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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 $C = 3 \times 10^8 \text{ ms}^{-1}$,

Boltzmann constant $K = 1.38 \times 10^{-23} \text{ J/K}$, Planck's constant $h = 6.625 \times 10^{-34} \text{ JS}$,

Acceleration due to gravity $g = 9.8 \text{ m/s}$,

Permittivity of free space $\epsilon_0 = 8.854 \times 10^{-12} \text{ Fm}^{-1}$, $e = 1.6 \times 10^{-19} \text{ C}$

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 \AA , 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 $0.39m^2/vs$ and $0.19m^2/vs$. (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 $1.188 \times 10^{-6}m$, 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\AA 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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