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## First/Second Semester B.E. Degree Examination, July/August 2022 Engineering Physics

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Physical constants : Velocity of light,  $c = 3 \times 10^8 \text{ m/s}$ ,  
Planck's constant,  $h = 6.625 \times 10^{-34} \text{ J-S}$   
Mass of electron,  $m = 9.1 \times 10^{-31} \text{ kg}$   
Boltzmann constant,  $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$   
Avagadro number,  $N_A = 6.023 \times 10^{26} / \text{K mol}$ .

### Module-1

- 1 a. Explain Compton effect and give its physical significance. (04 Marks)  
b. Using time – independent Schrodinger wave equation, derive an expression for energy eigen value, eigen function, zero – point energy and normalization of wave function of a particle in a one dimensional potential well of infinite height. (08 Marks)  
c. What is the minimum uncertainty in the energy state of an atom. If an electron remain in this state for  $10^{-9}$  seconds. (04 Marks)

OR

- 2 a. What is Wave function? Give its properties and physical significances. (05 Marks)  
b. Define Phase Velocity and Group Velocity. Derive the relation between them in terms of wavelength ' $\lambda$ '. (07 Marks)  
c. An electron at rest is accelerated through a potential of 150.7V. Calculate the de – Broglie wavelength of Mattu – wave associated with it. (04 Marks)

### Module-2

- 3 a. State and explain "Relaxation time" and "Drift velocity" of conduction electrons. (04 Marks)  
b. Explain Meissner effect and BCS theory of superconductivity. (08 Marks)  
c. A uniform silver wire has a resistivity of  $1.54 \times 10^{-8} \Omega - \text{m}$  at room temperature. For an electric field of  $1 \text{ V cm}^{-1}$ , calculate i) the drift velocity and ii) the mobility of electrons assuming that there  $5.8 \times 10^{28}$  conduction electrons per  $\text{m}^3$  of the material. (04 Marks)

OR

- 4 a. Explain 'Fermi factor'. Discuss three different cases of Probability of occupation of various energy states by electrons at  $T = 0^\circ \text{ K}$  and  $T > 0^\circ \text{ K}$ . On the basis of Fermi factor. (08 Marks)  
b. Write a short note on Maglev vehicles. (04 Marks)  
c. Calculate the probability of finding an electron at energy 0.02 eV above Fermi level at 290K. (08 Marks)

### Module-3

- 5 a. Explain the construction and working of semiconductor LASER. (06 Marks)  
b. What is Stimulated Emission? Derive an expression for energy density of radiation in terms of Einstein's A & B coefficients. (06 Marks)  
c. The refractive index of core and cladding for a step – index optical fibres are 1.518 and 1.42 respectively. Calculate the Numerical aperture and Acceptance angle. (04 Marks)

OR

- 6 a. With a neat diagram, explain three different types of Optical fibre and write one advantage of graded index over step index. (07 Marks)
- b. What is Attenuation coefficient in an Optical fibre? Explain two attenuation mechanisms. (05 Marks)
- c. The ratio of population of two energy levels is  $1.059 \times 10^{-30}$ . Find the wavelength of light radiation emitted at 310K. (04 Marks)

Module-4

- 7 a. With a neat diagram, explain Seven Crystal system. (07 Marks)
- b. What is Atomic Packing Factor? Calculate the Atomic packing factor for SC and FCC structures. (05 Marks)
- c. The lattice constant for a unit cell of aluminum is  $4.04\text{\AA}$ . What is the distance between the planes with Miller – indices : i) (200) ii) (110) iii) (111). (04 Marks)

OR

- 8 a. What are Miller Indices and derive Bragg's law for X – ray diffraction. (06 Marks)
- b. Explain how Bragg's spectrometer is used to determine the interplanar distance of a crystal. (06 Marks)
- c. In an Orthorhombic crystal, a lattice plane cuts the intercepts of length  $3a$ ,  $2b$  and  $3c/2$  along three axis. Obtain the Miller indices of the plane, where  $a$ ,  $b$  and  $c$  are primitive vertices of the unit cell. (04 Marks)

Module-5

- 9 a. What is Mach Number? Explain the difference between Ultrasonic and Supersonic waves. (04 Marks)
- b. Explain the Sol – Gel method of synthesis of Nano materials. (05 Marks)
- c. Explain with principle, the working of Scanning Electron Microscope. (07 Marks)

OR

- 10 a. What is a Carbon nano tube? Write down properties and application of Carbon Nano Tube. (05 Marks)
- b. What are Shock Waves? Describe the construction and working of Reddy's Shock tube. (07 Marks)
- c. Calculate the distance between the sensors, if the Mach number is 2 and time taken by the shock wave to travel the distance is  $50\mu\text{s}$ , given velocity of sound in the medium is  $2200\text{ ms}^{-1}$ . (04 Marks)

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