CBCS SCHEME

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21PHY12/22

First/Second Semester B.E./B.Tech. Degree Examination, June/July 2025
Engineering Physics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Draw neat sketches wherever necessary.
3. Physical Constants: Speed of light C = 3×10^8 ms^{-1},
Boltzmann constant K = 1.38×10^{-23} J/K, Planck's constant h = 6.625×10^{-34} JS,
Acceleration due to gravity g = 9.8 m/s,
Permittivity of free space $\epsilon_0 = 8.854 \times 10^{-12}$ Fm^{-1}, e = 1.6×10^{-19} C

Module-1

1 a. Define simple harmonic motion and mention any two examples. Derive the differential equation using Hooke's law. **(07 Marks)**

b. With a neat diagram, explain the construction and working of Reddy shock tube. Mention any three applications of shock waves. **(09 Marks)**

c. For a particle executing SHM, its acceleration is found to be 15 cm/s^2 when it is at 3 cm from its mean position. Calculate time period. **(04 Marks)**

OR

2 a. What are damped oscillations? Discuss the theory of damped oscillations. **(09 Marks)**

b. What is a shock wave? Mention the properties of shockwaves. **(07 Marks)**

c. The distance between the two pressure sensors in a shock tube is 150 mm. The time taken by a shock wave to travel this distance is 0.3 ms. If the velocity of sound under the same condition is 340 m/s. Find the Mach number of the shock wave. **(04 Marks)**

Module-2

3 a. State the assumptions of Planck's radiation law. Show how Planck's law could be reduced to Wien's law and Rayleigh – Jeans law. **(09 Marks)**

b. State Heisenberg's uncertainty principle. Show that electron doesn't exist inside the nucleus by this principle. **(07 Marks)**

c. An electron is bound in an one dimensional potential well of width 1 $\mathring{A}$, but of infinite wall height. Find its energy values in the ground state also in the first two excited states. **(04 Marks)**

OR

4 a. Assuming the time independent Schrodinger's wave equation discuss the solution for a particle in one dimensional potential well of infinite height and hence obtain the normalized wave function. **(10 Marks)**

b. Explain the nature of black body radiation spectrum with neat diagram. **(06 Marks)**

c. A particle having mass 0.5 Mev/c^2 has a kinetic energy of 100 eV. Calculate the de-Broglie wavelength, where C is the velocity of light. **(04 Marks)**

Module-3

5 a. Explain the construction and working of semiconductor laser with the help of necessary neat diagram. **(08 Marks)**

b. Describe different types of optical fibers with neat diagrams. Mention any two advantages of optical fiber communication. **(08 Marks)**

c. The ratio of population of two energy levels is 1.059×10^{-30}. Find the wavelength of light emitted by spontaneous emissions at 330 K. **(04 Marks)**

OR

6 a. Derive an expression for energy density of radiation under equilibrium, in terms of Einstein's coefficients. **(09 Marks)**

b. With neat diagram, explain the working of intensity based displacement sensor using optical fiber. **(07 Marks)**

c. Estimate the attenuation in an optical fiber of length 500 m when a light signal of power 100 mW emerges out of fiber with a power 90 mW. **(04 Marks)**

Module-4

7 a. Mention any four assumptions of classical free electron theory and discuss the success of quantum free electron theory. **(10 Marks)**

b. Describe in brief the various types of polarization mechanisms. **(06 Marks)**

c. The intrinsic charge carrier concentration of germanium is $2.4 \times 10^{19}/m^3$, calculate its resistivity if mobility of electrons and holes respectively are $0.39 m^2/vs$ and $0.19 m^2/vs$. **(04 Marks)**

OR

8 a. What is Hall effect? Obtain the expression for the Hall coefficient. **(08 Marks)**

b. Deduce the expression for electrical conductivity of a conductor using the quantum free electron theory of metals. **(08 Marks)**

c. The dielectric constant of sulphur is 3.4. Assuming a cubic lattice for its structure, calculate the electronic polarizability of sulphur (given, density of sulphur = 2.079/cc and atomic weight = 32.07). **(04 Marks)**

Module-5

9 a. Explain the construction and working of X-ray diffractometer. Mention the applications. **(10 Marks)**

b. Explain briefly nanocomposite with example and applications. **(05 Marks)**

c. Determine the wave length of X-rays for crystal size of 1.188×10^{-6}m, peak width is 0.5° and peak position 30° for a cubic crystal. Given Scherrer's constant K = 0.92. **(05 Marks)**

OR

10 a. With a neat diagram, explain the principle construction and working of atomic force microscope. **(10 Marks)**

b. Define nano material and classify the nanomaterials on the dimensional constraints. **(05 Marks)**

c. First order Bragg reflection occurs when a monochromatic beam of X-rays of wavelength $0.675 A^{\circ}$ is incident on a crystal at a glancing angle of $4^{\circ}51'$. What is the glancing angle for third order Bragg reflection to occur? **(05 Marks)**

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