



RM-6009

B. E. I (Sem. I & II) Examination

May / June – 2010

Engg. Physics

Time : 3 Hours]

[Total Marks : 100

Instruction :

(1)

નીચે દર્શાવેલ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of signs on your answer book.

Name of the Examination :
B. E. 1 (Sem. 1 & 2)

Name of the Subject :
Engg. Physics

Subject Code No. : 6 0 0 9 Section No. (1, 2,.....): 1&2

Seat No. :

Student's Signature

- (2) Attempt all questions.
(3) Figures to the **right** indicate full marks of the question.
(4) Standard constants
 $h = 6.625 \times 10^{-34}$ J-S
 $c = 3 \times 10^8$ m/s
 $m_e = 9.11 \times 10^{-31}$ kg
 $\sigma = 5.67 \times 10^{-8}$ mkg
 $e = 1.6 \times 10^{-19}$ C
 $k = 1.38 \times 10^{-23}$ J/mol^ok

SECTION - I

- 1 (a) Give the following answers in short. 10
- (i) State the full form of Laser.
(ii) Define birefringence
(iii) Laser Polychromatic source - True/False
(iv) State the types of coherence.
(v) What is the necessary condition to occur diffraction.
(vi) Define diffraction grating.
(vii) State the Malus law
(viii) In He-Ne laser the population inversion takes place at the energy level of _____ atom.
(ix) Ruby laser produces the light of wavelength _____ A.
(x) Define interference.

- 2 (a) Answer any **two** in detail. 12
- (i) Explain the construction and working of He-Ne laser.
 - (ii) Give the characteristics and applications of laser.
 - (iii) Obtain the relation between Einstein's coefficients.
- (b) Solve any one : 2
- (i) A laser beam $\lambda = 5800\text{\AA}$ on earth focussed by lens of diameter 2 m on the moon. How big is the spot on the moon. (distance between earth and moon is 4×10^5 km)
 - (ii) Calculate the energy difference in eV between two energy levels of Ne atom of He-Ne laser. The transition between these levels emits the light of wavelength 632.8 nm.
- 3 (a) Answer any **three** in detail. 18
- (i) Explain the formation of Newton's rings and prove that the radius of the n^{th} dark ring is directly proportional to the square root of the natural number of the ring.
 - (ii) Explain the term interference. Derive the equation for intensity at any point on the screen in Young's double slit exp.
 - (iii) State and derive Malus law for plane polarised light.
 - (iv) State the characteristics of ordinary and extra ordinary beam.
 - (v) Discuss the Fraunhofer diffraction of circular aperture. Show that the first diffraction minimum is position at $\theta = \frac{1.22 \lambda f}{d}$
- 3 (b) Solve any **two** from following : 6
- (i) The diameter of 14th dark ring changes from 1.52 cm to 1.37 cm when the liquid of refractive index μ is introduced between plate and lens. Calculate the refractive index of liquid.
 - (ii) Find the angular width of central bright maximum Fraunhofer diffraction pattern of single slit of width 12×10^{-5} cm, when slit is illuminated by light of wavelength 6000 \AA .

- (iii) When unpolarised light is incident on thin transparent material of refractive index μ , the deviation in the transmitted beam due to refraction is 24° . Calculate μ .
- (c) Write any **one** short note : 2
- (i) Types of coherence
- (ii) Brewster's law.

SECTION - II

- 4 (a) Answer any **two** questions from the following : 12
(each carries **six** marks)
- (i) What is meant by high energy particle accelerator? Explain the construction and working principle of the cyclotron or betatron.
- (ii) What is a solenoid? Using Ampere's theorem, set up an expression for the magnetic induction (\vec{B}) at a point on the axis of an infinitely long solenoid.
- (iii) Define three magnetic vectors. Derive an expression $\vec{B} = \mu_0 \vec{H} + \mu_0 \vec{M}$.
- (b) Solve any **two** numericals from the following : 6
(each carries **three** marks)
- (i) What is a Toroid? Use Ampere's theorem to get toroid magnetic field at an inner point.
- (ii) An n-type semiconductor has impurity atom density of 10^{20}m^{-3} . It is used in the experiment of Hall effect. The magnetic field is 0.5 wb m^{-2} and the current density is 600 Am^{-2} . Find the Hall voltage if the specimen is 3 mm thick.
- (iii) The current in a long solenoid of 300 turns and length 1.0 m is 1.0 amp and has iron in its core of cross-section area $5 \times 10^{-4} \text{m}^2$. Find (a) B in the core (b) number of flux lines in the core (c) the permeability of iron at this magnetising field, the value of $B = 1.3 \text{ web/m}^2$.
- 5 (a) Answer any **three** questions from the following : 18
(each carries **six** marks)
- (i) What is meant by cavity radiator? Why it is called ideal source of light? Give the Planck's hypothesis for cavity radiation. Give his spectral radiancy formula account the spectral radiancy distribution for cavity radiator.

- (ii) State the de-Broglie hypothesis for matter waves. Show that (a) the wavelength of the waves associated with electron accelerated under potential difference equal to V volt is (a) $\lambda = \frac{h}{\sqrt{2 MeV}}$ (b) $uv = c^2$ symbols have their usual meaning.
- (iii) Write the energy formula for electron in Hydrogen atom using (a) and (b); derive the formula. For frequency of the emitted photon and explain the Balmer spectrum.
- (iv) What is the photoelectric effect? Define the terms :
 (a) Threshold frequency
 (b) Stopping potential.
 Give the main features of the photoelectric effect.
- (v) What is Compton's effect? Write an expression for Compton's shift and explain the experimental results.
- (b) Solve any **three** numericals from the following : 9
 (each carries **three** marks)
- (i) Calculate the binding energy of the hydrogen atom.
- (ii) An oven with an inside temperature $T = 227^\circ\text{C}$ in a room having a temperature $T_r = 27^\circ\text{C}$. There is a small opening of area 5.0 cm^2 in one side of the oven. How much net power is transferred from the oven to room consider both the oven and room as cavities. Take $\sigma = 5.67 \text{ watt/m}^2\text{k}^4$.
- (iii) A bullet of mass 40 gram travels at 1000 m/s
 (a) What wavelength can we associate with it?
 (b) Why does the wave nature of the bullet not reveal itself through diffraction effect?
- (iv) A photon of energy $3 \times 10^3 \text{ eV}$ collides with a free electron, initially at rest. What is the energy of the photon scattered at an angle of 60° . Take Compton's wavelength $2.43 \times 10^{-12} \text{ m}$.
- (v) Photo electric work function of a metal silver is 2.1 eV. Investigate whether this metal exhibits photoelectric emission for orange-red at 6800 \AA .
- (c) Write any **two** short notes : 5
- (i) The correspondence principle
 (ii) Uncertainty principle
 (iii) Bragg's law
 (iv) Franck and Hertz experiment
 (v) Limitations of Bohr's principle.