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**First/Second Semester B.E. Degree Examination, Dec.2017/Jan.2018**  
**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:**  $h = 6.625 \times 10^{-34} \text{ JS}$ ,  $m_e = 9.1 \times 10^{-31} \text{ kg}$ ,  $K = 1.38 \times 10^{-23} \text{ J/K}$ ,  
 $C = 3 \times 10^8 \text{ m/s}$ ,  $e = 1.602 \times 10^{-19} \text{ C}$ ,  $N_A = 6.025 \times 10^{26} / \text{k mol}$ .

**Module-1**

- 1 a. Explain the energy distribution in the spectrum of a blackbody. (05 Marks)  
 b. Set up time independent Schrödinger wave equation in one dimension. (07 Marks)  
 c. A particle of mass  $0.5 \text{ Me V/c}^2$  has kinetic energy  $100 \text{ eV}$ . Find its de-Broglie wavelength. (04 Marks)

**OR**

- 2 a. Define phase velocity and Group velocity. Show that group velocity is equal to particle velocity. (06 Marks)  
 b. State and explain Heisenberg's uncertainty principle. (06 Marks)  
 c. An electron is bound in one dimensional potential well of width  $0.18 \text{ nm}$ . Find the energy value in eV of the second excited state. (04 Marks)

**Module-2**

- 3 a. What is superconductivity? Explain superconductivity on the basis of BCS theory. (06 Marks)  
 b. Explain the failures of classical free electron theory. (06 Marks)  
 c. Calculate the probability of an electron occupying an energy level  $0.02 \text{ eV}$  above the Fermi level at  $400 \text{ K}$  in a material. (04 Marks)

**OR**

- 4 a. What is Fermi factor? Discuss the 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. (06 Marks)  
 b. What is Meissner effect? Explain the working of maglev. (06 Marks)  
 c. The electron mobility and hole mobility of silicon are  $0.17 \text{ m}^2/\text{volt-sec}$  and  $0.035 \text{ m}^2/\text{volt-sec}$  respectively at room temperature. If the carrier density is known to be  $1.1 \times 10^{16} / \text{m}^3$ , calculate the resistivity of silicon semiconductor material. (04 Marks)

**Module-3**

- 5 a. Derive the expression for energy density of radiation in terms of Einstein's coefficients. (06 Marks)  
 b. With neat diagrams explain the different types of optical fibers. (06 Marks)  
 c. A medium in thermal equilibrium at temperature  $300 \text{ K}$  has two energy levels with a wavelength separation of  $1 \mu\text{m}$ . Find the ratio of population densities of the upper and lower levels. (04 Marks)

**OR**

- 6 a. What is Holography? With a neat diagram, explain the construction, reconstruction of Hologram. (06 Marks)

- b. What is numerical aperture? Obtain an expression for numerical aperture in terms of refractive indices of core and cladding. (06 Marks)
- c. The attenuation of light in an optical fiber is 3.6dB/km, what fraction of its initial intensity remains after i) 1km ii) 3km ? (04 Marks)

**Module-4**

- 7 a. What are Miller indices? Derive the expression for the interplanar spacing in terms of Miller indices. (06 Marks)
- b. Describe the construction and working of Bragg's X-ray spectrometer. (06 Marks)
- c. First order Bragg reflection occurs when a monochromatic beam of X-rays of wavelength  $0.675\text{\AA}$  is incident on a crystal at a glancing angle of  $4^\circ 51'$ . What is the glancing angle for third order Bragg reflection to occur? (04 Marks)

**OR**

- 8 a. Define coordination number and atomic packing factor. Calculate the coordination number for sc, bcc and fcc structures. (07 Marks)
- b. Derive Bragg's law. (05 Marks)
- c. Draw the crystal planes (100) (200) (001) and (011) in a cubic unit cell. (04 Marks)

**Module-5**

- 9 a. What is Mach number? Distinguish between acoustic, ultrasonic, subsonic and supersonic waves. (05 Marks)
- b. What are nanomaterials? Explain the Sol – Gel method of synthesis of nano-materials. (07 Marks)
- c. In a scanning electron microscope, electrons are accelerated by an anode potential difference of 60kV. Estimate the wavelength of the electron in the scanning beam. (04 Marks)

**OR**

- 10 a. What is a shock wave? Describe the construction and working of Reddy's shock tube. (07 Marks)
- b. What is a carbon nano tube? Explain how it is synthesized using pyrolysis method. (05 Marks)
- c. Mention the principle and three applications of SEM. (04 Marks)

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