BME-260

Roll No. | | | | | | | | | | |

B. Tech.
Year: 2nd Semester: 4th
Minor Test: 2025-2026

Fundamentals of Mechanical Engineering

Time: 2 Hr. **Max Marks: 20**

Note: Attempt ALL questions.

Q1.		Attempt any **TWO** parts of the following.	Marks	CO	BL	PO	PI Code
	a)	Define a polytropic process. Starting from the first law of thermodynamics, prove that polytropic specific heat can be negative for certain values of polytropic index.	4	1	5	2	2.4.1
	b)	Draw the stress-strain diagram for a ductile material and explain the significance of each point. Also, draw the stress-strain diagrams for (i) a linear elastic material with strain hardening and (ii) a brittle material. Further, clearly explain the difference between proportional limit and elastic limit.	4	4	4	1	1.4.1
	c)	A refrigerator working between –5°C and 35°C removes heat at the rate of 6 kW. The actual COP of the refrigerator is 60% of the COP of an ideal Carnot refrigerator. Determine the followings • COP of the Carnot refrigerator • Power input required	4	1	4	1	1.4.1
Q.2		Attempt any **TWO** parts of the following.					
	a)	Derive an expression for the overall efficiency of two heat engines connected in series. If the efficiency of the first engine is 30% and that of the second engine is 40%, calculate the overall efficiency of the engines.	3	1	5	2	2.4.1
	b)	Work is done on an adiabatic system due to which its velocity changes from 10 m/s to 20 m/s, elevation increases by 20 m and temperature increases by 2 K. The mass of the system is 5 kg. If there is no change in any other component of the energy of the system, determine the magnitude of total work done (in kJ) on the system as well as the amount of heat transfer from the or to the system.	3	1	4	2	2.4.1
	c)	Derive the air-standard efficiency of the Diesel cycle. Clearly state all assumptions used in the derivation. Also, explain the effect of the compression ratio as well as cut-off ratio on Diesel cycle efficiency.	3	1	5	2	2.4.1

Q.3		Attempt any **TWO** parts of the following.					
	a)	The stress-strain behaviour of a material can be idealized as: • Linear elastic up to 200 MPa at strain 0.002 • Perfectly plastic up to fracture at strain 0.15 Determine the toughness of the material.	3	4	4	1	1.4.1
	b)	Discuss any three of the following in brief: • Volumetric strain • Modulus of resilience (MOR) • Endurance strength and Endurance limit for ductile material • Malleability • Homogenous and isotropic material	3	4	3	1	1.4.1
	c)	Define Poisson ratio. For a material, Young's modulus = 200 GPa and Poisson's ratio = 0.25. Calculate: • Modulus of rigidity (G) • Bulk modulus (K) Also, state the effect of Poisson's ratio over bulk modulus and modulus of rigidity.	3	4	4	2	2.4.1

~End of Question Paper~

PYQORA

BME-260

Roll No. | | | | | | | | | | |

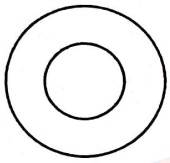
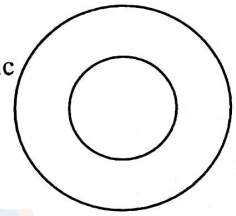
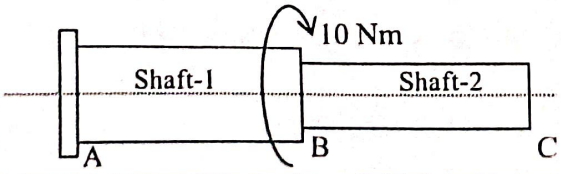
B.Tech.
Year: 2nd, Semester: 4th (EVEN SEM)
MAJOR EXAMINATION, 2025-26
FUNDAMENTALS OF MECHANICAL ENGINNERING

Time: 3 Hours ***Max. Marks: 50***

Note: Attempt **ALL** questions. Each question carries equal marks.

Q 1.	Attempt any **Five** parts of the following.		Marks	CO	BL	PO	PI Code
	(a).	For an ideal gas, show that $C_P - C_V = R$, where C_P and C_V are the specific heats at constant pressure and constant volume, respectively, and R is the characteristics gas constant.	2	1	3	1	1.4.1
	(b).	State the statements of the Second Law of Thermodynamics. Further, explain the difference between a heat engine and a heat pump with suitable diagrams and expressions.	2	4	2	1	1.4.1
	(c).	Neatly draw the pressure–enthalpy (P-h) and temperature–entropy (T-s) diagrams of the vapor compression refrigeration cycle for saturated vapor at the compressor inlet. Also explain each process of the cycle.	2	2	2	1	1.4.1
	(d).	An engine running on an air standard Otto cycle has a displacement volume of 250 cm^3 and a clearance volume of 35.7 cm^3. The pressure and temperature at the beginning of the compression process are 100 kPa and 300 K, respectively. Heat transfer during constant volume heat addition process is 800 kJ/kg. Assume specific heats remain constant during the cycle. Determine the maximum pressure in the cycle (in kPa). For air assume suitable value of specific heats.	2	2	3	1	1.4.1
	(e).	Explain the difference between resilience, proof resilience, and modulus of resilience with a suitable diagram. Also explain the method used to calculate the toughness of a material.	2	6	2	1	1.4.1
	(f).	A metallic rod of 500 mm length and 50 mm diameter, when subjected to a tensile force of 100 kN at the ends, experiences an increase in its length by 0.5 mm and a reduction in its diameter by 0.015 mm. Determine the Poisson's ratio of the rod material	2	6	3	1	1.4.1

	(g)	A material has a Young's modulus of 100 GPa and a modulus of rigidity of 80 GPa. Determine the ratio of Young's modulus to the bulk modulus.	2	6	3	1	1.4.1
Q 2.	Attempt any **Two** parts of the following.						
	(a).	What is the main difference between a sensor and a transducer? Explain any three classifications and any five characteristics of a transducer.	5	1	2	1	1.4.1
	(b).	A strain gauge with the following properties is connected in a quarter Wheatstone bridge circuit: • Initial resistance of strain gauge $R = 120\,\Omega$ • Gauge factor $GF = 2.1$ • Applied strain $\varepsilon = 750\times10^{-5}$ • Bridge supply voltage $V_s = 10\,V$ Calculate: 1. Change in resistance ΔR 2. New resistance of the strain gauge 3. Output voltage of the bridge	5	3	3	1	1.4.1
	(c).	The readings t_A and t_B of two thermometers A and B at ice point and steam point are related by the equation $t_A = l + mt_B + nt_B^2$ Where $l, m,$ and n are constant. When both are immersed in oil A reads 51°C and B reads 50°C. Determine the reading of A when B reads 25°C.	5	4	5	1	1.4.1
Q 3.	Attempt any **Two** parts of the following.						
	(a).	What is grey cast iron? Explain its properties. Also provide a suitable comparison between grey cast iron and white cast iron.	5	2, 5	2	1	1.4.1
	(b).	Write short notes on any four of the following topics. • LVDT • Seeback effect • Curie point temperature • Stainless steels • High speed steels	5	2, 5	1	1	1.4.1
	(c).	What is the difference between steel and cast iron? Also classify carbon steels on the basis of carbon percentage.	5	2, 5	2	1	1.4.1
Q 4.	Attempt any **Two** parts of the following.						
	(a).	A simply supported beam of width 100 mm, height 200 mm and length 4 m is carrying a uniformly varying load of intensity varies from zero to 10 kN/m. Determine the magnitude of bending stress in the beam in MPa.	5	2, 5	4	1	1.4.1

	(b).	A beam carries a combination of loads such that the shear force changes sign at two points. Explain: What does this indicate physically? How will you identify points of maximum bending moment?	5	2, 5	5	1	1.4.1
	(c).	A simply supported beam of span 12 m carries: A UDL of 2 kN/m from left support up to 6 m A UVL from 0 to 4 kN/m from 6 m to 12 m Find: Reactions, draw SFD and BMD, and Locate the point at which bending moment is maximum.	5	2, 5	5	1	1.4.1
Q 5.	Attempt any **Two** parts of the following.						
	(a).	The cross sections of two hollow bars are made of the same material are concentric circles as shown in the figure. It is given that $r_3 > r_1$ and $r_4 > r_2$, and that the areas of the cross-sections are the same, J_1 and J_2 are the torsional rigidities of the bars on the left and right, respectively. Determine J_2/J_1 Concentric circle-1  r_1 is inside radius r_2 is outside radius Concentric circle-2  r_3 is inside radius r_4 is outside radius	5	3, 6	4	1	1.4.1
	(b).	A cylindrical transmission shaft of length 1.5 m and diameter 100 mm is made of a linear elastic material with a shear modulus of 80 GPa. While operating at 500 rpm, the angle of twist across its length is found to be 0.5 degrees. Determine the power transmitted by the shaft in kW at this speed.	5	6	5	1	1.4.1
	(c).	Consider a stepped shaft subjected to a twisting moment applied at B as shown in the figure. Assume shear modulus, G = 77 GPa. Length of both the shafts is same and it is equal to 500 mm each, whereas, diameter of shaft-1 and 2 is 20 mm and 10 mm, respectively. Determine the angle of twist at C in degree.  	5	6	4	1	1.4.1

~End of Question Paper~