CBCS SCHEME

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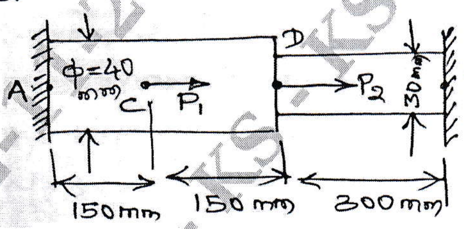
BME301

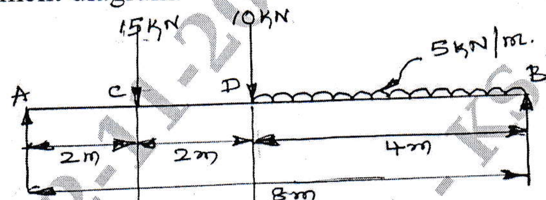
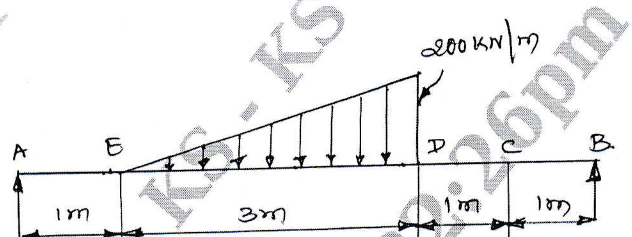
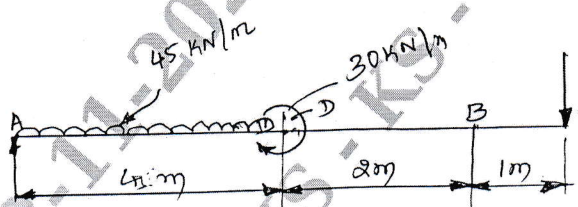
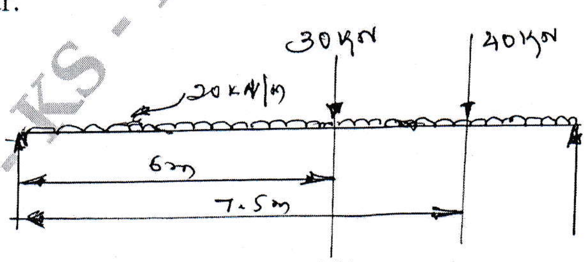
Third Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

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.	Describe with a neat sketch, stress-strain diagram of mild steel and cast iron indicating salient points.	05	L1	CO1
	b.	State Hooke's law and determine an expression for shortening/extension of bar.	05	L2	CO1
	c.	The tensile test was conducted on a mild steel bar. The following data was obtained from the test: diameter of the 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 the bar = 104 mm, diameter of the rod at failure = 12 mm. Determine: (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage elongation	10	L3	CO1
		OR			
Q.2	a.	Derive a relation between modulus of elasticity and bulk modulus.	04	L2	CO1
	b.	A member is of total length 2m, its diameter is 40 mm for the first 1m length. In the next 0.5 m length, its diameter gradually reduces from 40 mm to 'd' mm. For the remaining length of the member, the diameter remains 'd' mm uniform. When this member is subjected to an axial tensile force of 150 kN, the total elongation observed is 2.39 mm. Determine diameter 'd'. Assume Young's modulus = 2×10^5 MPa.	08	L3	CO1
	c.	A stepped bar of steel, held between two supports as shown in Fig.Q2(c) is subjected to loads P_1 = 80 kN and P_2 = 60 kN. Find the reaction developed at the ends A and B.  Fig.Q2(c)	08	L3	CO1
		Module – 2			
Q.3	a.	Derive an expression for normal and shear stress on a inclined plane of a member subjected to bi-axial stress system.	10	L2	CO2
	b.	A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3 N/mm^2. The diameter of the cylinder is 25 cms and the length is 75 cms. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter length and volume of the cylinder. Take E = 2.1×10^5 MPa and 1/m = 0.286.	10	L3	CO1

		OR			
Q.4	**a.**	At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa both tensile respectively, at right angles to each other with shearing stress of 20 MPa. Draw the Mohr's circle diagram and find out: (i) Principal stresses and their planes (ii) Maximum shear stress and its planes.	10	L4	CO2
	b.	Define thick and thin cylinders. Also derive an expression for circumferential stress in a thin cylinder.	10	L2	CO2
		Module – 3			
Q.5	**a.**	A simply supported beam of 10 m span as shown in the Fig.Q5(a) carries two concentrated loads and a uniformly distributed load. Draw shear force and bending moment diagram.  Fig.Q5(a)	10	L4	CO4
	b.	Draw the SFD and BMD for the beam loaded as shown in Fig.Q5(b). Also find the position of maximum bending moment and maximum bending moment.  Fig.Q5(b)	10	L4	CO4
		OR			
Q.6	**a.**	For a beam shown in Fig.Q6(a), determine the magnitude of the load acting at C, such that the reaction at support A and B are equal. Draw SFD and BMD indicating the values at the salient points. Locate point of contra flexure.  Fig.Q6(a)	10	L4	CO4
	b.	A simply supported beam is loaded as shown in Fig.Q6(b). Draw SFD and BMD for the beam and state the valves of maximum bending moment and maximum shear.  Fig.Q6(b)	10	L4	CO3

Module – 4

Q.7	**a.**	A simply supported beam having cross section of 20 mm × 20 mm fails when a central point load of 400 N is applied span of beam is 2m. What UDL will break a cantilever of same material 40 mm wide, 60 mm deep and 3m long.	**10**	**L3 L4**	**CO2 CO3**
	b.	A cast iron bracket subject to bending has the cross-section of I-form with unequal flanges. The dimension of the section are shown in Fig.Q7(b). Find the position of the Neutral axis and moment of inertia of the section about the neutral axis. If the maximum bending moment on the section is 40 MN-mm. Determine the maximum bending stress. What is the nature of the stress?	**10**	**L3 L4**	**CO1 CO2**

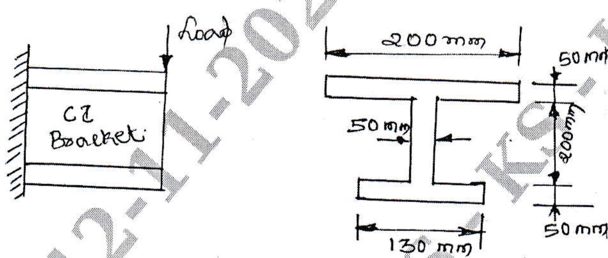


Fig.Q7(b)

OR

Q.8	**a.**	Derive an expression for bending stresses in beams.	**10**	**L2**	**CO1**
	b.	A 5m cantilever beam of cross-section 150 mm × 300 mm fails when a load of 30 kN is applied at the free end. Find the stress at failure.	**05**	**L3**	**CO2**
	c.	List assumptions made in pure bending theory.	**05**	**L1**	**CO1**

Module – 5

Q.9	**a.**	A solid shaft has to transmit 150 KW of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1° in a length of 4m. Find the suitable diameter of solid circular shaft. Take G = 84 GPa.	**10**	**L4**	**CO2**
	b.	Derive Euler's crippling load for a column when both its ends are hinged.	**10**	**L2**	**CO1**

OR

Q.10	**a.**	A 150 mm diameter solid steel shaft is transmitting 450 KW power at 90 rpm, compute the maximum shearing stress. Find the change that would occur in the shearing stress, if the speed were increased to 360 rpm.	**10**	**L4**	**CO2**
	b.	A 1.5m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using : (i) Rankine's formula taking yield stress 560 N/mm^2 and $a = \frac{1}{600}$ (ii) Euler's formula taking $E = 1.2 \times 10^5$ MPa	**10**	**L4**	**CO2**

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BME303

Third Semester B.E./B.Tech. Degree Supplementary 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.	Define Material Science and Engineering. List eight commonly encountered engineering material.	04	L1	CO1
	b.	What are the three metal crystal structures? List five metals that have each of these crystal structures.	08	L1	CO1
	c.	What are imperfections? Explain different types of imperfections.	08	L2	CO1
		OR			
Q.2	a.	Define Atomic Packing Factor (APF). Calculate APF for BCC structure.	08	L3	CO1
	b.	Platinum is FCC and has a lattice constant of 0.39239nm. Calculate a value for atomic radius of platinum atom in nanometer.	06	L2	CO1
	c.	Define and differentiate crystalline solids and amorphous solid.	06	L2	CO1
		Module – 2			
Q.3	a.	State I and II Fick's law of diffusion.	04	L1	CO2
	b.	What is diffusion? Explain the factors affecting the diffusion.	06	L2	CO2
	c.	Draw of neat Iron Carbon equilibrium diagram and label all the phases. Write invariant reaction like eutectoid, eutectic and pretectic reactions.	10	L3	CO2
		OR			
Q.4	a.	Discuss the Hume – Rothery rules for formation of solid solution.	04	L2	CO2
	b.	Explain the diffusion mechanism.	06	L2	CO2
	c.	Explain the eutectic system binary phase diagram for two metals completely soluble in liquid state but completely insoluble in solid state.	10	L2	CO2
		Module – 3			
Q.5	a.	Define homogeneous and heterogeneous nucleation. Obtain an expression for critical radius of nucleus.	08	L3	CO3
	b.	What is heat treatment and mention the classification.	05	L1	CO3
	c.	With sketch explain flame hardening process.	07	L2	CO3
		OR			
Q.6	a.	Explain strain hardening and solid state hardening process of strengthening of metals.	07	L2	CO3
	b.	Sketch and explain Annealing heat treatment process.	07	L2	CO3
	c.	What is hardenability? Discuss factors affecting hardenability.	06	L2	CO3
		Module – 4			
Q.7	a.	Explain the Physical Vapour Deposition (PVD) process, in brief.	06	L2	CO4
	b.	List advantages and disadvantages of surface coating.	04	L1	CO4
	c.	With a flow diagram explain the operations involved in making powder metallurgy parts.	10	L2	CO4
		OR			
Q.8	a.	Explain the characteristics of metal powder.	06	L2	CO4
	b.	What are the applications of powder metallurgy?	06	L1	CO4
	c.	Explain the Chemical Vapour Deposition (CVD) process with neat sketch.	08	L2	CO4

Module – 5					
Q.9	**a.**	Classify engineering materials. Explain them with example.	**10**	**L2**	**CO4**
	b.	Sketch and explain the fabrication of MMC's using Stir Casting process.	**10**	**L2**	**CO3**
OR					
Q.10	**a.**	Give a broad classification of composites.	**06**	**L2**	**CO3**
	b.	Discuss various applications of composites.	**06**	**L2**	**CO3**
	c.	Explain material selection process for various machine components.	**08**	**L2**	**CO5**

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BME304

Third Semester B.E./B.Tech Degree Supplementary 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. Used of thermodynamic data hand book is permitted.

		Module – 1	M	L	C
Q.1	a.	Explain Zeroth law of thermodynamics.	4	L2	CO1
	b.	Define heat and work in thermodynamics. Show that work is a path function.	8	L1	CO1
	c.	The temperature 'T' on thermometric scale is defined in terms of property 'P' by the relation $T = a \log_e P + b$, where a and b are constants. The temperature at ice point and steam point are 0 and 100°C respectively. Instrument gives values of 'P' 1.86 and 6.81 at ice and stream point respectively. Evaluate temperature corresponding to a reading of P = 2.5.	8	L3	CO1
		OR			
Q.2	a.	Derive an expression for displacement work for : i) Isothermal process ii) Isentropic process.	10	L2	CO1
	b.	A cylinder contains $0.5 m^3$ of gas at 1 bar and 90°C. The gas compressed to a volume of $0.125 m^3$. The final pressure being 6 bar. Find : i) The mass of the gas ii) Value of 'n' iii) The heat transferred iv) Internal energy.	10	L3	CO1
		Module – 2			
Q.3	a.	State the first law of thermodynamics applied to cyclic process and non cyclic process.	6	L1	CO2
	b.	Show that internal energy is a property of system.	6	L2	CO2
	c.	A closed system undergoes a cycle. The energy transfer are as obtained : i) Complete the table ii) Determine rate of work in KW.	8	L3	CO2

Process	Q(kJ/min)	W(kJ/min)	DE(kJ/min)
AB	400	150	–
BC	200	–	300
CD	–200	–	–
DA	0	75	–

		OR			
Q.4	**a.**	Starting the assumptions, derive steady flow energy equation.	**6**	**L2**	**CO2**
	b.	A nozzle is a device for increasing the velocity of steadily flowing steam. Enthalpy of the fluid at inlet is 3000kJ/kg and velocity is 60m/s. Enthalpy at discharge end is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it : i) Find velocity at exit of nozzle ii) If inlet area is $0.1 m^2$ and specific volume is $0.187 m^3/kg$, find mass flow rate. iii) If specific volume at exit is $0.498 m^3/kg$ find diameter at exit of nozzle.	**8**	**L3**	**CO2**
	c.	The power capacity of a system is 3000KW for the following data determine the fluid flow rate in kg/hour. The heat rejection from fluid = 100 kJ/s Inlet velocity = 300 m/s Inlet pressure = 600 KPa Inlet internal energy = 2000 kJ/kg Inlet volume = $0.2 m^3/kg$ Outlet velocity = 120 m/s Outlet pressure = 150 Kpa Outlet internal energy = 1500 kJ/kg Final volume = $1.2 m^3/kg$ The fluid enters and leaves the system at same elevation.	**6**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Give the Kelvin plank and Clausius statements of second law of thermodynamics and prove their equivalence.	**10**	**L1**	**CO3**
	b.	Explain PMMK – 1 and PMMK – 2.	**4**	**L1**	**CO3**
	c.	A series combination of two Carnot engines operate between temperature of 180°C and 20°C. Calculate the intermediate temperature, if engine produces : i) Equal amount of work ii) Engines having same efficiency.	**6**	**L3**	**CO3**
		OR			
Q.6	**a.**	State and prove Clausius inequality.	**8**	**L1**	**CO3**
	b.	Show that entropy is a property of a system.	**6**	**L2**	**CO3**
	c.	5 kg of copper block of 200°C is dropped to an insulated tank with 100kg of oil at 30°C. Find the increase in entropy of the universe. Take C_p(copper) = 0.4kJ/kg-k, C_p(oil) = 2.1kJ/kg-k .	**6**	**L3**	**CO3**

		Module – 4			
Q.7	**a.**	With T – S diagram briefly explain the available energy and unavailable energy.	**6**	**L1**	**CO4**
	b.	Obtain an expression for maximum work available in steady flow system.	**6**	**L2**	**CO4**
	c.	Define the following with respect to the pure substance : i) Latent heat of vapourisation ii) Sensible heat iii) Saturation temperature iv) Triple point v) Dryness fraction vi) Wet steam.	**8**	**L1**	**CO4**
		OR			
Q.8	**a.**	With a neat sketch explain the working of a separating and throttling calorimeter.	**10**	**L1**	**CO4**
	b.	In a test to find the quality of the steam in a pipe using a combined separating and throttling calorimeter, the following data was obtained : Pressure of steam in steam mains = 14 bar Pressure of steam after throttling = 1.19 bar Temperature after throttling = 120°C Water collected in separator = 0.45 kg Steam condensed after throttling = 6.75 kg Describe the condition of the steam in the mains. Take SP heat of superheated steam as 2.1 kJ/kg-k.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Clearly distinguish between ideal and real gases.	**6**	**L1**	**CO5**
	b.	Explain briefly Dalton's law and Amagat's law.	**6**	**L1**	**CO5**
	c.	Derive an expression for specific heat at constant pressure and constant volume for mixture of gases.	**8**	**L2**	**CO5**
		OR			
Q.10	**a.**	Explain reduced properties and compressibility chart.	**6**	**L1**	**CO5**
	b.	Write Maxwell relations and explain the terms involved.	**6**	**L1**	**CO5**
	c.	Determine the pressure exerted by carbon-dioxide in a container of $1.5m^3$ capacity when it contains 5kg at 27°c using. i) Ideal gas equation ii) Vander walls equation Take a = 364.3 $kN/m^4/kg\ mol^2$ b = 0.0427 m^3/kg mol.	**8**	**L3**	**CO5**

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