

Total No. of Questions : 11]

SEAT No. :

PC5148

[6351]-112

[Total No. of Pages :4

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

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- 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 - 1000nm
 - 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 $1 \text{ \AA}$. [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 $0.72 \text{ \AA}$, 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 $\frac{1}{2}$ 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 $5.82 \times 10^{-7} \text{m}$ falls normally on a glass wedge of angle 20° . 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 $4 \mu\text{s}$. 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]

