Enrollment No.....................................

Faculty of Engineering / Science
End Sem Examination May-2023
EN3BS13 / BC3BS02 Engineering Physics
Programme: B.Tech.   Branch/Specialisation: All
/ B.Sc.

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i.   The material in which population inversion can take place is   **1**
          called-
          (a) Active medium   (b) Passive medium
          (c) Gaseous medium   (d) Vapour medium

     ii. Which component provides additional strength and prevents the   **1**
          fiber from any damage?
          (a) Core   (b) Cladding
          (c) Buffer Coating   (d) None of these

     iii. Where do Rayleigh criteria apply?   **1**
          (a) Resolving an equipment (b) Distinguish two sources
          (c) Reflecting two minimum (d) None of these

     iv. Transverse nature of light can be proved by-   **1**
          (a) Interference   (b) Diffraction
          (c) Polarization   (d) None of these

     v.   The de-Broglie wavelength associated with electrons, which are **1**
          accelerated by a voltage of 100V is-
          (a) 12.27 Å   (b) 122.7 Å   (c) 1.22 Å   (d) 0.122 Å

     vi. The uncertainty principle is applies to-   **1**
          (a) Microscopic particle   (b) Macroscopic particle
          (c) Gases   (d) None of these

     vii. Superconductors are strongly-   **1**
          (a) Diamagnetic   (b) Paramagnetic
          (c) Ferromagnetic   (d) Ferrimagnetic

viii. The Hall coefficient R_H is defined as- **1**

(a) $R_H = \dfrac{V_H.t}{B}$ (b) $R_H = \dfrac{V_H.B}{It}$

(c) $R_H = \dfrac{V_H.Bt}{I}$ (d) $R_H = \dfrac{V_H.t}{BI}$

ix. A mass on a spring undergoes SHM. The maximum displacement from the equilibrium is called- **1**
(a) Period   (b) Frequency (c) Amplitude (d) Wavelength

x. The unit of absorption coefficient is- **1**
(a) Sabin   (b) Decibel   (c) Hertz   (d) Newton

Q.2   i.   Why a three-level laser normally provides pulsed output? **2**

ii. An optical fiber has a numerical aperture of 0.20 and cladding refractive index of 1.59. Determine the acceptance angle for the fiber in water, which has a refractive index of 1.33. **3**

iii. Draw the energy level diagram of Helium Neon laser. Explain the operation principle of He-Ne laser. How this laser is superior to ruby laser? **5**

OR   iv.   Derive an expression for acceptance angle. Explain why numerical aperture is small for a graded index fiber in comparison to an identical step index fiber. **5**

Q.3   i.   Two slits are separated by a distance of 0.2 mm are illuminated by a monochromatic light of wavelength 5500 Å. Calculate the fringe width on a screen at distance of 1 m from the slits. **2**

ii. Explain Huygen's principle of double refraction. **3**

iii. With relevant theory and mathematical derivation explain how radius of curvature of a convex lens be determined by forming Newton's rings. **5**

OR   iv.   Discuss Fraunhofer single slit diffraction with the use of ray diagram. Obtain the conditions for maxima and minima and then draw intensity distribution curves. **5**

Q.4   i.   An x-ray photon of wavelength 0.4 Å is scattered through an angle $45°$ by a loosely bound electron. Find- **4**
(a) Wavelength of the scattered photon
(b) Maximum wavelength present in the scattered photon

ii. Derive an expression for energy of a particle of mass m confined to infinite potential well of width L. Why such a particle cannot have zero energy? **6**

OR   iii.   Write short note on phase velocity, group velocity and wave pocket. **6**

Q.5   i.   What are Miller indices? Give their significance. How are they determined? **4**

ii. State and explain Meissner effect. Justify why Meissner effect is reversible. **6**

OR   iii.   Give postulates of band theory of solids. Draw the Fermi level for n-type and p-type semiconductor as a function of temperature. **6**

Q.6   Attempt any two:

i. What do you mean by simple harmonic oscillator? Explain at what distance from the mean position, kinetic energy in a simple harmonic oscillator equal to potential energy? **5**

ii. Define reverberation time and absorption coefficient. A classroom has dimensions $20×15×5$ m^3. The reverberation time is 3.5 sec. Calculate the total absorption of its surfaces. **5**

iii. Write short note on: **5**
(a) Compound Pendulum
(b) Acoustic requirements of good auditorium

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MEDI-CAPS UNIVERSITY *Knowledge is Power*	End Sem Examination May-2023
	EN3BS13 Engineering Physics
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Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	The material in which population inversion can take place is called a) Active medium	1
	ii)	Which component provides additional strength and prevents the fiber from any damage? (c) Buffer Coating	1
	iii)	Where do Rayleigh criteria apply? b) Distinguish two sources	1
	iv)	Transverse nature of light can be proved by c) Polarization	1
	v)	The de-Broglie wavelength associated with electrons, which are accelerated by a voltage of 100V is c) 1.22 Å	1
	vi)	The uncertainty principle is applies to (a) microscopic particle	1
	vii)	Superconductors are strongly (a) diamagnetic	1
	viii)	The Hall coefficient R_H is defined as (d) $R_H = \dfrac{V_H \cdot t}{BI}$	1
	ix)	A mass on a spring undergoes SHM. The maximum displacement from the equilibrium is called? (c) Amplitude	1
	x)	The unit of absorption coefficient is (a) Sabin	1

Q.2	i.	Why a three level laser normally provides pulsed output? Explanation 2 marks	2
	ii.	An optical fiber has a numerical aperture of 0.20 and cladding refractive index of 1.59. Determine the acceptance angle for the fiber in water, which has a refractive index of 1.33. Formula $$NA = \frac{\sqrt{n_1^2 - n_2^2}}{n_0} \qquad \text{1.5 marks}$$ $$\theta_{max} = Sin^{-1} NA \qquad \text{1.5 marks}$$ $$= 11.47$$	3
	iii.	Draw the energy level diagram of Helium Neon laser. Explain the operation principle of He-Ne laser. How this laser is superior to ruby laser? Energy level diagram 2 marks Explain of operation principle 2 marks Superiority over Ruby laser 1 marks	5
OR	iv.	Derive an expression for acceptance angle. Explain why numerical aperture is small for a graded index fiber in comparison to an identical step index fiber. Ray diagram 1 marks Expression for acceptance angle 3 marks Explanation 1 marks	5
Q.3	i.	Two slits are separated by a distance of 0.2 mm are illuminated by a monochromatic light of wavelength 5500 Å. Calculate the fringe width on a screen at distance of 1 m from the slits. $$\overline{X} = \frac{\lambda D}{2d}$$ Formula 1 marks	2

		Answer $\overline{X} = 2.75mm$ 1 marks	
	ii.	Explain Huygen's principle of double refraction. Diagram 1.5 marks Explanation 1.5 marks	3
	iii.	With relevant theory and mathematical derivation explain how radius of curvature of a convex lens be determined by forming Newton's rings. Theory with diagram 2.5 marks Derivation 2.5 marks	5
OR	iv.	Discuss Fraunhofer single slit diffraction with the use of ray diagram. Obtain the conditions for maxima and minima and then draw intensity distribution curves. Diagram and explanation 2 marks Conditions for maxima and minima 2 marks Intensity distribution curves 1 marks	5
Q.4	i.	An x-ray photon of wavelength 0.4 Å is scattered through an angle $45°$ by a loosely bound electron. Find wavelength of the scattered photon 2 marks $$\lambda' - \lambda = \frac{h}{m_0 c}(1 - \cos\theta)$$ $\lambda' = 0.4071\overset{0}{\text{Å}}$ maximum wavelength $\lambda' = 0.4484\overset{0}{\text{Å}}$ 2 marks	4
	ii.	Derive an expression for energy of a particle of mass m confined to infinite potential well of width L. Why such a particle cannot have zero energy?	6

		Derivation with diagram 4 marks Reason for non zero energy 2 marks	
OR	iii.	Discuss the formation of wave packet and hence prove that for a non dispersive medium phase velocity is equal to the group velocity. formation of wave packet and diagram 2 marks Proof 4 marks	6
Q.5	i.	What are Miller indices? Give their significance. How are they determined? Definition 1marks Significance 1 marks Steps 2 marks	4
	ii.	State and explain Meissner effect. Justify why Meissner effect is reversible. Statement 2 marks Explanation 2 marks Justification 2 marks	6
OR	iii.	Give postulates of band theory of solids. Draw the Fermi level for n-type and p-type semiconductor as a function of temperature. Postulates 4 marks Diagram 2 marks	6
Q.6		Attempt any two:	
	i.	What do you mean by simple harmonic oscillator? Explain at what distance from the mean position, kinetic energy in a simple harmonic oscillator equal to potential energy? Definition 2 marks Distance 3 marks	5
	ii.	Define reverberation time and absorption coefficient. A classroom has dimensions 20×15×5 m^3. The reverberation time is 3.5 sec. Calculate the total absorption of its surfaces.	5

		Definition of reverberation time and absorption coefficient	2.5 marks	
		$$T = \frac{0.161V}{\sum aS}$$ $$\sum aS = 69\, m^2 - sabins$$	2.5 marks	
	iii.	Write short note on: (i) Compound Pendulum 2.5 marks (ii) Acoustic requirements of good auditorium 2.5 marks		**5**

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