CBCS SCHEME

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1BPHYM102

First Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Physics 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.
3. VTU formula handbook is permitted.

		Module – 1	M	L	C
Q.1	a.	Define force constant. Derive the expression for equivalent force constant for two springs connected in series and parallel combination.	8	L2	CO1
	b.	Define Simple harmonic motion. Derive the differential form of expression for Simple Harmonic motion.	6	L2	CO1
	c.	A mass of 0.4 Kg causes an extension of 0.02m in a spring and the system is set for oscillations. Find the force constant of the spring, angular frequency and period of resulting oscillations.	6	L3	CO1
		OR			
Q.2	a.	Discuss the different types of springs used for various applications. Obtain the differential form of expression for a body undergoing forced oscillations and mention the expression for amplitude and phase of oscillations.	10	L2	CO1
	b.	Discuss the condition for amplitude resonance and hence emphasize on sharpness of resonance.	5	L2	CO1
	c.	Calculate the resonance amplitude of the vibration of the system whose natural frequency is 1000 Hz when it oscillates in the resistive medium for which the value of damping per unit mass is 0.008 rad/s under the action of an external periodic force/unit mass of amplitude 5 N/kg, with tunable frequency.	5	L3	CO1
		Module – 2			
Q.3	a.	Define Young's modulus (Y), Rigidity modulus (η) and Poissons ratio (σ). Derive the relation between them.	10	L2	CO2
	b.	With a neat diagram explain the stress- strain curve for elastic materials.	6	L2	CO2
	c.	In a stretching experiment, the extension produced in a wire for a load of 1.5 Kg is 0.2×10^{-2} m. If length and radius of cross section of the wire are 2m and 0.013 cm respectively, determine Young's modulus of materials of the wire.	4	L3	CO2
		OR			
Q.4	a.	Derive the expression for bending moment in terms of moment of inertia and hence arrive at the expression for bending moment for the beams with circular and rectangular cross sections.	9	L2	CO2

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	b.	Explain different mechanisms of failure of engineering materials.	6	L2	CO2
	c.	Calculate the force required to produce an extension of 1mm in steel wire of length 2m and diameter 1mm. Given young's modulus of the wire $Y = 2 \times 10^{11} N/m^2$.	5	L3	CO2
		Module – 3			
Q.5	a.	Derive the expression for thermo emf in terms of temperatures of hot and cold junctions.	8	L2	CO3
	b.	Describe the construction and working of a thermoelectric generator.	7	L2	CO3
	c.	The e.m.f of a lead-iron thermocouple, one junction of which is at 0°C, is given by $E = 1784\,T - 2.4\,T^2$ (in μ volts), T being temperature in °C. Find the neutral temperature and Peltier coefficient.	5	L3	CO3
		OR			
Q.6	a.	Describe the construction and working of a thermocouple. Mention their advantages.	9	L2	CO3
	b.	Explain the application of thermoelectricity for refrigerators.	6	L2	CO3
	c.	EMF of a thermo couple is 1200 μV, when working between 0 °C and 100 °C. If its neutral temperature is 300 °C, find the value of coefficients a and b.	5	L3	CO3
		Module – 4			
Q.7	a.	Explain the liquification of oxygen by cascade process.	7	L2	CO4
	b.	Deduce the equation $\Delta T = \Delta P \frac{1}{C_P}\left[\frac{2a}{RT} - b\right]$ and hence discuss three cases.	9	L2	CO4
	c.	Mention the properties and uses of liquid Helium.	4	L3	CO4
		OR			
Q.8	a.	Describe the experimental arrangement and working of porous plug experiment. What are the conclusions drawn from it?	9	L2	CO4
	b.	Explain the construction and working of platinum resistance thermometer.	7	L2	CO4
	c.	In a Joule-Thomson experiment, temperature changes from 100°C to 150° C for pressure changes of 20Mpa to 170Mpa. Calculate Joule- Thomson coefficient.	4	L3	CO4
		Module – 5			
Q.9	a.	Describe the construction and working of an X-ray diffractometer.	7	L2	CO5
	b.	Discuss the motion of a particle in 1D potential well of infinite height and hence obtain it eigen function and eigen values.	9	L2	CO5

	c.	Determine the crystal size, when the peak width is 0.5 and peak position 30^0 for a cubic crystal. Given that, wavelength of the X-rays used is 100^0A and the Scherrer's constant K=0.92.	4	L3	CO5
		OR			
Q.10	a.	Explain quantum confinement in 0, 1, 2 and 3 dimensions and give the graphical representation of density of states.	8	L2	CO5
	b.	Describe the principle, construction and working of an atomic force microscope with a neat diagram.	8	L2	CO5
	c.	A beam of monochromatic X-rays is diffracted by a cubic crystal with a glancing angle of 12° for first order. Calculate wavelength of the X-rays, if the inter planar spacing of the crystal is 2.82 ^{0}A.	4	L3	CO5

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