CBCS SCHEME

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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 |
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| 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 275μs. 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 $K_1 = K_2 = K_3 = 50N/m$, then calculate the change in length of the three springs. Assume accelerating due to gravity as $g = 10\ m/s^2$. | 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 × 15mm and 1m long is subject to compressive load of 22.5kN. Calculate the stress and decrease in length if Young's modulus is $200 \times 10^9\ N/m^2$. | 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 (σ). 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 $Y = 12.25 \times 10^{10}\ N/m^2$ and $\eta = 4.55 \times 10^{10}\ N/m^2$. | 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 |

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|---|---|---|---|---|---|
| | 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 |
| | | **OR** | | | |
| 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 2160μV, 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 |
| | | **Module – 4** | | | |
| 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 |
| | | **OR** | | | |
| 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 $a = 0.244$ atom $L^2/mol^2$, $b = 0.027$ L/mol, and $R = 0.0821$ L atom/K/mol. | 4 | L3 | CO3 |
| | | **Module – 5** | | | |
| 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 $1.188 \times 10^{-6}$m. Peak width 0.5° and peak position 30° for a cubic crystal. (Given: Scherrer constant K = 0.92). | 4 | L3 | CO4 |
| | | **OR** | | | |
| 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 = 0.282nm in the second order. | 4 | L3 | CO4 |

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