. Take efficiency as 75%.	**10**	**L3**	**CO3**
	b.	A plate of 80 mm wide and 10 mm thick is to be collected to another plate by means of two parallel fillet welds. The plates are subjected to an axial load of 50kN. Find the length of the weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium. Carbon steel having allowable stress of 230 MPa. Design the gear completely. Take Number of teeth on pinion as 24.	**20**	**L3**	**CO4**
		Module – 4			
Q.7	**a.**	Design a pair of bevel gears to transmit 12kW at 300 rpm of gear and 1470 rpm of the pinion. The angle between the shaft axes is 90°. The pinion has 20 teeth and the material for both pinion and gear is cast steel having allowable stress of 188.33 MPa. Take service factor as 1.25. Suggest suitable surface hardness for the gear pair.	**20**	**L3**	**CO4**

		OR			
Q.8		Complete the design and determine the input capacity of a worm gear speed reducer unit which consists of a hardened steel worm and a phosphor bronze gear having 20° stub involute teeth. The center distance is to be 200 mm and transmission ratio is 10 and the worm speed is 2000 rpm.	**20**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	In a machine the radial width of the friction material is 0.2 times the maximum radius. Take coefficient of friction as 0.25, maximum diameter of the clutch is 250 mm, axial force is 600 N, power is 60 kW and the speed is 3000 rpm. Find how many discs are required, also find the pressure at the contact surface.	**10**	**L3**	**CO3**
	b.	A simple band brake operates on 600 mm diameter brake down, running at 200 rpm and has a contact angle of 270°. The coefficient of friction is 0.25, one end of the band is connected to a pin and the other end at a distance of 125mm from the pin and 625 mm from the free end of the lever, where the operating force is applied. Find the maximum pull required, if 50 kW power is absorbed and what is the direction of minimum pull, if the maximum tensile stress in the band is limited to 50 MPa. Find width and thickness of the band. Also design the lever if depth is 2 times the width of the lever.	**10**	**L3**	**CO3**
		OR			
Q.10	**a.**	Derive Petroff's equation for coefficient of friction. Also state the assumption made.	**10**	**L3**	**CO5**
	b.	A turbine shaft 60 mm in diameter, rotates at a speed of 1000 rpm. The load on each bearing is estimated at 2 kN and the length of the bearing is 80 mm. Taking radial clearance as 0.05 mm and SAE – 20 oil for lubrication. Determine the coefficient of friction by Mckee's equation, power loss, minimum oil film thickness and the oil flow rate. The temperature of the bearing is not to exceed 50°C.	**10**	**L3**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME654B**

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Renewable Energy Power Plant

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Explain an overview of global energy demand and the need for renewable energy source.	**10**	**L2**	**CO1**
	b.	List advantages and disadvantages of renewable energy resource.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Explain spectral distribution of extra-terrestrial radiation.	**10**	**L2**	**CO2**
	b.	Explain the terrestrial radiation received on the earth surface with figure.	**10**	**L2**	**CO2**
		Module – 2			
Q.3	**a.**	With a neat sketch, explain the working principle of solar pond electric power generation.	**10**	**L2**	**CO2**
	b.	Write short note on : i) Sunshine recorder ii) Pyrheliometer	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	List the types of solar power plant and explain any one.	**10**	**L2**	**CO1**
	b.	List and explain design consideration for solar power plants.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	With a neat sketch explain components of horizontal axis wind mill and also list some advantage and disadvantages.	**10**	**L2**	**CO3**
	b.	Describe the main consideration in selecting the site for wind generator.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	List the types of geothermal station and explain any one with schematic diagram.	**10**	**L2**	**CO4**
	b.	Explain the problem associated with geothermal energy conversion.	**10**	**L2**	**CO4**
		Module – 4			
Q.7	**a.**	Explain the working principle of single tide basin and list few advantages and disadvantages.	**10**	**L2**	**CO4**
	b.	Explain the fundamental characteristics of tidal powers.	**10**	**L2**	**CO4**

		OR			
Q.8	**a.**	Explain the working principle of OTEC with neat sketch.	**10**	**L2**	**CO4**
	b.	Explain the problem associated with OTEC.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Sketch and explain the working of a fixed dome biogas plant.	**10**	**L2**	**CO5**
	b.	List the application of biogas. What are the problems involved in production of biogas?	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	With a neat block diagram, explain the process of production of hydrogen by electrolysis method.	**10**	**L2**	**CO4**
	b.	Write the advantage, disadvantage and application of hydrogen energy.	**10**	**L2**	**CO4**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

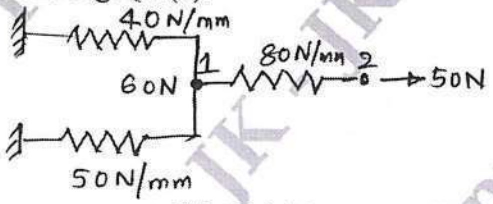
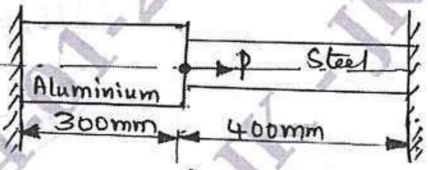
BME701

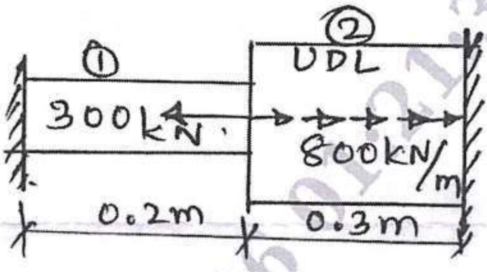
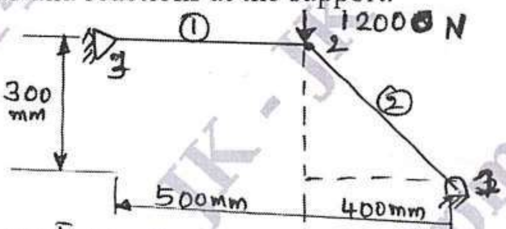
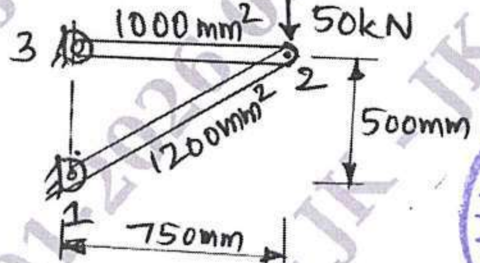
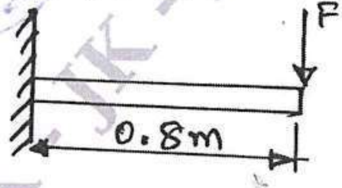
Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

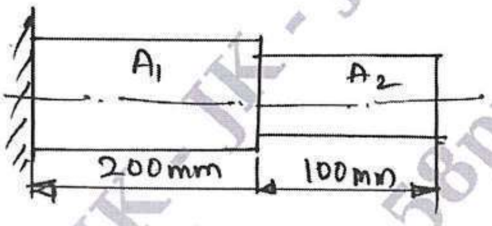
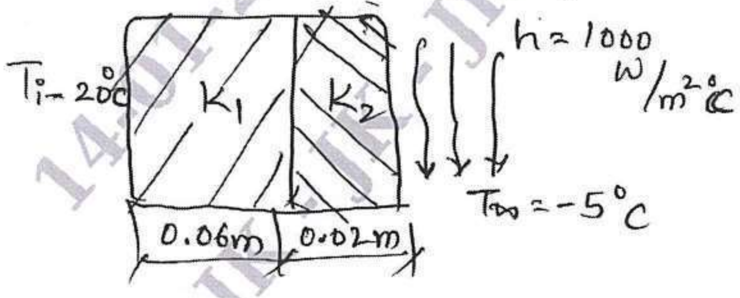
Finite Element Methods

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			**M**	**L**	**C**
Q.1	**a.**	Define FEM. Explain the basic steps in the finite element methods.	**10**	**L2**	**CO1**
	b.	Explain the plane stress and plane strain problems with examples, write the relation between stress and strain.	**10**	**L2**	**CO1**
OR					
Q.2	**a.**	Using minimum potential energy determine the nodal displacement of a spring system shown in Fig.Q.2(a).  Fig.Q.2(a)	**8**	**L3**	**CO1** **CO2**
	b.	A simply supported beam subjected to point load at the centre. Derive an equation for maximum deflection using trigonometric function by Rayleigh Ritz method.	**12**	**L3**	**CO1** **CO2**
Module – 2					
Q.3	**a.**	Derive shape functions (interpolation polynomial) for a 1-D bar element in natural coordinates.	**8**	**L2**	**CO3**
	b.	For the stepped bar shown in Fig.Q.3(b). Determine the nodal displacements, stress in each element and reaction at supports.  $E_{al} = 70 \times 10^9 N/m^2$ $E_s = 200 \times 10^9 N/m^2$ $A_{al} = 2400 mm^2$ $A_s = 600 mm^2$ $P = 200 kN$ Fig.Q.3(b)	**12**	**L3**	**CO4** **CO5**
OR					
Q.4	**a.**	Derive element stiffness matrix of a 1-D bar element. List the properties of stiffness matrix.	**10**	**L2**	**CO3**

	b.	Find the nodal displacements, stress and reaction for the bar subjected to load as shown in Fig.Q.4(b). Take E_1 = 70 GPa, E_2 = 200 GPa.  $A_1 = 7.85 \times 10^{-8} m^2$ $A_2 = 3.14 \times 10^{-7} m^2$ Fig.Q.4(b)	**10**	**L3**	**CO4** **CO5**
		Module – 3			
Q.5	**a.**	For the two-bar truss shown in Fig.Q.5(a) determine the displacements stress in each elements and reactions at the support.  $E = 2 \times 10^5 N/mm^2$ $A = 200\ mm^2$ Fig.Q.5(a)	**10**	**L3**	**CO4** **CO5**
	b.	For the two bar truss shown in Fig.Q.5(b). Determine the nodal displacements and stress in each member. Also find support reaction. Take E = 200GPa  Fig.Q.5(b)	**10**	**L3**	**CO4** **CO5**
		OR			
Q.6	**a.**	Derive Hermite shape function for a beam element.	**10**	**L2**	**CO3**
	b.	Find the deflection at the free end and the support reaction of a cantilever beam shown in Fig.Q.6(b).  F = 250kN E = 200GPa $I = 4 \times 10^{-6} m^4$ Fig.Q.6(b)	**10**	**L3**	**CO4** **CO5**

		Module – 4			
Q.7	**a.**	Derive shape functions of Constant Strain Triangular (CST) element in natural coordinates.	**10**	**L2**	**CO3**
	b.	Obtain the shape functions of 4 noded rectangular (quadrilateral) element in Lagrangian-in natural coordinates.	**10**	**L2**	**CO3**
		OR			
Q.8	**a.**	Explain the concept of isoparametric, sub parametric, super parametric elements, with sketches.	**10**	**L2**	**CO2**
	b.	Obtain the shape functions of nine (9) noded rectangular element in Lagrangian.	**10**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Derive an expression of element mass matrix for a bar element.	**6**	**L2**	**CO3**
	b.	For the stepped bar shown in Fig.Q.9(b) determine the eigen values and eigen vector. Take $A_1 = 400$ mm^2, $A_2 = 200$ mm^2, $\rho = 7850$ kg/m^3, E = 200 GPa.  Fig.Q.9(b)	**14**	**L3**	**CO4** **CO5**
		OR			
Q.10	**a.**	Briefly describe rate equations and boundary conditions in heat transfer analysis.	**6**	**L2**	**CO2**
	b.	Determine the temperature distribution through composite wall shown in Fig.Q.10(b), when the convective heat loss occurs on the right surface. Take $K_1 = 6$ W/m°C, and $K_2 = 20$ W/m°C.  Fig.Q.10(b)	**14**	**L3**	**CO4** **CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME702**

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Hydraulics and Pneumatics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define fluid power system and explain the structure of basic hydraulic system with a block diagram.	**10**	**L1**	**CO1**
	b.	List and explain the difference between hydraulics and pneumatics focusing on the advantages, disadvantages and applications.	**10**	**L1**	**CO1**
		OR			
Q.2	**a.**	Define hydraulic fluid and explain the necessary properties of a good hydraulic fluid.	**10**	**L2**	**CO1**
	b.	Identify and describe various filter locations in a hydraulic system with a neat sketch.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	Classify fixed displacement pumps.	**5**	**L2**	**CO2**
	b.	Describe the pumping theory of positive displacement pumps.	**5**	**L2**	**CO2**
	c.	With a neat sketch, explain the working of an unbalanced vane pump.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	Explain the working of single-acting and double acting hydraulic cylinder with neat sketch.	**10**	**L3**	**CO2**
	b.	Write short notes on : i) Cylinder cushioning ii) Accumulator	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of a 4/3 solenoid – operated Directional Control Valve (DCV)	**10**	**L3**	**CO3**
	b.	With a neat sketch, explain the functions and applications of shuttle valve. Also, mention the truth table of the same.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	With a neat sketch, explain the working of meter – in hydraulic circuit. Mention its advantages and applications.	**10**	**L3**	**CO3**
	b.	With a neat hydraulic circuit, explain the working and applications of a regenerative circuit.	**10**	**L3**	**CO3**

		Module – 4			
Q.7	**a.**	With a block diagram, explain the working of a pneumatic control system.	**10**	**L2**	**CO4**
	b.	Write short notes on : i) Characteristics of compressed air ii) FRL unit.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	With a neat circuit diagram, explain the working and applications of a quick exhaust valve.	**10**	**L3**	**CO4**
	b.	Write short notes on : i) Rod-less pneumatic cylinder ii) Mounting methods in pneumatic	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Explain two types of throttling methods in pneumatic systems. Also mention their advantages and applications.	**10**	**L2**	**CO5**
	b.	Explain the direct and indirect actuation methods using neat pneumatic circuits.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Construct and explain a pneumatic circuit to achieve the sequence $A^+ B^+ B^- A^-$ of the pneumatic cylinders. Mention its applications.	**10**	**L3**	**CO5**
	b.	Write short notes on : i) Time delay valve ii) Signal overlapping in pneumatics	**10**	**L2**	**CO5**

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CBCS SCHEME

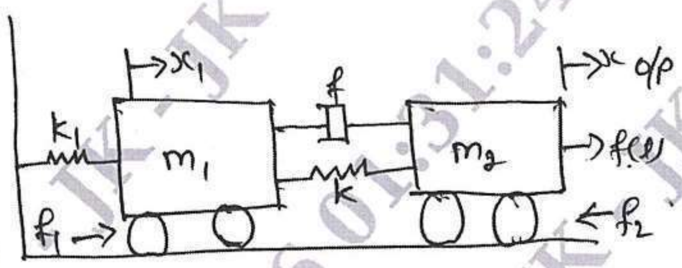
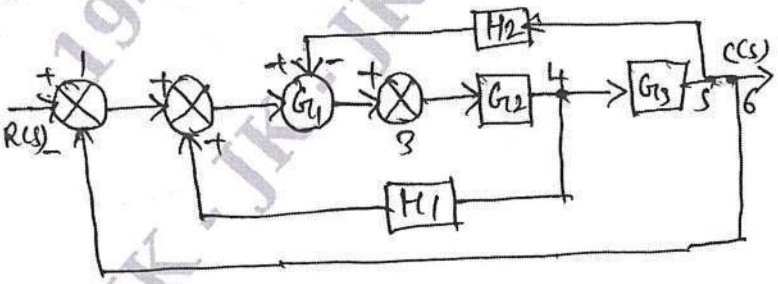
USN ☐☐☐☐☐☐☐☐☐☐ **BME703**

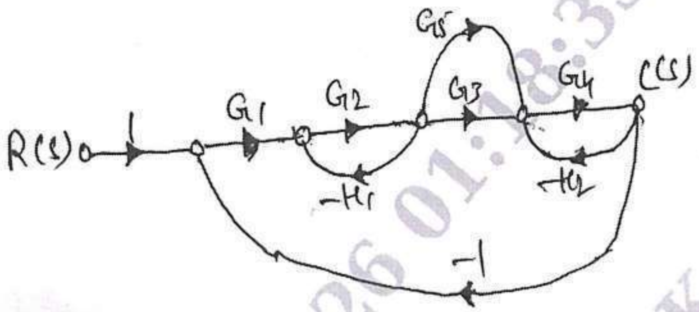
Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Control System. List out the comparison between open loop and closed loop control system.	**6**	**L1**	**CO1**
	b.	Elaborate the concept of feedback control system with an example.	**6**	**L1**	**CO1**
	c.	Describe the requirements of an ideal control system.	**8**	**L1**	**CO1**
		OR			
Q.2	**a.**	Explain proportional plus integral controller action with the characteristics.	**10**	**L1**	**CO1**
	b.	Obtain the transfer function of the mechanical system shown in Fig.Q.2(b) writing the physical system equations.  Fig.Q.2(b)	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	For the system shown in Fig.Q.3(a), use block diagram reduction technique to find $\frac{C}{R}$ equation.  Fig.Q.3(a)	**10**	**L2**	**CO1**

	b.	Find the overall transfer function by using Mason's gain formula for the signal flow graph shown in Fig.Q.3(b).  Fig.Q.3(b)	10	L3	CO2
		OR			
Q.4	**a.**	Explain in detail the types of system compensation with a neat sketch.	10	L3	CO2
	b.	Explain the following: i) Lag compensator ii) Lead compensator	10	L3	CO2
		Module – 3			
Q.5	**a.**	Elaborate the following terms with graph and equations: i) Step ii) Ramp input iii) Parabolic input iv) Impulse input	10	L2	CO3
	b.	Derive the expression for error constant and steady state errors and also define the steady state error.	10	L3	CO3
		OR			
Q.6	**a.**	Derive the expression for transient response of second order system for unit step input.	10	L2	CO5
	b.	For with feedback control system having open-loop transfer function: $G(s)=\frac{K(s+2)}{s(s^3+7s^2+12s)}$ Find: i) Type of system ii) Error coefficients iii) Steady state error for input of $\frac{R}{2}t^2$	10	L2	CO3
		Module – 4			
Q.7	**a.**	The characteristics equation of a system is given by $s^6+3s^5+4s^4+6s^3+5s^2+3s+2=0$ Determine the stability using RH criteria.	8	L2	CO4

	b.	By applying Routh criterion, discuss the stability of the closed loop system as a function of K for the following open loop transfer function. $G(s)H(s) = \dfrac{k(s+1)}{s(s-1)(s^2+4s+16)}$	12	L2	CO4
		OR			
Q.8		The loop transfer function of a unity feedback control system is $G(s) = \dfrac{k(s+6)}{s(s+1)(s+2)}$ Draw the root locus diagram for all values of K ranging from 0 to ∞ and mark the salient points on the root locus.	20	L2	CO4
		Module – 5			
Q.9	a.	Sketch the polar plot for the transfer function $G(s) = \dfrac{1}{(1+s)(1+2s)}$	6	L2	CO4
	b.	Using Nyquist criterion, investigate the stability of a system whose open loop transfer function is $G(s)H(s) = \dfrac{K}{(s+1)(s+2)(s+3)}$	14	L2	CO4
		OR			
Q.10		Construct the bode plot for a unity feedback system whose open loop transfer function is given by: $G(s)H(s) = \dfrac{10}{s(1+s)(1+0.02s)}$ From Bode plot determine: i) Gain and phase cross over frequencies ii) Gain and phase margin iii) Stability of the closed loop system	20	L2	CO4

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **BME714A**

Seventh Semester B.E/B.Tech. Degree Examination, Dec.2025/Jan.2026

Additive Manufacturing

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
1	a.	Define additive manufacturing and list its advantages over conventional manufacturing.	**5**	**L1**	**CO1**
	b.	Distinguish between additive manufacturing and CNC machining.	**5**	**L2**	**CO1**
	c.	Illustrate the generic additive manufacturing process chain with a neat sketch.	**10**	**L3**	**CO1**
		OR			
2	a.	Describe the role of reverse engineering in additive manufacturing.	**5**	**L1**	**CO1**
	b.	List and classify additive manufacturing processes.	**5**	**L2**	**CO1**
	c.	Apply design for additive manufacturing principles to improve component performance.	**10**	**L3**	**CO1**
		Module – 2			
3	a.	Define stereolithography and explain the SL resin curing process.	**5**	**L2**	**CO2**
	b.	Describe the working principle of selective laser sintering.	**5**	**L2**	**CO2**
	c.	Illustrate the various powder bed fusion mechanisms.	**10**	**L3**	**CO2**
		OR			
4	a.	Distinguish between SLS and EBM.	**5**	**L2**	**CO2**
	b.	State advantages and disadvantages of photo-polymerization process.	**5**	**L2**	**CO2**
	c.	Explain bio-extrusion and list its applications.	**10**	**L3**	**CO2**
		Module – 3			
5	a.	Define 3D printing and explain its evolution as an additive manufacturing process.	**5**	**L1**	**CO3**
	b.	Explain the principle of laminated object manufacturing.	**5**	**L2**	**CO3**
	c.	Illustrate the working of a typical beam deposition process with a neat sketch.	**10**	**L3**	**CO3**

		OR			
6	a.	What are the technical challenges associated with printing deposition processes.	**5**	**L1**	**CO3**
	b.	Describe the materials used and bonding methods in sheet lamination.	**5**	**L2**	**CO3**
	c.	Apply sheet lamination process to explain "Bond them form" and form then bond processes.	**10**	**L2**	**CO3**
		Module – 4			
7	a.	Define process selection and state its importance in additive manufacturing.	**5**	**L1**	**CO4**
	b.	Explain the selection methods used for part manufacturing.	**5**	**L2**	**CO4**
	c.	Explain how production planning and control is managed in additive manufacturing environments.	**10**	**L3**	**CO4**
		OR			
8	a.	List post processing techniques which are used to enhance components, which are manufactured by AM process.	**5**	**L1**	**CO4**
	b.	Explain the common problems encountered in STL files.	**5**	**L2**	**CO4**
	c.	Apply post processing methods to explain thermal and non thermal methods.	**10**	**L3**	**CO4**
		Module – 5			
9	a.	Evaluate discrete and blended multiple material processes with example.	**10**	**L4**	**CO5**
	b.	Describe the limitations of AM for medical applications.	**10**	**L3**	**CO5**
		OR			
10	a.	Compare direct digital manufacturing with rapid prototyping.	**10**	**L3**	**CO5**
	b.	Apply direct digital manufacturing in the production of customized foot wear.	**10**	**L4**	**CO5**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BME755A

Seventh Semester B.E/B.Tech. Degree Examination, Dec.2025/Jan.2026

Non-Traditional Machining

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
1	a.	Define Non-Traditional Machining (NTM) and explain its need.	5	L1	CO1
	b.	Classify NTM processes based on the type of energy used, giving one example each.	5	L2	CO1
	c.	Discuss the selection criteria for choosing on NTM process for a given job.	10	L3	CO1
		OR			
2	a.	Compare traditional and non-traditional machining processes.	10	L1	CO1
	b.	List advantages, limitations and applications of NTM processes.	10	L2	CO1
		Module – 2			
3	a.	Explain with neat sketch the construction and working of Ultrasonic Machining (USM).	8	L2	CO2
	b.	Describe process parameters affecting MRR and surface finish in USM.	8	L3	CO2
	c.	List advantages, limitations and applications of USM.	4	L1	CO2
		OR			
4	a.	Explain the working principle and construction of Abrasive Jet Machining (AJM) with neat sketch.	8	L2	CO2
	b.	Discuss the effect of process parameters such as carrier gas pressure, abrasive type and stand – off distance.	8	L3	CO2
	c.	State advantages and applications of AJM.	4	L1	CO2
		Module – 3			
5	a.	Explain with neat sketch the construction and working of Electro Chemical Machining (ECM).	8	L2	CO3
	b.	Discuss process parameters affecting performance of ECM.	8	L3	CO3
	c.	Differentiate between Electrochemical Grinding (ECG) and Electrochemical Honing (ECH).	4	L2	CO3

OR					
6	a.	Explain with neat sketch the working of Chemical Machining (CHM) process.	8	L2	CO3
	b.	Describe Maskants and Etchants used in CHM.	6	L3	CO3
	c.	Write advantages, limitations and applications of CHM.	6	L1	CO3
Module – 4					
7	a.	Explain the construction and working of Electrical Discharge Machining (EDM).	8	L2	CO4
	b.	Describe functions of dielectric fluid and flushing methods in EDM.	6	L3	CO4
	c.	Explain the principle and working of Wire EDM (WEDM).	6	L2	CO4
OR					
8	a.	Explain the set up and working of Plasma Arc Machining (PAM) with neat sketch.	8	L2	CO4
	b.	Discuss process parameters and safety precautions in PAM.	8	L3	CO4
	c.	Mention advantages and limitations of PAM.	4	L1	CO4
Module – 5					
9	a.	Explain the principle, setup, working of Laser Beam Machining (LBM).	10	L2	CO5
	b.	Write advantages, limitations and applications of LBM.	5	L1	CO5
	c.	Explain how laser parameters influence machining accuracy and surface quality.	5	L2	CO5
OR					
10	a.	Explain the principle and working of Electron Beam Machining (EBM).	10	L2	CO5
	b.	Compare LBM and EBM based on principle, Equipment and applications.	5	L2	CO5
	c.	Write advantages, limitations and applications of EBM.	5	L1	CO5

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