REG. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL UNIVERSITY, MANIPAL

FIRST SEMESTER B.Tech. END-SEMESTER EXAMINATION - NOV 2017

SUBJECT: ENGINEERING PHYSICS (PHY1001)

Time: 3 Hrs. 20-11-2017 **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	$= 3.00 \times 10^{8}$ m/s	Electron charge	$= 1.60 \times 10^{-19}$ C
Electron mass	$= 9.11 \times 10^{-31}$ kg	Avogadro number	$= 6.023 \times 10^{23}$ /mol
Boltzmann constant	$= 1.38 \times 10^{-23}$ J/ K	Planck's constant	$= 6.63 \times 10^{-34}$ J.s

1A. Obtain an expression for the width of the any principal maximum in diffraction pattern due to multiple slits. **[4]**

1B. A thin film of acetone (refractive index = 1.25) is coating a thick glass plate (refractive index = 1.50). Plane light waves of variable wavelengths are incident normal to the film. When one views the reflected wave, it is noted that complete destructive interference occurs at a wavelength of 600 nm and constructive interference at a wavelength of 700 nm. Calculate the minimum thickness of the acetone film. **[3]**

1C. A single slit is illuminated by light whose wavelengths are λ_A and λ_B, so chosen that the first diffraction minimum of λ_A component coincides with the second minimum of the λ_B component. What is the relationship between the two wavelengths? Do any other minima in the two patterns coincide? **[3]**

2A. Obtain an expression for numerical aperture in terms of refractive index of core and cladding and then arrive at the condition for ray propagation in an optical fiber. **[5]**

2B. In a double-slit experiment, the distance of the screen from the slits is 52 cm, the wavelength is 480 nm, slit separation is 0.12 mm and the slit width is 0.025 mm. What is the spacing between adjacent fringes? What is the distance from the central maximum to the first minimum of the fringe envelope? **[3]**

2C. Calculate the energy of a photon whose frequency is 620 THz. Determine the wavelength of this photon. **[2]**

3A. Derive the compton shift equation. **[5]**

3B. Neutrons (mass = 1.67×10^{-27} kg) in thermal equilibrium at room temperature (300 K) have kinetic energy of kT, where k is the Boltzmann constant. Find their momentum and de Broglie wavelength. **[3]**

3C. Find the peak wavelength of the blackbody radiation emitted by the tungsten filament of a light bulb, which operates at 2000 K. Sketch schematically the graph of intensity vs wavelength for this. Wien's constant = 2.898×10^{-3} m.K. **[2]**

4A. Calculate the probability that the electron in the ground state of H-atom will be found outside the Bohr radius (a_o). The wave function for an electron in H-atom is $\psi_{1S}(r) = \frac{1}{\sqrt{\pi a_o^3}} \exp\left(-\frac{r}{a_o}\right)$. **[5]**

4B. Sketch schematically, the lowest three energy states, wave-functions, probability densities for the particle in a one-dimensional "box". **[3]**

4C. What are the mathematical features of a wave function? **[2]**

5A. Draw a representative graph of Resistance Vs Temperature for a superconductor. Explain briefly the BCS theory of superconductivity in metals. **[5]**

5B. Show that the average kinetic energy $\left[E_{AV} = \frac{1}{n_e}\int EN(E)dE\right]$ of a conduction electron in a metal at zero K is (3/5)E_F, where the density of conduction electrons is $n_e = \frac{2}{3}\frac{8\sqrt{2}\pi m^{3/2}E_F^{3/2}}{h^3}$. E_F= Fermi energy. **[3]**

5C. Light from a hydrogen discharge tube is incident on a CdS crystal (E_G= 2.42 eV). Which spectral line from the Balmer series (656 nm, 486 nm, 434 nm, 410 nm) are absorbed and which are transmitted ? **[2]**

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