Total No. of Questions : 11]

SEAT No. :

PC5148

[Total No. of Pages :4

[6351]-112

F.E.

BSC-102-BES : ENGINEERING PHYSICS

(2024 Pattern) (Semester-I) (Credit System)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Question No. 1 is compulsory.***
2) ***Questions No. 2 to No. 11 carry equal marks.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***
5) ***Use of an electronic calculator is allowed.***

Physical Constants:

- Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
- Charge on electron, $e = 1.6 \times 10^{-19}$ C
- Planck's constant, $h = 6.63 \times 10^{-34}$ J-sec

Q1) Multiple choice questions. **[10×1=10]**

a) The process of raising the atoms from a lower energy state to a higher one to create population inversion is called:

i) Pumping ii) Stimulated emission

iii) Spontaneous emission iv) Absorption

b) The main principle of optical fiber is:

i) Total internal reflection ii) Total internal refraction

iii) Total internal dispersion iv) None of the above

c) The full form of STM is:

i) Scientific technical microscope

ii) Scanning tunneling microscope

iii) Super tensile microscope

iv) None of the above

P.T.O.

d) The wavelength of a matter wave is ____ to the velocity of the particle:

i) Equal
ii) Inversely proportional
iii) Directly proportional
iv) Independent

e) The condition for a dark fringe in a reflected system for a uniform thickness thin film is:

i) $2\mu t \cos r = n\lambda$
ii) $2\mu t \sin r = n\lambda$
iii) $2\mu t \cos r = (2n \pm 1))\lambda/2$
iv) $2\mu t \sin r = (2n \pm 1)\lambda/2$

f) In a positive crystal, the velocity of the O-ray is:

i) half of velocity of the E-ray
ii) Less than the velocity of the E-ray
iii) Greater than the velocity of the E-ray
iv) None of the above

g) Pure semiconductors are known as:

i) Compound
ii) Extrinsic
iii) Doped
iv) Intrinsic

h) Hall Effect is true for:

i) Metals only
ii) Semiconductors only
iii) N-type semiconductors only
iv) Both metals and semiconductors

i) Superconductors are perfectly:

i) Paramagnetic
ii) Ferromagnetic
iii) Diamagnetic
iv) All of the above

j) Nanostructures have sizes between:

i) 1-100 Å
ii) 1 - 100 nm
iii) 100 - l000nm
iv) None of the above

Q2) a) With a neat labelled diagram, explain the construction, and working of a CO2 laser. **[6]**

b) If an optical fiber has a core refractive index of 1.55 and a cladding refractive index of 1.46, calculate the Numerical Aperture of the fiber. **[3]**

c) Define the following terms: **[3]**

i) Metastable state

ii) Population inversion

iii) Stimulated emission

OR

Q3) a) What is attenuation in optical fibers? Discuss in brief the various internal and external factors responsible for attenuation. **[6]**

b) What is a LASER? State important characteristics of a laser. **[3]**

c) Differentiate between step index and graded index fibers. (Any three points) **[3]**

Q4) a) Derive the Schrödinger's Time-Independent Wave Equation. **[6]**

b) For an electron accelerated by a potential difference V, derive the expression for its de Broglie wavelength. **[3]**

c) Find the lowest energy of an electron confined to a box of length 1 Å. **[3]**

OR

Q5) a) With a neat labelled diagram, explain the principle, construction, and working of a Scanning Tunnelling Microscope (STM). **[6]**

b) State the properties of matter waves (Any three). **[3]**

c) If the de Broglie wavelength is 0.72 AU, then find the momentum of the particle. **[3]**

Q6) a) State the phenomenon of double refraction. Hence, explain Huygens's wave theory of double refraction. **[6]**

b) Explain the application of interference in: **[3]**

Antireflection coating

c) How should the Polarizer and Analyzer be oriented to reduce the intensity of the beam to ½ of its original intensity. **[3]**

OR

Q7) a) Derive the conditions for brightness and darkness for the thin parallel film of thickness t and refractive index μ. **[6]**

b) State and explain Malus's Law. **[3]**

c) A beam of monochromatic light of wavelength 5.82×10^{-7}m falls normally on a glass wedge of angle 20 sec. If the refractive index (RI) of glass is 1.5, find the bandwidth. **[3]**

Q8) a) Explain the classification of solids into conductors, semiconductors, and insulators on the basis of band theory. **[6]**

b) State the any three properties of ultrasonic waves. **[3]**

c) An ultrasonic pulse is sent through a block of copper. The echo pulse is recorded after 4 μs. If the velocity of ultrasonic waves in copper is 5000 m/s, calculate the thickness of the copper block. **[3]**

OR

Q9) a) With a neat labelled diagram, explain the principle, construction, and working of a Piezoelectric Oscillator. **[6]**

b) Write the formula for the Fermi-Dirac probability distribution function, specifying the meaning of each symbol. **[3]**

c) For a P-N junction diode, draw an energy band diagram showing the position of the Fermi level in: **[3]**

Forward bias mode

Q10)a) Explain the Optical and Mechanical properties of nanoparticles. **[6]**

b) State and Explain the Meissner effect. Show that superconductors exhibit perfect diamagnetism. **[6]**

OR

Q11)a) What are the types of superconductors? Distinguish between them. **[6]**

b) What is quantum confinement? How does it affect the properties of nanoparticles? Explain the ball milling method for the synthesis of nanoparticles. **[6]**