

# CBGS SCHEME

USN

--	--	--	--	--	--	--	--	--	--

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  $M = 9.1 \times 10^{-31}$  kg, Electron charge  $e = 1.6 \times 10^{-19}$  C,  
Velocity of light  $C = 3 \times 10^8$  m/s, Planck's constant  $h = 6.626 \times 10^{-34}$  Js,  
Avagadro number  $N_A = 6.025 \times 10^{26}$  /k mol,  
Permitivity of free space  $\epsilon_0 = 8.854 \times 10^{-12}$  F/m,  
Acceleration due to gravity  $g = 9.8$  m/s<sup>2</sup>, Boltzman constant  $K = 1.38 \times 10^{-23}$  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  $2\pi$  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 exist 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  $3 \text{ \AA}$  and  $m_n = 1.67 \times 10^{-27}$  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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**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  $5500 \text{ \AA}$  constitutes  $1.5 \text{ J}$  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  $2.7 \times 10^{28} \text{ atom/m}^3$ . (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  $0.5 \text{ eV}$  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  $5.6534 \text{ \AA}$ . The first order Bragg reflection is located at  $13^\circ 40'$ . 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  $12 \text{ nm}$ , the peak width  $0.5^\circ$  and peak position  $23^\circ$  for a cubic crystal. Given  $K = 0.94$ . (05 Marks)

\*\*\*\*\*