(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9927 9913 Roll No. | | | | | | | | | | |

B.Tech.

SECOND SEMESTER EXAMINATION, 2005-2006

PHYSICS

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** questions.*
(ii) All questions carry equal marks.
(iii) In case of numerical problems assume data wherever not provided.
(iv) Be precise in your answer.

Physical Constants :

Planck constant	$= h =$	6.63×10^{-34} *J.s*
Velocity of light	$= c =$	3×10^{8} *meter/second*
mass of electron	$= m_e =$	9.1×10^{-31} *kg.*
mass of proton	$= m_p =$	1.67×10^{-27} *kg.*
1 ev	$=$	1.6×10^{-19} *Joule*

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Differentiate inertial and noninertial frames of reference and show that inertial frames move with constant velocity relative to each other.

(b) State Einstein's postulates of special theory of relativity. Explain, why Galilean relativity failed to explain the actual results of Michelson Morley Experiment and hence obtain Lorentz transformations.

(c) Show that space-time interval $x^2 + y^2 + z^2 - c^2 t^2$ is invariant under Lorentz transformations.

(d) Show that, when an object moves with velocity $v (v \to c)$, relative to a fixed frame, its measured length appears to be contracted in the direction of its motion by a factor $\sqrt{1 - v^2/c^2}$.

(e) Show that clock moving with velocity v relative to an observer appears to him go slow by a factor of $\sqrt{1 - v^2/c^2}$, than at rest relative to him.

(f) Show that relativistic kinetic energy of a particle is given by $K = (m - m_0)c^2 = m_0 c^2 \left[(1 - {}^{v^2}/_{c_2})^{-\frac{1}{2}} - 1 \right]$ and hence calculate the work done to increase the speed of electron of rest energy 0.5 MeV from 0.6 c to 0.8 c.

2. Attempt ***any two*** parts of the following : **(10x2=20)**

(a) (i) Explain conditions of interference for optical waves and differentiate between interference due to division of wavefront and division of amplitude giving one example each.

(ii) Explain, what are coherent sources. How two coherent sources are produced ? Explain coherence length, spatial coherence and temporal coherence.

(b) (i) Describe the Newton's ring method to determine the wavelength of sodium light. What will happen to fringes if air film between the plano-convex lens and glass plate is filled with a liquid of refractive index μ. Explain.

(ii) A film of refractive index μ is illuminated by white light at an angle of incidence i. In reflected light two consecutive bright fringes of wavelength λ_1 and λ_2 are found overlapping. Obtain expression for thickness of film.

(c) (i) Explain phenomenon of diffraction and distinguish Fresnel and Fraunhoffer diffraction. Obtain intensities of diffraction pattern in Fraunhoffer diffraction due to a single slit.

(ii) Explain Rayleigh criteria for limit of resolution. Obtain expression for Resolving power of a Grating. Can D_1 and D_2 lines of Na light be resolved (for $\lambda_{D1} = 5890$ A°, $\lambda_{D2} = 5896$ A°) in second order. Number of lines in Grating of 2.0cm wide = 4500.

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) Explain principle of a laser and describe working of Ruby laser. In a Ruby laser, total number of Cr^{+3} ions is 2.8×10^{19}. If the laser emits radiation of wavelength 7000 A°, calculate energy of laser pulse.

(b) (i) Explain phenomenon of double refraction. Describe Huygen's theory of double refraction when optic axis is parallel to upper face and lying in plane of incidence.

(ii) Describe how plane, circular and elliptically polarized light is produced.

(c) (i) Explain what is optical activity. Calculate the specific rotation, which rotates the plane of polarization 15.2° in 20% sugar solution of 25 cm length.

(ii) The refractive indices of quartz for right handed and left handed circularly polarized light of wavelength 6300 A° are 1.53915 and 1.53921 respectively. Calculate the angle of rotation produced by quartz plate of thickness 0.5 mm.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) State Ampere's law in differential and integral forms. Discuss the modification made by Maxwell's taking displacement current in consideration. Explain the displacement current and its implications.

(b) Starting from Maxwell's equations and constitutive equations obtain electromagnetic wave equation in free space.

(c) Explain ferromagnetism and discuss

(i) What is Hysterisis ? Show that hysteresis loss is equal to the area of its loop.

(ii) Describe Langevin Theory of Diamagnetism. Show that magnetic susceptibility is independent of temperature.

5. Attempt *any four* parts of the following : **(5x4=20)**

(a) State Heinsenberg uncertainty principle. Use this to show that electron cannot reside in atomic nucleus.

(b) Calculate the smallest possible uncertainty in position of an electron moving with velocity $v = 3 \times 10^7$ m/second.

(c) Derive time dependent Schrodinger wave equation and find the energy of an electron moving in one dimension in an infinitely high potential box of 1A° width.

(d) Explain compton effect, show that compton wavelength shift $\Delta\lambda = \frac{h}{m_0 c}(1-\cos\theta)$

(e) A photon of frequency v is scattered by an electron initially at rest. Prove that maximum kinetic energy of recoil electron is given by,

$$\frac{2h^2v^2}{m_0c^2\left[1+\frac{2hv}{m_0c^2}\right]}$$

(f) Describe Bragg's Law and Bragg's spectrometer.

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