CBCS SCHEME

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21PHY12/22

First/Second Semester B.E. Degree Examination, July/August 2022
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 : Electron mass $M = 9.1\times10^{-31}$kg, Electron charge $e = 1.6\times10^{-19}$C,
Velocity of light $C = 3\times10^{8}$ m/s, Planck's constant $h = 6.626\times10^{-34}$ Js,
Avagadro number $N_A = 6.025\times10^{26}$/k mol,
Permitivity of free space $\in_0 = 8.854\times10^{-12}$F/m,
Acceleration due to gravity $g = 9.8$ m/s^2, Boltzman constant $K = 1.38\times10^{-23}$ J/K

Module-1

1 a. What are forced oscillations? Obtain expression for displacement of forced oscillations. **(08 Marks)**

b. With a neat diagram explain the construction and working of Reddy's shock tube. **(08 Marks)**

c. For a particle executing simple harmonic motion amplitude is 13m and period is 2π sec. Find its velocity when the displacement is 5m from the mean position. **(04 Marks)**

OR

2 a. Find the effective spring constant in case of spring connected in series and parallel combination. **(08 Marks)**

b. Define SHM and mention any two examples. Obtain differential equation of motion for SHM and its natural frequency of oscillation. **(08 Marks)**

c. A mass of 2 kg suspended by a spring of force constant 51.26 N/m is executing damped SHM with a damping 5 kg/s. Identify whether it is the case of underdamping or of overdamping. Also estimate the value of damping required for the oscillation to be critically damped (Ignore the mass of spring) **(04 Marks)**

Module-2

3 a. Using Schrodinger wave equation, obtain the eigen function and eigen value for a particle in a box. **(09 Marks)**

b. State Heisenberg Uncertainty Principle. Show that an electron does not exists inside the nucleus on the basis of Heisenberg Uncertainty Principle. **(07 Marks)**

c. Calculate the energy of the neutron in eV, if its deBroglie wavelength is 3 Å and $m_n = 1.67\times10^{-27}$ kg. **(04 Marks)**

OR

4 a. Discuss the spectral radiancy in Black body? Deduce Wein's law and Rayleigh-Jean's law from Planck's radiation law. **(09 Marks)**

b. Setup one-dimensional time-independent Schrodinger wave equation. **(07 Marks)**

c. An electron is bound in a 1-dimensional box of 0.1 nm length. Calculate the energy required to excite it from its ground state to third excited state. **(04 Marks)**

Module-3

5 a. Explain the requisites for a laser action? Obtain the expression for energy density using Einstein's coefficients at thermal equilibrium condition. **(10 Marks)**

b. With neat diagram explain the principle, construction and working of phase modulated temperature sensor. **(06 Marks)**

c. How many photons of yellow light of wavelength 5500 Å constitutes 1.5 J of energy. **(04 Marks)**

OR

6 a. Explain the construction and working of carbon dioxide laser with the help of energy level diagram. **(09 Marks)**

b. What is numerical aperture? Derive the expression for acceptance angle of an optical fiber. **(07 Marks)**

c. Calculate the refractive indices of core and cladding of a given optical fiber with numerical aperture of 0.22 and fractional index change variation 0.012. **(04 Marks)**

Module-4

7 a. Mention any three assumptions of classical free electron theory? Discuss the success of Quantum free electron theory. **(09 Marks)**

b. Obtain expression for electrical conductivity in semiconductors. **(07 Marks)**

c. The dielectric constant of He gas at NTP is 1.0000684. Calculate the electronic polarisability of He atoms if the gas contains 2.7×10^{28} atom/m^3. **(04 Marks)**

OR

8 a. What is Hall Effect? Obtain expression for Hall voltage and express Hall voltage in terms of Hall coefficient. **(09 Marks)**

b. What is polarization? Explain different types of polarization. **(07 Marks)**

c. Find the temperature at which there is 1% probability that a state with an energy 0.5 eV above Fermi energy is occupied. **(04 Marks)**

Module-5

9 a. With a neat diagram, explain the principle, construction and working of Atomic Force Microscope. **(10 Marks)**

b. What are nano-materials and classify the nano materials based on the dimensional constraints. **(05 Marks)**

c. GaAs has its principle planes separated at 5.6534 Å. The first order Bragg reflection is located at 13° 40′. Calculate
(i) The wavelength of the x-ray
(ii) The angle for second order Bragg reflection. **(05 Marks)**

OR

10 a. Explain the construction and working of x-ray diffractometer. **(07 Marks)**

b. Describe the principle, construction and working of scanning electron microscope with the help of neat diagram. **(08 Marks)**

c. Determine the crystal size given the wavelength of x-ray 12 nm, the peak width 0.5° and peak position 23° for a cubic crystal. Given K = 0.94. **(05 Marks)**

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