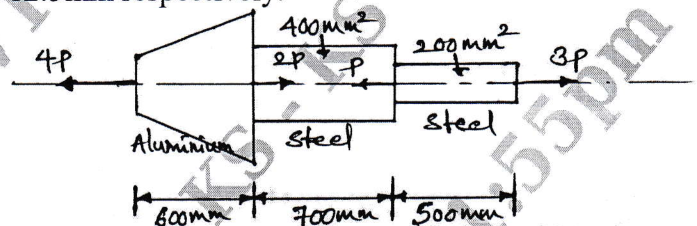
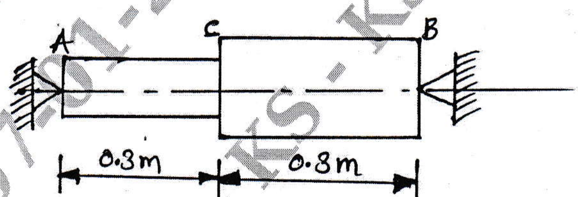
CBCS SCHEME

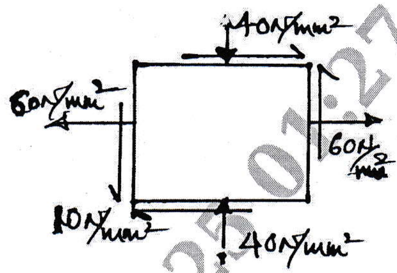
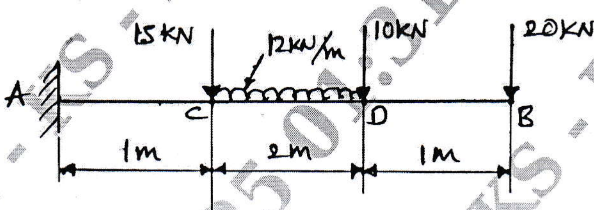
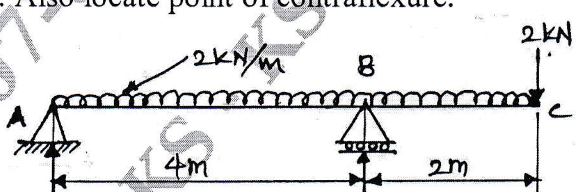
USN | | | | | | | | | | | **BME301**

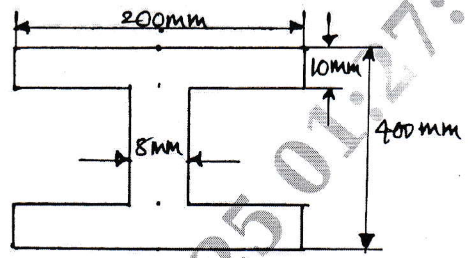
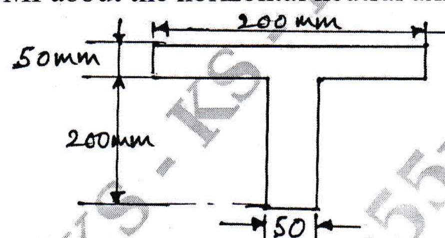
Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechanics of Materials

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 $\alpha = 12\times10^{-6}/°C$ for steel. Area of cross-section of AC is 400 mm^2 and of BC is 800 mm^2.  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. $G = 9\times10^4\ N/mm^2$.	**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 $\alpha = 1/1600$. (ii) Euler's formula, taking $E = 1.2\times10^5\ N/mm^2$.	**10**	**L4**	**CO5**

* * * * *

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

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 $Fe\text{-}Fe_3C$ 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**

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**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

BME306A

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Electric and Hybrid Vehicle Technology

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.	Discuss the need of Electric and hybrid vehicles. List their advantages and limitations.	10	L1	CO1
	b.	Explain the basic architecture and types of EV and HV.	10	L2	CO1
		OR			
Q.2	a.	Discuss the methods and technology used in disposal of batteries, cell, hazardous materials.	10	L1	CO1
	b.	Explain the impact on environment of conventional, EV, HEV.	10	L2	CO1
		Module – 2			
Q.3	a.	Discuss the various power, energy management strategies and its general architecture in EV and HV.	10	L1	CO2
	b.	With a neat sketch, explain Fuel cells and their characteristics.	10	L2	CO2
		OR			
Q.4	a.	Discuss briefly importance, advantages and application of super capacitors.	10	L1	CO2
	b.	Discuss the various energy storage devices and also explain the selection criteria of them.	10	L1	CO2
		Module – 3			
Q.5	a.	Explain various types of motors and size and selection criteria of them.	10	L2	CO3
	b.	Explain traction motors variable speed electric motor characteristics with a neat sketch.	10	L2	CO3
		OR			
Q.6	a.	Explain IPM motors and their characteristics.	10	L2	CO3
	b.	Discuss the types of mechanical and electrical connections of motors.	10	L2	CO3
		Module – 4			
Q.7	a.	Sketch and explain rolling resistance and aero dynamic drag in electric vehicles.	10	L2	CO4
	b.	Discuss the design parameters of batteries ultra capacitors and Fuel cells.	10	L1	CO4
		OR			
Q.8	a.	Explain the total tractive effort, torque required, transmission efficiency of the drive wheel.	10	L2	CO4
	b.	With a neat sketch, explain Lead-Ion batteries.	05	L2	CO4
	c.	Explain major types of rechargeable in EV and HVE.	05	L2	CO4
		Module – 5			
Q.9	a.	Define the term battery charging and termination. Name different methods of battery charging.	10	L1	CO5
	b.	Explain importance of power electronics converters for battery charging.	10	L2	CO5
		OR			
Q.10	a.	Discuss the battery charging stations and its installation and commissioning.	10	L1	CO5
	b.	Discuss the domain related grid inter-connections of electric and hybrid vehicles.	10	L1	CO5

* * * * *