Ref. No. : EX/PH/T/2A/2017(OLD)

B. ENGG. 1ST YEAR 2ND SEM. EXAM. 2017(OLD)

Subject : PHYSICS IIA(OLD) Time : Three Hours Full Marks : 100

Answer any five questions

1. a) State and prove Gauss's theorem of electrostatics. Show that electric field just outside a conductor is perpendicular to its surface and estimate the value of normal component of this field.

b) Gravitational acceleration (g) on the surface of the Earth is 9.8 m/S. Calculate the value of g above 1500km assuming the Earth to be a sphere of diameter 6000km. How much work must be done to raise a body of unit mass to that height.

c) Determine the electric potential and field of an electric dipole at a large distance and its radius vector making an angle 45^0 with dipole axis.

7+7+6 = 20

2. a) State Ampere's law. Explain under what condition it is useful.

b) Calculate magnetic field at any point on the symmetry axis of a circular loop using Biot-Savart law.

c) State Faraday's laws of electromagnetic induction. Calculate self inductance per unit length of a long solenoid.

5+5+10 =20

3. a) Derive the conditions required for sustained interference of light coming from two sources.

b) What are Newton's ring and how they are produced? Explain how the experimental set up of Newton's ring can be used to determine refractive index of liquid.

c)In a Newton's ring experiment the diameter of the 6^{th} and 14^{th} dark rings are 0.40cm and 0.70cm respectively. Find the diameter of 20^{th} dark ring.

7+8+5 = 20

4. a) Calculate an expression for intensity of Fraunhoffer diffraction pattern for a plane transmission grating.

b) Determine conditions of principal maxima and secondary maxima of intensity.

c) Find the condition for absent spectra in plane transmission grating.

8+6+6 = 20

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5. a) Describe an experiment that suggests light is transverse wave.

b) What is double refraction? Describe the properties of ordinary rays and extra ordinary rays.

c) State Brewster's law of polarization. Calculate polarizing angle of water if its refractive index is 1.33.

6+8+6 = 20

6. a) What is observed in a Compton scattering experiment? How this phenomenon is explained?

b) Calculate the change of wavelength in Compton scattering.

c) An X-ray photon of wavelength of 0.1 Å is scattered at an angle of 45° with its original direction after collision with a free electron. Find the wavelength of modified radiation and momentum of the recoil electron.

4+10+6=20

7. a) Explain the origin of continuous and characteristic X-ray spectra. Electrons are accelerated by 50 kV supply in an X-ray tube. Find the maximum speed of electron and minimum wavelength of X-ray.

b) Derive Bragg's law of X-ray diffraction.In a X-ray diffraction experiment with a cubic crystal of lattice parameter a=4.8Å, First order Bragg peak from (111) plane is obtained for glancing angle 15^0. Calculate the wavelength of X-ray used.

10+10 = 20

8. a) State Heisenberg uncertainty principle and explain its significance. Discuss wave particle duality in context of uncertainty principle.

b) Write down Bohr's postulate of hydrogen atom and find the stationary state energy levels of the same. Also calculate the expression of wave number ($1/\lambda$) for Balmer lines.

6+14 = 20

Values of some useful constants:
(e=1.60x10^{-19}C, h=6.626x10^{-34} JS, m_o=9.11x10^{-31}Kg, ε_o=8.854x10^{-12} F/m, μ_0=4πx10^{-7} N/A^2).