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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL UNIVERSITY, MANIPAL

FIRST SEMESTER B.Tech. END-SEMESTER EXAMINATION - NOVEMBER 2016

SUBJECT: ENGINEERING PHYSICS (PHY1001)

Time: 3 Hrs. **Max. Marks: 50**

Note:

Answer **ALL** the questions. Each question carries **10** marks
Answer all the sub questions of a main question in a continuous sequence.
Write specific and precise answers. Any missing data may suitably be assumed.
Write question number on the margin only. Draw neat sketches wherever necessary.

Physical Constants:

Speed of light in vacuum	= 3.00×10^{8} m/s	Electron charge	= 1.60×10^{-19} C
Electron mass	= 9.11×10^{-31} kg	Planck's constant	= 6.63×10^{-34} J.s
Boltzmann constant	= 1.38×10^{-23} J/ K		

1A. Obtain an expression for the fringe-width in the case of interference of light of wavelength λ, from a double-slit of slit-separation d. **[5]**

1B. A diffraction grating with 600 slit/mm, produces a principal maximum at 33.0°. What are the possible wavelengths of incident light for this principal maximum, in the visible range (400 nm – 700 nm)? **[3]**

1C. The atoms in a hypothetical laser medium have energy levels with energy 0.0 eV (ground state), 1.1 eV (first excited state). Calculate the ratio of the number of atoms in the first excited state to that in the ground state in this laser medium, for a temperature of 2000 K. **[2]**

2A. Define numerical aperture of an optical fiber and fractional refractive index change, Δ. Obtain the relation between Δ & numerical aperture NA. **[3]**

2B. Light of wavelength 580 nm is incident on a slit having a width of 0.300 mm. The viewing screen is 2.00 m from the slit. Find the position of the first dark fringe and the width of the central bright fringe. **[3]**

2C. Use the uncertainty principle to show that if an electron were confined inside an atomic nucleus of diameter 2 x 10^{-15} m, it would have to be moving relativistically. **[4]**

3A. Explain the experiment on compton effect. **[5]**

3B. Using the simple model of a particle in a box to represent an atom, calculate the wavelength of the photon required to raise an atom from the state n = 1 to the state n = 2. Assume the atom has a radius of 0.10 nm and that the moving electron carries the energy that has been added to the atom. **[3]**

3C. When green light from a mercury lamp (λ = 546 nm) is used to illuminate a photocathode in a photoelectric effect experiment, a stopping potential of 0.376 V reduces the photocurrent to zero. What is the work function of this photocathode? **[2]**

4A. What is a wave function ? What is its physical interpretation ? What are the mathematical features of a wave function? **[4]**

4B. Write the mathematical expression (explaining the meaning of the symbols) for the potential energy of H-atom, used in quantum model of H-atom. Determine the number of allowed states corresponding to the principal quantum number n = 2, and calculate the energies of these states. **[3]**

4C. Consider a cube of gold 1.00 mm on edge. Calculate the approximate number of conduction electrons in this cube at zero K, whose energies lie in the range 3.000 eV to 3.010 eV, which are less than the Fermi energy. **[3]**

5A. Distinguish between conductors, insulators and semiconductors on the basis of band theory. **[5]**

5B. A thin rod of superconducting material 2.50 cm long is placed into a 0.540-T magnetic field with its cylindrical axis along the magnetic field lines. Sketch the directions of the applied field and the induced surface current. Find the magnitude of the surface current on the curved surface of the rod.

Permeability of free space = $= 4\pi \times 10^{-7}$ Tm/A **[3]**

5C. Indicate the position of donor levels and acceptor levels in the energy band diagram of a semiconductor. Label all the relevant energy levels at room temperature. **[2]**

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