Faculty of Engineering / Science
End Sem (Even) Examination May-2022
EN3BS13 / SC3BS05 Engineering Physics

Programme: B.Tech. / B.Sc.   Branch/Specialisation: All / AIML/CS/CTIS/MAIS

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.

Q.1 i. Which event is likely to take place when a photon of energy equal to the difference in energy between two levels is incident in a system? **1**
(a) Absorption   (b) Emission
(c) Absorption and emission   (d) None of these

ii. The normalized frequency of an optical fibre is equal to 2. Then the number of modes propagating through the fibres are: **1**
(a) Two   (b) One   (c) Three   (d) Infinite

iii. The criterion of resolution of optical instruments was given by- **1**
(a) Newton   (b) Huygen   (c) Rayleigh   (d) Ramsden

iv. Which phenomenon causes the polarisation of light- **1**
(a) Double reflection   (b) Double refraction
(c) Diffraction   (d) None of these

v. Which of the following statement about the energy in a quantum is true? **1**
(a) Varies directly with frequency   (b) Same for all frequencies
(c) Varies inversely with frequency   (d) None of these

vi. Heisenberg's uncertainty relation holds good for: **1**
(a) Microscopic as well as macroscopic particles both
(b) Only microscopic particles
(c) Only macroscopic particles
(d) None of these

vii. The coordination number for face centred cubic lattice is- **1**
(a) 12   (b) 8   (c) 6   (d) 26

viii. The transition temperature of mercury is- **1**
(a) 1 K   (b) 1.14 K   (c) 4.2 K   (d) 9.22 K

ix. Ultrasonic waves are- **1**
(a) Sound waves of very long wavelength
(b) Move slower than sound waves
(c) Move faster than sound waves
(d) Move with the same velocity as sound waves

x. Total energy of the particle executing simple harmonic motion is **1** same at-
(a) Equilibrium position   (b) Extreme position
(c) Midway (between zero & maximum)   (d) All of these

Q.2 i. What is spontaneous and stimulated emission? **2**

ii. Differentiate between step index and graded index optical fibre and **3** draw their refractive index profile.

iii. An optical fibre is made of glass with refractive index 1.55 and is **5** cladded with another glass with refractive index 1.51. the fibre has a core diameter of 50μm and is used at a light wavelength of 0.8 μm. Find the following:
(a) Numerical aperture (b) Fractional refractive index change
(c) Acceptance angle (d) V-number (e) Approximate number of modes.

OR iv. Explain the working of Ruby laser with the help of block diagram and **5** energy level diagram.

Q.3 i. What is Double refraction, Positive crystal and Negative crystal? **3**

ii. Describe Fresnel's bi-prism. Obtain the expressions for the fringe width **7** and distance between virtual coherent sources by deviation method.

OR iii. Derive an expression for the intensity due to single slit diffraction. **7** Show that the intensity at first secondary maxima is about 4.5 % of that of principal maxima.

Q.4 i. What is phase velocity and group velocity? **2**

ii. X-ray of wavelength 10.0 pm are scattered from a target. **3**
(a) Find the wavelength of the X ray scattered through 45°.
(b) Find the maximum wavelength present in the scattered X-ray.

iii. Write down the Schrodinger's equation for a particle in a box. Solve it **5** to obtain Eigen functions and show that the energy Eigen values are discrete.

OR iv Write short note on: **5**
(a) Heisenberg's uncertainty principle
(b) Limitations of classical mechanics

Q.5 i. What is position of Fermi level in intrinsic and extrinsic **2** Semiconductor?

ii. A plane cuts intercepts 2a, 3b and c along the crystallographic axis in a **3** crystal. Determine the Miller Indices of plane.

iii. What is Hall Effect? Derive the expression of Hall coefficient. **5**

OR iv Explain Meissner effect of super conductors. Discuss type-I and type-II **5** super conductor.

Q.6 Attempt any two:
i. What is Sabine's formula and its limitations? **5**
ii. Give any one method of production and detection of ultrasonic waves. **5**
iii. Derive an expression for the total energy of a harmonic oscillator and **5** show that it is constant and proportional to the square of the amplitude.

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Marking Scheme
EN3BS13 / SC3BS05 Engineering Physics

Q.1 i. Which event is likely to take place when a photon of energy equal to **1** the difference in energy between two levels is incident in a system?
(a) Absorption

ii. The normalized frequency of an optical fibre is equal to 2. Then the **1** number of modes propagating through the fibres are:
(b) One

iii. The criterion of resolution of optical instruments was given by- **1**
(c) Rayleigh

iv. Which phenomenon causes the polarisation of light- **1**
(a) Double reflection

v. Which of the following statement about the energy in a quantum is true? **1**
(a) Varies directly with frequency

vi. Heisenberg's uncertainty relation holds good for: **1**
(b) Only microscopic particles

vii. The coordination number for face centred cubic lattice is- **1**
(a) 12

viii. The transition temperature of mercury is- **1**
(c) 4.2 K

ix. Ultrasonic waves are- **1**
(d) Move with the same velocity as sound waves

x. Total energy of the particle executing simple harmonic motion is **1** same at-
(d) All of these

Q.2 i. Spontaneous emission   1 mark   **2**
Stimulated emission   1 mark

ii. Difference b/w step index and graded index optical fibre   **3**
                                               2 marks
Their refractive index profile   1 mark

iii. (a) Numerical aperture   1 mark   **5**
(b) Fractional refractive index change   1 mark
(c) Acceptance angle   1 mark
(d) V-number   1 mark
(e) Approximate number of modes   1 mark

OR iv. Working of Ruby laser   1 mark   **5**
Block diagram   1 mark
Energy level diagram with explanation   2 marks
Active medium, active centre & wavelength   1 mark

Q.3 i. Double refraction   2 marks   **3**
Positive crystal   0.5 mark
Negative crystal   0.5 mark

ii. Fresnel's bi-prism   2 marks   **7**
Diagram required for Fringe width calculation 1 mark
Complete derivation for fringe width   3 marks
Expression for 2d calculation by deviation method 1 mark

OR iii. Diagram   1 mark   **7**
Expression up to the Intensity relation   4 marks
Expression 4.5% of I_o 2 marks

Q.4 i. Phase velocity   1 mark   **2**
Group velocity   1 mark

ii. Correct formula: $\Delta\lambda = (h / mc)(1-\cos\theta)$ 1 mark **3**
Value of λ' for $\theta=45^0$ $\lambda' = 0.1007$ Å 1 mark
Value of λ' for $\theta=180^0$ $\lambda' = 0.1484$ Å. 1 mark

iii. Diagram and correct boundary condition   1 mark   **5**
Derivation up to the wave function determination 2 marks
Derivation of energy Eigen value   1 mark
Determination of constant 'A' by normalization condition 1 mark

OR iv. (a) Heisenberg's uncertainty principle   2.5 marks   **5**
(b) Limitations of classical mechanics   2.5 marks

Q.5 i. Position of Fermi level in intrinsic   1 mark   **2**
Position of Fermi level in extrinsic Semiconductor 1 mark

ii. Determine the intercepts of the face along the crystallographic axes, in terms **3** of unit cell dimensions   1 mark
Take the reciprocals of the coefficients of the intercept 1 mark
Clear fractions   1 mark
Step marking three marks for correct answer

iii. Hall Effect and diagram   2 marks   **5**
Derivation of Hall coefficient   3 marks

OR	iv	Meissner effect and diagram	2 marks	**5**
		Type-I	1.5 marks	
		Type-II super conductor	1.5 marks	

Q.6   Attempt any two:

	i.	Sabine's formula	3 marks	**5**
		Its limitations	2 marks	
	ii.	Production of ultrasonic waves	2.5 marks	**5**
		Detection of ultrasonic waves.	2.5 marks	
	iii.	Expression of total energy of a harmonic oscillator	3 marks	**5**
		Show that it is constant and proportional to the square of the amplitude	2 marks	

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