



First/Second Semester B.E./B.Tech. Degree Examination, June/July 2026 Physics of Materials (Mech stream)

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 Hand Book is permitted.

Module – 1			M	L	C
Q.1	a.	Derive the expression for equivalent force constant for two springs connected in series and parallel combination and mention the expression for period of oscillation.	10	L2	CO1
	b.	Define natural frequency, period of oscillation and set up a differential equation for simple harmonic oscillations.	6	L2	CO1
	c.	A spring undergoes an extension of 5 cm for a load of 50 gm. Find its frequency of oscillations if it is set for vertical oscillations with a load of 200 gm is attached to its bottom.	4	L3	CO1
OR					
Q.2	a.	Define Resonance and obtain a differential equation for a body undergoing forced oscillations and mention expression for amplitude and phase of oscillation.	10	L2	CO1
	b.	Discuss the applications of damped oscillation in case of automatic doors closures and automobile suspension system.	6	L2	CO1
	c.	A mass of 0.5kg causes an extension of 0.03 m in spring and the system is set for oscillation, find the force constant and angular frequency .	4	L3	CO1
Module – 2					
Q.3	a.	Define three types of elastic moduli and discuss the all three factors affecting the fatigue.	9	L2	CO2
	b.	Define Stress, Strain, and explain the stress-strain curve for elastic materials.	7	L2	CO2
	c.	Calculate the Young's modulus for the material given that Poisson's ratio is 0.34615 and rigidity modulus is $4.55 \times 10^{10} \text{ N.m}^{-2}$.	4	L3	CO2
OR					
Q.4	a.	Define bending moment and derive an expression for the same in terms of moment of inertia.	8	L2	CO2
	b.	Define Static loading, Dynamic loading, Poisson's ratio and discuss the limiting value for the Poisson's ratio.	7	L2	CO2
	c.	In single cantilever experiment, find the Young's modulus of the rectangular bar of breadth 2.5 cm and thickness 0.48 cm. depression observed for the mass of 0.2 kg is 0.175 cm. Mass is suspended at a distance of 30 cm from the fixed end.	5	L3	CO2
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Module – 3

Q.5	a.	State and explain the laws of thermoelectricity.	9	L2	CO3
	b.	Derive the relation between inversion temperature and neutral temperature.	6	L2	CO3
	c.	For Fe-Cu thermocouple it is observed that the thermo emf is zero when one of the junctions is at 20 °C and the other one is at some higher temperature. If the neutral temperature is 285°C, calculate the higher temperature. Hence find out the temperature of inversion, if the cold junction temperature is at -20°C.	5	L3	CO3

OR

Q.6	a.	State and discuss the Seebeck effect and Peltier effect with their coefficients.	8	L2	CO3
	b.	Describe the construction and working of thermoelectric generator (TEG).	7	L2	CO3
	c.	Calculate the neutral temperature for an iron-silver thermocouple. The values of a and b are 16.65 and -0.096 for iron and 2.86 and 0.017 for silver respectively.	5	L3	CO3

Module – 4

Q.7	a.	What is Joule-Thompson effect and derive an expression for Joule-Thompson coefficient (ΔT).	8	L2	CO4
	b.	Describe the construction and working of Platinum resistance thermometer.	8	L2	CO4
	c.	In Joule Thomson experiment temperature changes from 100°C to 150°C for a pressure change of 20MPa to 170MPa. Calculate the Joule Thomson coefficient.	4	L3	CO4

OR

Q.8	a.	Explain the liquefaction of Oxygen by the process of cascade method.	8	L2	CO4
	b.	Discuss the construction and working of liquefaction of Helium by Claude's method.	8	L2	CO4
	c.	Calculate the inversion temperature of a gas. Given $a = 0.244 \text{ atm L}^2 / \text{mol}^2$, $b = 0.027 \text{ L / mol}$, and $R = 0.0821 \text{ L atm / K / mol}$.	4	L3	CO4

Module – 5

Q.9	a.	With a labeled diagram explain the construction working of Scanning Electron Microscope (SEM).	8	L2	CO5
	b.	Explain quantum confinement in 0, 1, 2, and 3 dimensions and give the graphical representation of density of states.	8	L2	CO5
	c.	An X-ray undergoes First order Bragg's diffraction by the crystal with 'd' spacing 3.6 Å at a glancing angle 12°. Calculate wavelength of X-ray.	4	L3	CO5

OR

Q.10	a.	Derive the expression for eigen values and eigen function for particle in a 1-D potential well of finite width and infinite depth by using the 1-D Schrodinger time independent wave equation.	8	L2	CO5
	b.	With a labeled diagram explain the construction working of Atomic Force Microscope (AFM).	8	L2	CO5
	c.	Determine the crystal size given the wavelength of x-rays 12 nm, the peak width 0.5° and peak position 23° for a cubic crystal. Given $K = 0.94$.	4	L3	CO5