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

PAPER ID: 9927/9922 Roll No.⌞ ⎸ ⎸ ⎸ ⎸ ⎸ ⎸ ⎸ ⎸ ⎸

B. Tech.

(SEM. II) EXAMINATION, **2006-07**

PHYSICS

Time : 3 Hours]　　　　　　　　　　　*[Total Marks : 100*

Note :　　(1)　*Attempt* **all** *questions.*

　　　　(2)　*All questions carry equal marks.*

　　　　(3)　*The physical constants are given at the end of the question paper.*

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

　　(a)　What was the objective of conducting the Michelson-Morley experiment? Describe the experiment. How is the negative result of the experiment interpreted?

　　(b)　Derive Einstein's mass energy relation $E = me^2$ and discuss it. Give some evidence showing its validity.

　　(c)　Derive the relativistic velocity addition theorem. Show that it is consistent with Einstein's second postulate.

(d) Show that the momentum of a particle of rest mass m_0 and kinetic energy k is given by the expression

$$p = \sqrt{\frac{k^2}{c^2} + 2m_0 k}$$

(e) A clock keeps correct time. With what speed should it be moved relative to an observer so that it may appear to loose 4 minutes in 24 hours?

(f) The mass of a moving electron is 11 times its rest mass. Find its kinetic energy and momentum.

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

(a) (i) Explain the formation of interference fringes by means of a Fressel's biprism and derive the expression for the fringe-width.

(ii) White light is incident on a soap film at an angle $\sin^{-1}\dfrac{1}{4}$ and the reflected light is observed with a spectroscope. It is found that two consecutive dark bands correspond to wavelengths 6.1×10^{-5} cm and 6.0×10^{-5} cm respectively. If the refractive index of the film be 4/3, calculate the thickness.

(b)	Give the construction and theory of plane transmission grating and explain the formation of spectra by it. Explain what are absent spectra in the grating?

(c)	(i)	Explain the Rayleigh's criterion for limit of resolution. Derive the expression for the resolving power of a microscope.

(ii) A plane transmission grating has 15000 lines per inch. Find the resolving power of the grating and the smallest wavelength difference that can be resolved with a light of wavelength 6000 A in the second order.

3.	Attempt any two parts of the following :	10x2=20
(a)	Discuss the phenomena of the rotation of plane of polarisation of light by optically active materials. Give the necessary theory. Show that the rotation of plane of polarisation is

given by $-\frac{7td}{\lambda}(\frac{1}{\mu_A} \sim \frac{1}{\mu_C})$, where μ_A and

are the refractive indices of the crystal in the direction of optic axis for anticlockwise and clockwise circularly polarized light respectively and d is the thickness of the crystal plate.

(b) (i) Describe how a nicol prism can be used as polarizer and analyzer?

(ii) A 5% solution of cane sugar placed in a tube of length 40 cm, causes the optical rotation of 20°. How much length of 10% solution of the same substance will cause 35° rotation?

(c) (i) Explain the action of a helium-neon laser. How is it superior to a ruby laser?

(ii) What are Einstein's coefficients? Derive Einstein's relation.

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

(a) (i) Explain the concept of Maxwell's displacement current and show how it led to the modification of Ampere's law.

OR

State and prove Stoke's theorem. What is its importance? (ii) Show that the wave equation for electric

field E is given by $S/^2E = [i_Q e_Q \frac{-\text{»}}{dt^2}$

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(b) Derive Poynting theorem for the flow of energy in an electromagnetic field.

(c) Discuss Langevin's theory of diamagnetism. Show that the diamagnetic susceptibility is negative and independent of temperature.

OR

Explain the terms magnetic flux, magnetomotive force and magnetic reluctance and obtain the relation between them.

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

(a) Describe Bragg's X-ray spectrometer and derive the necessary formula.

(b) X-rays of wavelength $X = 0.3 \overset{o}{A}$ are incident on a crystal with a lattice spacing $0.5 \overset{o}{A}$. Find the angles at which second and third Bragg's diffraction maxima are observed.

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(c) Calculate Compton shift if X-rays of wavelength $X = 1.0\,\overset{o}{A}$ are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam.

(d) What are matter waves? Show that de-Broglie wavelength associated with a particle of mass *m* and Kinetic Energy *E* is given by

$$\frac{}{\sqrt{2mE}}$$

(e) Find the energy of an electron moving in one dimension in an infinitely high potential box of width $1\,\overset{o}{A}$

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

$$\frac{2h^2v^2}{m_0c^2}$$

Physical constants :

Planck's constant : $h = 6.63 \times 10^{-34}$ J-s

Velocity of light in free space : $c = 3 \times 10^8$ m/s

Rest mass of electron : $m_e = 9.1 \times 10^{-31}$ kg.

Charge of electron : $e = 1.6 \times 10^{-19}$ C

Permittivity of free space : $e_0 = 8.85 \times 10^{-12}$ F/m

Permeability of free space : $\mu_o = 4\pi \times 10^{-7}$ H/m

Mass of neutron : $m_n = 1.67 \times 10^{-27}$ kg.

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