



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech(OLD)/SEM-2/PH-201/2013

2013

ENGINEERING PHYSICS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following questions : 10 × 1 = 10

i) Newton's ring experiment is based on

- a) division of amplitude
- b) division of wave-front
- c) none of these.

ii) de Broglie wavelength of a particle of mass m and kinetic energy E is

a) $\lambda = \frac{h}{2mE}$

b) $\frac{h}{\sqrt{2mE}}$

c) $\frac{\sqrt{2mE}}{h}$



- iii) Mass of a photon of frequencies ν is given by
- a) $\frac{h\nu}{c}$
 - b) $\frac{h\nu}{c^2}$
 - c) $\frac{h\nu^2}{c}$
- iv) The eigenvalue of the eigenfunction e^{ix} for the operator $\frac{d^2}{dx^2}$ is
- a) 1
 - b) 0
 - c) -1.
- v) Miller indices of a plane which cut intercepts of 2, 3 and 4 units along the three axes are
- a) (2, 3, 2)
 - b) (2, 3, 4)
 - c) (6, 4, 3).
- vi) In a plane transmission grating, light
- a) diffracts to produce the resultant pattern
 - b) diffracts and interfares to produce the resultant pattern
 - c) Interfares to produce the resultant pattern.



- vii) The atomic radius of a face centred cubic crystal of lattice constant a is
- $\frac{a}{2}$
 - $\frac{\sqrt{3}a}{4}$
 - $\frac{\sqrt{2}a}{4}$.
- viii) An X-ray tube is subjected to a potential difference of 50 kV with the corresponding current of 8 mA through it. The number of electrons striking per second on the target material is
- 5×10^{16}
 - 6×10^{11}
 - none of these.
- ix) In He-Ne laser, the laser light emits due to the transition from
- $3s \rightarrow 2p$
 - $3s \rightarrow 3p$
 - $2s \rightarrow 2p$.
- x) For an optical fibre, if n_0 , n_1 and n_2 are the refractive index of air, core and cladding region respectively, then
- $n_0 > n_2 > n_1$
 - $n_1 > n_2 > n_0$
 - $n_2 > n_1 > n_0$.
- xi) If the speed of an electron increases, the specific charge
- increases
 - decreases
 - remains constant.



- xii) One milligram of matter converted into energy will give
- a) 90 joule
 - b) 9×10^{10} joule
 - c) None of these.
- xiii) Relative velocity of two particles moving with velocity (C) of light in opposite direction is
- a) C
 - b) $2C$
 - c) 0 .

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. a) What is the difference between temporal coherence and spatial coherence ? 2
- b) If the amplitudes of two coherent light waves are in the ratio 1 : 4, find the ratio of maximum and minimum intensity in the interference pattern. 3
3. a) What is Compton effect ? Calculate the Compton wavelength for an electron. $1\frac{1}{2} + 1\frac{1}{2}$
- b) Why does the unmodified line appear in Compton scattering ? 2



4. a) Deduce the formulae for interplaner spacing of a simple cubic crystal. 4
 - b) Why X-ray diffraction is used for crystal structure analysis ? 1
5. Find the possible arrangements of two particles in three cells for
 - (i) Bose-Einstein Statistics
 - (ii) Fermi-Dirac Statistics. $2\frac{1}{2} + 2\frac{1}{2}$
6. a) Describe briefly the working principle of laser action. 3
 - b) Mention at least three main advantages of optical fibre over wire or cable ? 2
7. a) What are the basic postulates of special theory of relativity ? 2
 - b) Show that for $V \ll C$, Lorentz transformation reduces to the Galilean transformation. 3
8. a) Discuss the important characteristics of nuclear forces. 2
 - b) Why nuclear fission reaction must be done first before nuclear fusion ? 3



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

9. a) What is double refracting crystal ? 2
- b) Discuss Nicol prism as polarizer and analyzer. 4
- c) Determine the Brewster's angle for glass of refractive index 1.5 immersed in water of refractive index 1.33. 3
- d) Prove that the intensit of secondary maxima formed for Fraunhofer diffraction at a single slit are of decreasing order. 3
- e) In a plane transmission grating the angle of diffraction for 2nd order maxima for wavelength 5×10^{-5} cm is 30° . Calculate the number of lines in one centimetre of the grating surface. 3
10. a) State and explain de Broglie hypothesis. 2
- b) Prove that the product of phase velocity and group velocity for a de Broglie wave is equal to the square of the velocity of light. 5
- c) Compute the smallest possible uncertainty in the position of an electron moving with velocity 3×10^7 m/s. The rest mass of electron is 9.1×10^{-31} kg. 3
- d) Derive the Wein's displacement law from Planck's radiation law. 5
11. a) Write down the postulates of Fermi-Dirac statistics. 3
- b) Plot electron distribution function governed by Fermi-Dirac statistics in metal at $T = 0K$ and $T > 0K$. Explain their physical significance. $2 + (3 + 3)$
- c) Why Compton effect cannot be observed with visible light but can be observed due to X-rays ? 4



12. a) If an electron is subjected to a potential difference of v volts then prove that the corresponding de-Broglie wavelength. $\lambda = \frac{12 \cdot 26}{\sqrt{v}} \text{ \AA}$. 3
- b) On the average, an excited state of a system remains in the state for 10^{-11} s. What is the minimum uncertainty in the energy of an excited state. 3
- c) State the position-momentum Heisenberg uncertainty principle. 2
- d) What is the value of $\left| \frac{\partial}{\partial x}, \frac{\partial}{\partial t} \right|$? 3
- e) When a particle moves with a velocity much less compared to the velocity of light in free space, then show that the relativistic expression of K.E approaches the classical limit. 4
13. a) What is the difference between unpolarised light and polarized light ? Explain how polarized light can be obtained from unpolarised light. 2 + 2
- b) What are plane of vibration and plane of polarization ? 2
- c) Discuss the phenomenon of double refraction. Distinguish between *O*-ray and *E*-ray. 2 + 4
- d) A ray of light is incident at the polarizing angle on the surface of a glass plate having refractive index 1.5. Find the angle of refraction of the ray. 3

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