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21PHY12/22

First/Second Semester B.E. Degree Examination, June/July 2023
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. Constants: Speed of light "C" = 3×10^8 m/s, 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/s², permittivity of free space. "ϵ_0" = 8.854×10^{-12} F/m.

Module-1

1 a. Obtain the expressions for force constant for series and parallel combination of springs also mention expressions for period of oscillation for series and parallel combination. **(08 Marks)**
   b. What are damped oscillations? Establish equation of motion for damped vibrations and obtain its general solution. **(08 Marks)**
   c. A car has a spring system that supports the in-built mass 1000kg. When a person with a weight 980N sits at the centre of gravity, the spring system sinks by 2.8cm. When the car hits a bump, it starts oscillating vertically. Find the period and frequency of oscillation. **(04 Marks)**

OR

2 a. Give the theory of forced vibration and obtain expression for amplitude and phase. **(08 Marks)**
   b. Illustrate the generation of shock waves using the Reddy shock tube and give any four applications of shock waves. **(08 Marks)**
   c. The distance between the two pressure sensors in shock tube is 100mm. The time taken by a shock wave to travel this distance is 100 microsecond. If the velocity of sound under the same condition is 340m/s, find the Mach number of the shock wave. **(04 Marks)**

Module-2

3 a. State Heisenberg uncertainty principle and give its physical significance. Show that electron does not exists inside the nucleus by this principle. **(08 Marks)**
   b. Starting from Planck's quantum theory of radiation arrive at Wien's law and Rayleigh Jean's law. **(08 Marks)**
   c. Compute the de Broglie wavelength for a neutron moving with one tenth part of the velocity of light, given, mass of neutron = 1.674×10^{-27} kg. **(04 Marks)**

OR

4 a. Set up one-dimensional time-independent Schrodinger's equation. **(08 Marks)**
   b. Discuss the eigenfunction, eigenvalues and probability density for a particle in a potential well of infinite height. **(08 Marks)**
   c. An electron has a speed of 100m/s. The inherent uncertainty in its measurement is 0.005%. Calculate corresponding uncertainty that arises in the measurement of its position. **(04 Marks)**

Module-3

5 a. Derive the expression for energy density in terms of Einstein's coefficients. **(06 Marks)**

b. Derive the expression for numerical aperture of an optical fiber and discuss the block diagram of point-to-point communication. **(10 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 330K. **(04 Marks)**

OR

6 a. Explain construction and working of CO_2 laser with necessary diagrams. **(08 Marks)**

b. What is attenuation? Explain different types of optical fibers. **(08 Marks)**

c. The attenuation of light in an optical-fiber is estimated at 2.2dB/km. What fractional initial intensity remains after 2km and 6km. **(04 Marks)**

Module-4

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

b. Define polarization, dipole and dipole moment derive Clausius-Mossotti equation. **(08 Marks)**

c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-meter. Assuming electron and hole mobilities as 0.38 and $0.18m^2$/vs respectively, calculate the intrinsic carrier density. **(04 Marks)**

OR

8 a. Define Fermi energy and Fermi factor. Discuss the dependence of Fermi factor on temperature and energy. **(08 Marks)**

b. Discuss merits of quantum free electron theory give expressions for holes and electrons concentration in semiconductors. **(08 Marks)**

c. Find the probability that an energy level at 0.2ev below Fermi level being occupied at temperatures 300K and 1000K. **(04 Marks)**

Module-5

9 a. With neat diagram, explain the principle, construction and working of X-ray photoelectron spectroscope. **(08 Marks)**

b. With necessary diagram, explain the principle construction and working of Atomic force microscope. **(08 Marks)**

c. X-ray of wavelength 0.12nm are found to undergo second order reflection at a Bragg angle of 28° from crystal. What is the interplanar spacing of the reflecting planes of the crystal? **(04 Marks)**

OR

10 a. With the help of neat diagram describe the principle construction and working of scanning electron microscope. **(08 Marks)**

b. Define nano material, mention classification of nano materials explain in brief how crystal size is determined by Scherrer's equation. **(08 Marks)**

c. The spacing between principal planes of the crystals is 2.82 Å. It is found that first order Bragg reflection occurs at an angle of 10°, what is the wavelength of X-rays? **(04 Marks)**

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