



ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE - 2009

ENGINEERING PHYSICS

SEMESTER - 2

Time : 3 Hours]

[Full Marks : 70

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : 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.

2141 (17, 06)



- 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
- a) $\frac{a}{2}$
- b) $\frac{\sqrt{3}a}{4}$
- c) $\frac{\sqrt{2}a}{4}$
- 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
- a) 5×10^{16}
- b) 6×10^{11}
- c) none of these.
- ix) In He-Ne laser, the laser light emits due to the transition from
- a) $3s \rightarrow 2p$
- b) $3s \rightarrow 3p$
- c) $2s \rightarrow 2p$.
- 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
- a) $n_0 > n_2 > n_1$
- b) $n_1 > n_2 > n_0$
- c) $n_2 > n_1 > n_0$.

2441 (17/03)



- xi) If the speed of an electron increases, the specific charge
 - a) increases
 - b) decreases
 - c) 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 × 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. $2 \frac{1}{2} + 2 \frac{1}{2}$

2441 (17/06)



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* questions.

3 × 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 intensity 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 $T = 0\text{K}$ and $T > 0\text{K}$. Explain their physical significance. 2 + (3 + 5)
 c) Why Compton effect can not be observed with visible light but can be observed due to X-rays? 4

2441 (17/06)



12. a) Discuss the operation of a Ruby laser with the help of energy level diagram. 5 + 1
 b) Find the numerical aperture and angle of acceptance of a given optical fibre. [Given, the refractive indices of core and cladding are 1.562 and 1.497 respectively]. 3
 c) In a He-Ne laser transition from 3s to 2p level gives a laser beam of wavelength 632.8 nm. If the 2p level has energy equal to 15.2×10^{-19} J, calculate the required pumping energy (assuming no loss of energy). 4
 d) What is the role of optical resonator in laser production ? 2
13. a) Write down Schrödinger equation for one dimensional motion of a free particle in a one dimensional potential box. Find its eigenfunction and eigenenergy. 1 + 3 + 3
 b) Prove that the first excited energy state of a free particle in a cubical box has three fold degeneracy. 4
 c) Copper has FCC structure and the atomic radius is 0.1278 nm. Find its density and the interplaner spacing for (321) planes. The atomic weight of copper is 63.5. 4
14. a) What are the differences between inertial and non-inertial frame of references ? 2
 b) Deduce an expression of time dilation on the basis of Lorentz transformation equation. 5
 c) Find the mass and speed of 2 MeV electron. 2 + 2
 d) If the total energy of a particle is thrice of its rest energy, find the velocity of the particle. 4
15. a) What is nuclear binding energy ? 2
 b) Draw a binding energy curve. What informations do you set from such a curve ? 2 + 3
 c) Find the energy released for the following nuclear fussion reaction : 3
 $4\text{}_{1}\text{H}^1 \rightarrow 2\text{}_{2}\text{He}^4 + 2\text{}_{+1}\text{e}^0 + \text{energy}$
 Given that
 mass of $1\text{}_{1}\text{H}^1$ atom = 1.007825 amu
 mass of $2\text{}_{2}\text{He}^4$ atom = 4.0026 amu
 mass of $+1\text{}e^0$ (positron) = 0.00055 amu.
 d) Differentiate conductor, insulator and semiconductor on the basis of energy band diagram. 3

END

24+1 (17/06)