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BPHYM102/202

First/Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

**Applied Physics for ME Stream**

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.**2. VTU Formula Hand Book is permitted.**3. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	What are damped and forced oscillations? Obtain the differential equation of motion of a body undergoing forced oscillation and mention the expression for amplitude and phase of oscillation.	9	L2	CO1
	b.	Describe the construction and working of Reddy shock tube.	7	L1	CO1
	c.	In a Reddy shock tube, the time taken to travel between two sensors is 275 $\mu$ s. If the distance between two sensors is 140mm, calculate the Mach number. Assume the speed of sound as 340 m/s.	4	L3	CO1
OR					
Q.2	a.	Define stiffness factor. Derive the expression for equivalent force constant for two springs connected in series and parallel combination.	9	L2	CO1
	b.	Define Mach number and Mach angle. Mention four characteristics of shock wave.	6	L2	CO1
	c.	Three springs are connected in series and 500gm object attached at one end of a spring. If spring constant $K_1 = K_2 = K_3 = 50\text{N/m}$ , then calculate the change in length of the three springs. Assume accelerating due to gravity as $g = 10\text{ m/s}^2$ .	5	L3	CO5
Module – 2					
Q.3	a.	State and explain Hook's law. With neat diagram, explain the stress-strain curve for elastic materials.	8	L2	CO1
	b.	Explain differential elastic moduli and mention the relation between them.	7	L2	CO1
	c.	A rod of cross section area 15mm $\times$ 15mm and 1m long is subject to compressive load of 22.5kN. Calculate the stress and decrease in length if Young's modulus is $200 \times 10^9\text{ N/m}^2$ .	5	L3	CO1
OR					
Q.4	a.	What is Poisson's ratio? Derive the relation between bulk modulus (K). Young's modulus (Y) and Poisson's ratio ( $\sigma$ ). What are the limiting values of Poisson's ratio?	9	L2	CO1
	b.	What is Bending moment? Discuss different types of beams and mention their engineering application.	7	L2	CO1
	c.	Calculate the Poisson, ratio for the material. Given that $Y = 12.25 \times 10^{10}\text{ N/m}^2$ and $\eta = 4.55 \times 10^{10}\text{ N/m}^2$ .	4	L3	CO1
Module – 3					
Q.5	a.	Discuss Seebeck effect and Peltier effect with their coefficients.	8	L2	CO2
	b.	Describe the construction and working of Thermo Electric Generators (TEG)	7	L2	CO2

	c.	The thermo emf (in eV) of a thermocouple, one junction of which is at 0°C is given by $e = 1600T - 4T^2$ , where T is temperature of hot junction. Find the neutral temperature and Peltier coefficient.	5	L3	CO2
<b>OR</b>					
Q.6	a.	Derive the expression for thermo emf in terms of $T_1$ and $T_2$ .	8	L2	CO2
	b.	Explain the construction and working of thermopile. Mention four advantages.	7	L2	CO2
	c.	The thermo emf of a Cu-Fe thermocouple is 2160 $\mu$ V, where the cold junction is at 0°C and hot junction at 250°C. Calculate the constants a and b if the neutral temperature is 330°C.	5	L3	CO2
<b>Module – 4</b>					
Q.7	a.	What is Joule-Thomson's effect? Derive the expression $\Delta T = \frac{P_1 - P_2}{C_p} \left[ \frac{2a}{RT} - b \right]$ using the theory of Joule theorem effect.	8	L2	CO3
	b.	Explain briefly the application of cryogenics in aerospace and tribology.	8	L2	CO3
	c.	In Joule – Thomson's experiment, temperature changes from 100°C to 150°C for pressure change of 20MPa to 170 MPa. Calculate the Joule – Thomson coefficient.	4	L3	CO3
<b>OR</b>					
Q.8	a.	Explain the construction and working of Porous plug experiment with neat diagram.	8	L2	CO3
	b.	Explain the liquefaction of Helium.	8	L2	CO3
	c.	Calculate the inversion temperature of 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	CO3
<b>Module – 5</b>					
Q.9	a.	Explain the construction and working of X-ray diffraction meter (XRD).	7	L2	CO4
	b.	With a neat sketch, explain the principle construction and working of Transmission Electron Microscope (TEM).	9	L2	CO4
	c.	Determine the wavelength of X-rays for crystal size of $1.188 \times 10^{-6} \text{ m}$ . Peak width $0.5^\circ$ and peak position $30^\circ$ for a cubic crystal. (Given: Scherrer constant $K = 0.92$ ).	4	L3	CO4
<b>OR</b>					
Q.10	a.	Describe the construction and working of X-ray photoelectron spectroscopy (XPS)	8	L2	CO4
	b.	Describe the construction and working of Atomic Force Microscopy (AFM).	8	L2	CO4
	c.	Calculate the longest wavelength that can be analyzed by using a rock salt crystal of spacing, $d = 0.282 \text{ nm}$ in the second order.	4	L3	CO4

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