



CBCS SCHEME

21PHY12/22

First/Second Semester B.E./B.Tech Degree Examination, June/July 2026 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. Constant : Speed of light $c = 3 \times 10^8 \text{ m/s}$, Boltzmann's constant $K = 1.38 \times 10^{-23} \text{ JK}^{-1}$

Planck's constant: $h = 6.625 \times 10^{-34} \text{ JS}$, $g = 9.8 \text{ m/s}^2$,

Permitting of free space $= \epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$, Charge on electron $e = 1.61 \times 10^{-19} \text{ C}$,

Mass of electron $m = 9.11 \times 10^{-31} \text{ Kg}$.

Module-1

- 1 a. Define force constant and mention its physical significance. Derive the expression for force constant for springs in series and parallel combination. (08 Marks)
- b. With a neat diagram, explain the construction and working of Reddy tube. Mention any four applications of shock waves. (08 Marks)
- c. A free particle is executing SHM in a straight line with a period of 25 seconds, 5 seconds after it has crossed the equilibrium point, the velocity is found to be 0.7 m/s. Find the displacement at the end of 10 seconds and also amplitude of oscillations. (04 Marks)

OR

- 2 a. Discuss the theory of forced vibrations and obtain the expression for amplitude and phase of vibration. (09 Marks)
- b. Define SHM and mention any two examples. Derive the differential equation of SHM using Hooke's law. (07 Marks)
- c. The distance between two pressure sensors in a shock tube is 150 mm. The time taken by shock wave to travel the distance is 0.3 ms. If the velocity of sound under the same conditions is 340 m/s. Find the Mach number of the shock wave. (04 Marks)

Module-2

- 3 a. What are the postulates of Planck's law of radiation? Deduce Wien's law and Rayleigh Jeans Law from Planck's law. (09 Marks)
- b. State Heisenberg's uncertainty principle. Show that electrons does not exists inside the nucleus. (07 Marks)
- c. An electron is bound in a one dimensional potential well of width $1 \text{ \AA}$, but infinite height. Find its energy values in the ground state and in the first two excited states.
(Planck's constant $h = 6.63 \times 10^{-34} \text{ JS}$, Mass of the electron $m = 9.1 \times 10^{-31} \text{ Kg}$) (04 Marks)

OR

- 4 a. Using Schrodinger's time independent wave equation, arrive at the eigen values and eigen functions of a particle in one dimensional potential well of infinite height and deduce normalization of wave equation. (09 Marks)
- b. State de-Broglie Hypothesis. Show that the wavelength of an electron accelerated through a potential difference of 'V' volt is $\frac{1.226}{\sqrt{V}}$ nm. (07 Marks)
- c. A particle having mass of $0.5 \text{ MeV}/c^2$ has a kinetic energy of 100 eV. Calculate the de-Broglie wavelength. Where 'C' is velocity of light = $3 \times 10^8 \text{ m/s}$, Planck's constant $h = 6.63 \times 10^{-34} \text{ JS}$. (04 Marks)

Module-3

- 5 a. Describe the construction and working of CO_2 Laser with suitable diagrams. (07 Marks)
- b. With suitable diagrams, explain the various types of optical fibers. Mention applications of optical fibers. (09 Marks)
- c. The average output power of a laser source emitting a laser beam of wavelength 632.8 nm is 5 mW. Find the number of photons emitted per second by the laser source. (Planck's constant $h = 6.63 \times 10^{-34} \text{ JS}$, Velocity of light $c = 3 \times 10^8 \text{ m/s}$). (04 Marks)

OR

- 6 a. Define Numerical aperture and acceptance angle. Derive the expression for numerical aperture of an optical fiber. (08 Marks)
- b. Explain how Laser is used in eye surgery and skin treatment. (08 Marks)
- c. Numerical aperture of an optical fiber is 0.3 when surrounded by air. Determine the refractive index of its core given the refractive index of cladding is 1.59. Also find the acceptance angle when it is in a medium of refractive index 1.33. (04 Marks)

Module-4

- 7 a. Give the assumptions of quantum free electron theory. Discuss the any two success of quantum free electron theory. (08 Marks)
- b. What is Hall effect? Obtain the expression for the Hall coefficient. (08 Marks)
- c. An elemental solid dielectric material has polarizability of $7 \times 10^{-40} \text{ Fm}^2$. Assuming the internal field to be Lorentz field, calculate the dielectric constant for the materials, if the material has $3 \times 10^{28} \text{ atoms/m}^3$. (Permittivity of free space $\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$)

(04 Marks)

OR

- 8 a. What are polar and non-polar dielectrics? Explain various types of polarization mechanisms. (08 Marks)
- b. Define Fermi Energy and Fermi Factor. Discuss the variation of Fermi factor with temperature. (08 Marks)
- c. The resistivity of Ge at 27° C is equal to 0.47 Ω -m. Assuming electron and hole mobilities as 0.38 and 0.18 $\text{m}^2 \text{v}^{-1}\text{s}^{-1}$ respectively, calculate the intrinsic carrier density. (Charge of electron $e = 1.6 \times 10^{-19} \text{C}$). (04 Marks)

Module-5

- 9 a. Explain the principle, construction and working of atomic force microscope with neat diagram. Mention any two applications. (10 Marks)
- b. Define nano-material and nano-composites. Classify the nano-materials based on the dimensional constraints. (06 Marks)
- c. Determine the crystal size, given the wavelength of X-rays 10nm, Peak width 0.5° and peak position 25° for a cubic crystal given $K = 0.94$. (04 Marks)

OR

- 10 a. Explain the principle, construction and working of scanning electron microscope with neat diagram. (08 Marks)
- b. Explain the principle, construction and working of X-ray photoelectron spectroscope with neat diagram. (08 Marks)
- c. First order spectrum is formed when X-rays of wavelength 1.5 Å is incident on a crystal at 12°. Calculate the interplaner spacing of the crystal. (04 Marks)

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