

# **SRM VALLIAMMAI ENGINEERING COLLEGE**

**(An Autonomous Institution)**  
SRM Nagar, Kattankulathur – 603 203

## **DEPARTMENT OF PHYSICS**

### **QUESTION BANK**



### **I SEMESTER**

### **PH3123 – ENGINEERING PHYSICS**

**Regulation – 2023**

**Academic Year 2026 - 27**

*Prepared by*

**Dr. M. ANBUCHEZHIAN,  
Dr. K. THIRUPPATHI, Dr. R. NITHYA BALAJI,  
Dr. S. GANDHIMATHI, Dr. D. PRAVEENA, Dr. RAMYA RAJAN M.P,  
Dr. S. PADMAJA, Dr.R.RAJKUMAR and Dr.S.GOBALAKRISHNAN**



DEPARTMENT OF PHYSICS  
QUESTION BANK

SUBJECT : PH3123 – ENGINEERING PHYSICS

SEM / YEAR: I SEMESTER / 2026-2027

UNIT I – PROPERTIES OF MATERIALS

Elasticity - Hooke's law - Stress-strain diagram and its uses - Poisson ratio - factors affecting elastic modulus and tensile strength.

Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattice - Miller indices - d-spacing - characteristics of unit cell - SC, BCC, FCC and HCP structure -- thermal and mechanical properties of materials - crystal growth techniques - Czochralski and Bridgmann.

PART – A

| Q.No | Questions                                                              | CO  | BT Level | Competence    |
|------|------------------------------------------------------------------------|-----|----------|---------------|
| 1.   | What do you mean by elasticity?                                        | CO1 | BTL 1    | Remembering   |
| 2.   | Define stress.                                                         | CO1 | BTL 2    | Understanding |
| 3.   | State Hooke's law of elasticity.                                       | CO1 | BTL 1    | Remembering   |
| 4.   | What do you understand by the term elastic limit?                      | CO1 | BTL 1    | Remembering   |
| 5.   | Draw the stress-strain diagrams for brittle and ductile materials.     | CO1 | BTL 2    | Understanding |
| 6.   | What do you infer from stress and strain diagram?                      | CO1 | BTL 2    | Understanding |
| 7.   | What is Poisson's ratio?                                               | CO1 | BTL 1    | Remembering   |
| 8.   | List any two factors that affects the elasticity of a material.        | CO1 | BTL 1    | Remembering   |
| 9.   | What is the effect of temperature on elasticity of a material?         | CO1 | BTL 2    | Understanding |
| 10.  | Give any two mechanical and thermal properties of materials.           | CO1 | BTL 1    | Remembering   |
| 11.  | What are single crystalline materials? Give example.                   | CO1 | BTL 2    | Understanding |
| 12.  | Distinguish crystalline and non-crystalline materials.                 | CO1 | BTL 2    | Understanding |
| 13.  | Define unit cell.                                                      | CO1 | BTL 1    | Remembering   |
| 14.  | Differentiate primitive and non-primitive unit cell.                   | CO1 | BTL 2    | Understanding |
| 15.  | What are Bravais lattices?                                             | CO1 | BTL 1    | Remembering   |
| 16.  | Name the seven types of crystal systems.                               | CO1 | BTL 1    | Remembering   |
| 17.  | Define atomic radius.                                                  | CO1 | BTL 1    | Remembering   |
| 18.  | Define packing factor.                                                 | CO1 | BTL 1    | Remembering   |
| 19.  | Determine the lattice constant for FCC Lead crystal of radius 1.746 Å. | CO1 | BTL 2    | Understanding |
| 20.  | What are Miller Indices?                                               | CO1 | BTL 1    | Remembering   |

|     |                                                                                        |     |       |               |
|-----|----------------------------------------------------------------------------------------|-----|-------|---------------|
| 21. | Sketch the planes for a cubic system with Miller Indices (100) and (111).              | CO1 | BTL 2 | Understanding |
| 22. | Give the definition of inter-planar spacing.                                           | CO1 | BTL 1 | Remembering   |
| 23. | Spacing between (220) planes is found to be is 1.41 Å. Determine the lattice constant. | CO1 | BTL 2 | Understanding |
| 24. | Write any two melt growth techniques for growing crystals.                             | CO1 | BTL 1 | Remembering   |

### PART – B

|     |                                                                                                                                                                                                          |             |            |                |                        |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|----------------|------------------------|
| 1.  | Draw the stress - strain diagram and discuss the behavior of a ductile material under loading. Also mention the uses of stress - strain diagram.                                                         | (16)        | CO1        | BTL 4          | Analyzing              |
| 2.  | Explain the elastic limit, yield point, ultimate strength and breaking point of an elastic material using stress – strain diagram.                                                                       | (16)        | CO1        | BTL 3          | Applying               |
| 3.  | (i) Draw the stress - strain diagram and explain the regions in it.<br>(ii) Explain the factors which affect the elasticity of the material.                                                             | (10)<br>(6) | CO1<br>CO1 | BTL 4<br>BTL 4 | Analyzing<br>Analyzing |
| 4.  | Describe the various types of crystal systems with neat sketches and also give examples.                                                                                                                 | (16)        | CO1        | BTL 4          | Analyzing              |
| 5.  | Calculate the number of atoms per unit cell, atomic radius, co-ordination number and packing factor for SC and BCC structure.                                                                            | (16)        | CO1        | BTL 3          | Applying               |
| 6.  | Derive the packing factor for SC and BCC structure using the atomic radius and co-ordination numbers of the same.                                                                                        | (16)        | CO1        | BTL 3          | Applying               |
| 7.  | (i) Show that FCC is the most closely packed of the three cubic structures by working out the packing factor.<br>(ii) Determine the lattice constant and volume of the FCC unit cell of radius 1.476Å.   | (13)<br>(3) | CO1<br>CO1 | BTL 4<br>BTL 4 | Analyzing<br>Analyzing |
| 8.  | Calculate the number of atoms per unit cell, atomic radius, co-ordination number and packing factor for BCC and FCC structure.                                                                           | (16)        | CO1        | BTL 3          | Applying               |
| 9.  | Describe FCC structure. Derive the details about number of atoms, co-ordination number, atomic radius and packing factor.                                                                                | (16)        | CO1        | BTL 3          | Applying               |
| 10. | (i) Explain the HCP structure.<br>(ii) Show that for an HCP structure $c/a = \sqrt{8} / \sqrt{3}$ and hence calculate packing fraction for HCP structure.                                                | (3)<br>(13) | CO1<br>CO1 | BTL 4<br>BTL 3 | Analyzing<br>Applying  |
| 11. | Describe the structure of HCP crystal. Calculate the c/a ratio, atomic radius, co-ordination number and packing factor for HCP structure.                                                                | (16)        | CO1        | BTL 4          | Analyzing              |
| 12. | Show that the atomic packing factors for FCC and HCP are equal.                                                                                                                                          | (16)        | CO1        | BTL 4          | Analyzing              |
| 13. | (i) Derive the expression for interplanar spacing for (hkl) planes of a cubic structure.<br>(ii) Show that $d_{101} : d_{100} : d_{001} :: \frac{a}{\sqrt{2}} : \frac{a}{\sqrt{1}} : \frac{a}{\sqrt{1}}$ | (12)<br>(4) | CO1<br>CO1 | BTL 4<br>BTL 4 | Analyzing<br>Analyzing |
| 14. | (i) Give the procedure for finding Miller indices of crystal planes.                                                                                                                                     | (4)         | CO1        | BTL 4          | Analyzing              |

|     |                                                                                                                                                  |             |            |                |                        |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|----------------|------------------------|
|     | (ii) Deduce the relation between inter-planar spacing and Miller indices of a cubic structure.                                                   | (12)        | CO1        | BTL 4          | Analyzing              |
| 15. | (i) Write the significance of Miller indices.<br>(ii) Derive the expression for inter planar spacing 'd' between (hkl) planes of a cubic system. | (3)<br>(13) | CO1<br>CO1 | BTL 4<br>BTL 4 | Applying               |
| 16. | Discuss the various melt growth techniques of growing the crystals.                                                                              | (16)        | CO1        | BTL 3          | Applying               |
| 17. | With neat diagrams, explain<br>(i) Bridgman technique<br>(ii) Czochralski's technique of growing crystals.                                       | (8)<br>(8)  | CO1<br>CO1 | BTL 4<br>BTL 4 | Analyzing<br>Analyzing |

## UNIT II – ULTRASONICS

Introduction - Properties - Production: Magnetostriction method and Piezoelectric method - Acoustical grating - determination of ultrasonic velocity in liquid - Application: Detection of flaw in materials (Non Destructive Testing) - ultrasonic soldering, welding - SONAR - diagnostic sonography - cars' air bag sensor - dispersion of fog - Probe sonication for 2D material formation.

### PART – A

| Q.N<br>O | Questions                                                                                                                                                                                                                                                      | CO  | BT<br>Level | Competence    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------------|
| 1.       | Classify sound waves on the basis of frequency.                                                                                                                                                                                                                | CO2 | BTL 1       | Remembering   |
| 2.       | What is meant by ultrasonic waves?                                                                                                                                                                                                                             | CO2 | BTL 1       | Remembering   |
| 3.       | List the properties of ultrasonic waves.                                                                                                                                                                                                                       | CO2 | BTL 1       | Remembering   |
| 4.       | Give reasons why ultrasonic waves cannot be generated using a loudspeaker.                                                                                                                                                                                     | CO2 | BTL 2       | Understanding |
| 5.       | State the different methods used for the production of ultrasonic waves.                                                                                                                                                                                       | CO2 | BTL 2       | Understanding |
| 6.       | Define the magnetostriction effect.                                                                                                                                                                                                                            | CO2 | BTL 2       | Understanding |
| 7.       | Calculate the natural frequency of 40 mm length of a pure iron rod used in magnetostriction oscillator. Given that the density of pure iron is $7.25 \times 10^3 \text{ kg m}^{-3}$ and its Young's modulus is $115 \times 10^9 \text{ Nm}^{-2}$               | CO2 | BTL 2       | Understanding |
| 8.       | Enumerate the advantages of a magnetostriction oscillator.                                                                                                                                                                                                     | CO2 | BTL 2       | Understanding |
| 9.       | A nickel crystal of length 10 cm with density $8.1 \times 10^3 \text{ kg/m}^3$ and Young's modulus is $8.2 \times 10^{11} \text{ Nm}^{-2}$ is used in a magnetostriction oscillator. Determine the frequency of the ultrasonic waves generated.                | CO2 | BTL 1       | Remembering   |
| 10.      | Define piezoelectric effect.                                                                                                                                                                                                                                   | CO2 | BTL 2       | Understanding |
| 11.      | What is meant by inverse piezoelectric effect?                                                                                                                                                                                                                 | CO2 | BTL 2       | Understanding |
| 12.      | Write any two advantages of a piezoelectric oscillator.                                                                                                                                                                                                        | CO2 | BTL 2       | Understanding |
| 13.      | A quartz crystal of thickness $2 \times 10^{-3} \text{ m}$ is vibrating at resonance. Calculate fundamental frequency. Assume Young's modulus of the quartz as $8.69 \times 10^{10} \text{ Nm}^{-2}$ and its density as $2.65 \times 10^3 \text{ kg m}^{-3}$ . | CO2 | BTL 2       | Understanding |
| 14.      | Calculate the fundamental frequency of quartz crystal of thickness 1.5 mm which is vibrating at resonance. Given Young's modulus of the quartz as $7.9 \times 10^{10} \text{ Nm}^{-2}$ and its density as $2650 \text{ kg m}^{-3}$ .                           | CO2 | BTL 2       | Understanding |
| 15.      | Give reasons why ultrasonic frequencies exceeding 3 MHz cannot be generated by the magnetostriction method.                                                                                                                                                    | CO2 | BTL 2       | Understanding |

|     |                                                                                                                                                                                                                        |     |       |               |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|---------------|
| 16. | What is an acoustical grating?                                                                                                                                                                                         | CO2 | BTL 1 | Remembering   |
| 17. | Calculate the velocity of ultrasonic waves in a liquid in an acoustic grating experiment using the following data. Wavelength 600 nm, frequency of ultrasonic wave 100 MHz and angle of first order diffraction is 5°. | CO2 | BTL 2 | Understanding |
| 18. | What is meant by SONAR?                                                                                                                                                                                                | CO2 | BTL 1 | Remembering   |
| 19. | What is the principle of an ultrasonic flaw detector?                                                                                                                                                                  | CO2 | BTL 1 | Remembering   |
| 20. | State the principle of sonogram.                                                                                                                                                                                       | CO2 | BTL 1 | Remembering   |
| 21. | Mention how ultrasonic waves help in the dispersion of fog.                                                                                                                                                            | CO2 | BTL 1 | Remembering   |
| 22. | Give any two applications of ultrasonic waves in industry.                                                                                                                                                             | CO2 | BTL 1 | Remembering   |
| 23. | Write a short note on Non-Destructive Testing (NDT).                                                                                                                                                                   | CO2 | BTL 2 | Understanding |
| 24. | Name any two uses of ultrasonic waves.                                                                                                                                                                                 | CO2 | BTL 1 | Remembering   |

### PART – B

|     |                                                                                                                                                                     |             |            |                |                      |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|----------------|----------------------|
| 1.  | Describe the construction and working of magnetostriction oscillator. Write its advantages and disadvantages.                                                       | (16)        | CO2        | BTL 4          | Analyzing            |
| 2.  | (i) Explain how ultrasonic waves are produced using magnetostriction oscillator.<br>(ii) Enumerate the advantages and disadvantages of magnetostriction oscillator. | (12)<br>(4) | CO2        | BTL 3          | Applying             |
| 3.  | How are ultrasonic waves produced using a magnetostriction oscillator? Explain with a neat diagram.                                                                 | (16)        | CO2        | BTL 3          | Applying             |
| 4.  | What is the principle of magnetostriction? Explain how it is used to generate high-frequency sound waves.                                                           | (16)        | CO2        | BTL 3          | Applying             |
| 5.  | Draw the circuit diagram of piezoelectric oscillator and explain the production of ultrasonic waves using it.                                                       | (16)        | CO2        | BTL 4          | Analyzing            |
| 6.  | (i) With a neat sketch, explain how ultrasonic waves are produced using a piezoelectric oscillator.<br>(ii) State its merits and demerits.                          | (12)<br>(4) | CO2        | BTL 4          | Analyzing            |
| 7.  | (i) What is meant by the inverse piezoelectric effect?<br>(ii) Explain the construction and working of a piezoelectric oscillator for generating ultrasonic waves.  | (3)<br>(13) | CO2<br>CO2 | BTL 3<br>BTL 3 | Applying<br>Applying |
| 8.  | Describe how the velocity of ultrasonic waves is determined using the acoustic grating method.                                                                      | (16)        | CO2        | BTL 4          | Analyzing            |
| 9.  | With a neat diagram, explain how an acoustic grating is used to measure the velocity of ultrasonic waves in a liquid.                                               | (16)        | CO2        | BTL 3          | Applying             |
| 10. | How is the velocity of ultrasonic waves determined using an acoustic grating? Explain.                                                                              | (16)        | CO2        | BTL 3          | Applying             |
| 11. | Describe how the pulse echo method is used to detect and characterize flaws, with a neat sketch.                                                                    | (16)        | CO2        | BTL 3          | Applying             |
| 12. | (i) Draw and explain the block diagram of an ultrasonic flaw detector.<br>(ii) Write short notes on ultrasonics welding and soldering.                              | (8)<br>(8)  | CO2        | BTL 3          | Applying             |
| 13. | Enumerate the engineering applications of ultrasonics.                                                                                                              | (16)        | CO2        | BTL 4          | Analyzing            |
| 14. | Discuss the principle and working of SONAR using ultrasonic pulse                                                                                                   | (16)        | CO2        | BTL 4          | Analyzing            |

|     |                                                                                                      |      |     |       |           |
|-----|------------------------------------------------------------------------------------------------------|------|-----|-------|-----------|
|     | techniques.                                                                                          |      |     |       |           |
| 15. | With a neat diagram, explain how SONAR locates objects and enumerate its advantages.                 | (16) | CO2 | BTL 3 | Applying  |
| 16. | Describe the construction and working of a sonogram with a neat block diagram.                       | (16) | CO2 | BTL 4 | Analyzing |
| 17. | Explain the probe sonication method used for the preparation of 2D materials using ultrasonic waves. | (16) | CO2 | BTL 3 | Applying  |

### UNIT III -LASER AND ITS APPLICATIONS

Basic concepts and characteristics - Einstein's A and B coefficients (derivation) - population inversion - Pumping methods - Nd-YAG laser - CO<sub>2</sub> laser - Semiconductor lasers: homo junction and heterojunction - applications: laser welding, laser cutting, laser cooling, pattern formation by laser etching, laser bar code scanner - LIDAR - Laser tissue interaction, laser surgery - Holography - NLO - electro-optic effect.

#### PART – A

| Q.No | Questions                                                                                           | CO  | BT Level | Competence    |
|------|-----------------------------------------------------------------------------------------------------|-----|----------|---------------|
| 1.   | What does the acronym LASER stands for?                                                             | CO3 | BTL 1    | Remembering   |
| 2.   | Name the four characteristics of a laser beam.                                                      | CO3 | BTL 1    | Remembering   |
| 3.   | What distinguishes laser light from ordinary light?                                                 | CO3 | BTL 2    | Understanding |
| 4.   | Mention the conditions required for laser action.                                                   | CO3 | BTL 2    | Understanding |
| 5.   | What is meant by population inversion?                                                              | CO3 | BTL 1    | Remembering   |
| 6.   | Differentiate spontaneous and stimulated emission.                                                  | CO3 | BTL 2    | Understanding |
| 7.   | List the components of Laser.                                                                       | CO3 | BTL 1    | Remembering   |
| 8.   | Define the term active center.                                                                      | CO3 | BTL 1    | Remembering   |
| 9.   | Define the term active medium.                                                                      | CO3 | BTL 1    | Remembering   |
| 10.  | What is meant by pumping action in Laser?                                                           | CO3 | BTL 2    | Understanding |
| 11.  | Name any two pumping methods in Laser.                                                              | CO3 | BTL 1    | Remembering   |
| 12.  | What is optical pumping?                                                                            | CO3 | BTL 1    | Remembering   |
| 13.  | Highlight the role of resonator in Laser.                                                           | CO3 | BTL 2    | Understanding |
| 14.  | List the different modes of vibration of CO <sub>2</sub> laser.                                     | CO3 | BTL 1    | Remembering   |
| 15.  | Differentiate homojunction and heterojunction lasers.                                               | CO3 | BTL 2    | Understanding |
| 16.  | Calculate the wavelength of the emission from GaAs semiconductor laser whose band energy is 2.8 eV. | CO3 | BTL 2    | Understanding |
| 17.  | Write any two industrial applications of lasers.                                                    | CO3 | BTL 2    | Understanding |
| 18.  | Mention any two medical applications of laser.                                                      | CO3 | BTL 2    | Understanding |
| 19.  | What is LIDAR?                                                                                      | CO3 | BTL 1    | Remembering   |
| 20.  | What is holography?                                                                                 | CO3 | BTL 1    | Remembering   |

|     |                                                 |     |       |               |
|-----|-------------------------------------------------|-----|-------|---------------|
| 21. | Distinguish between photography and holography. | CO3 | BTL 2 | Understanding |
| 22. | Give any two applications of hologram.          | CO3 | BTL 2 | Understanding |
| 23. | What is Nonlinear optics?                       | CO3 | BTL 1 | Remembering   |
| 24. | Define electro-optic effect.                    | CO3 | BTL 1 | Remembering   |

### PART – B

|     |                                                                                                                                                                                  |      |     |       |           |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|-------|-----------|
| 1.  | For atomic transitions, derive Einstein relations and hence deduce the expression for the ratio of spontaneous emission to stimulated emission.                                  | (16) | CO3 | BTL 3 | Applying  |
| 2.  | (i) Specify three types of possible energy transitions between two atomic energy levels<br>(ii) Derive an expression for Einstein's coefficients.                                | (4)  | CO3 | BTL 3 | Applying  |
|     |                                                                                                                                                                                  | (12) | CO3 | BTL 3 | Applying  |
| 3.  | Derive the Einstein's relation for stimulated emission to explain the existence of stimulated emission.                                                                          | (16) | CO3 | BTL 3 | Applying  |
| 4.  | Using the correct expressions, derive the relation between Einstein's coefficient of spontaneous and stimulated emissions.                                                       | (16) | CO3 | BTL 4 | Analyzing |
| 5.  | Outline the principle, construction and working of Nd-YAG laser.                                                                                                                 | (16) | CO3 | BTL 3 | Applying  |
| 6.  | With the help of an energy diagram, illustrate the construction and working of a four-level solid-state laser, where the $\text{Nd}^{3+}$ ions act as the active centers.        | (16) | CO3 | BTL 3 | Applying  |
| 7.  | (i) Draw energy level diagram of Nd:YAG laser.<br>(ii) Explain the construction and working of Nd:YAG laser. Mention its applications.                                           | (3)  | CO3 | BTL 3 | Applying  |
|     |                                                                                                                                                                                  | (13) | CO3 | BTL 3 | Applying  |
| 8.  | With the help of suitable diagrams, explain the principle, construction and working of a carbon dioxide laser.                                                                   | (16) | CO3 | BTL 3 | Applying  |
| 9.  | Explain in detail the principle, construction and working of a molecular gas laser.                                                                                              | (16) | CO3 | BTL 3 | Applying  |
| 10. | With a neat sketch, describe the principle, construction and working of $\text{CO}_2$ lasers.                                                                                    | (16) | CO3 | BTL 4 | Analyzing |
| 11. | (i) Explain the principle, construction and working of any one type of semiconductor diode laser.<br>(ii) Mention the advantages and disadvantages of semiconductor diode laser. | (13) | CO3 | BTL 4 | Analyzing |
|     |                                                                                                                                                                                  | (3)  | CO3 | BTL 3 | Applying  |
| 12. | Elucidate homo junction and hetero junction semiconductor lasers with neat diagrams.                                                                                             | (16) | CO3 | BTL 4 | Analyzing |
| 13. | Describe the principle, construction and working of LIDAR system.                                                                                                                | (16) | CO3 | BTL 4 | Analyzing |
| 14. | Discuss the applications of Lasers in industry and medical field.                                                                                                                | (16) | CO3 | BTL 3 | Applying  |
| 15. | With neat diagram discuss how a hologram is recorded and reconstructed using laser as a coherent beam.                                                                           | (16) | CO3 | BTL 4 | Analyzing |
| 16. | Describe the construction and reconstruction of a hologram with suitable diagrams.                                                                                               | (16) | CO3 | BTL 3 | Applying  |
| 17. | (i) Explain the construction of hologram using laser source<br>(ii) Explain the reconstruction of hologram using laser source.                                                   | (8)  | CO3 | BTL 4 | Analyzing |
|     |                                                                                                                                                                                  | (8)  | CO3 | BTL 4 | Analyzing |

## UNIT IV - FIBRE OPTICS

Structure and principle - Propagation of light through optical fibre - acceptance angle, numerical aperture - fractional index change - Types of optical fibres (material, mode and refractive index) - Attenuation: absorption, scattering and bending - Dispersion - Fibre optic communication system (Block diagram) and advantages over conventional methods - fibre optic sensors: pressure and displacement- Endoscope.

### PART – A

| Q.No | Questions                                                                                                                                  | CO  | BT Level | Competence    |
|------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|---------------|
| 1.   | What is an optical fiber?                                                                                                                  | CO4 | BTL 1    | Remembering   |
| 2.   | Draw a schematic layout of optical fiber.                                                                                                  | CO4 | BTL 2    | Understanding |
| 3.   | What is the basic principle of guiding light through an optical fiber?                                                                     | CO4 | BTL 2    | Understanding |
| 4.   | What is meant by total internal reflection?                                                                                                | CO4 | BTL 1    | Remembering   |
| 5.   | List out the conditions of total internal reflection.                                                                                      | CO4 | BTL 2    | Understanding |
| 6.   | Express Snell's law mathematically.                                                                                                        | CO4 | BTL 1    | Remembering   |
| 7.   | How would you define the acceptance angle of an optical fiber?                                                                             | CO4 | BTL 1    | Remembering   |
| 8.   | Define numerical aperture.                                                                                                                 | CO4 | BTL 2    | Understanding |
| 9.   | What is the role of core in an optical fiber?                                                                                              | CO4 | BTL 2    | Understanding |
| 10.  | What is meant by fractional index change?                                                                                                  | CO4 | BTL 2    | Understanding |
| 11.  | Classify the optical fiber type based on the material.                                                                                     | CO4 | BTL 2    | Understanding |
| 12.  | Mention any two difference between single mode and multimode fibers.                                                                       | CO4 | BTL 1    | Remembering   |
| 13.  | What is the importance of graded index fiber?                                                                                              | CO4 | BTL 2    | Understanding |
| 14.  | Calculate the refractive index of core from the following data. The Numerical aperture is 0.027 and relative refractive index is 0.015.    | CO4 | BTL 2    | Understanding |
| 15.  | Calculate the numerical aperture and acceptance angle of a fiber with a core index of 1.54 and cladding 1.50.                              | CO4 | BTL 2    | Understanding |
| 16.  | Enumerate any two uses of optical fibers.                                                                                                  | CO4 | BTL 1    | Remembering   |
| 17.  | What is meant by attenuation?                                                                                                              | CO4 | BTL 1    | Remembering   |
| 18.  | A light signal of 100 mW is injected into a fibre of length 1 km. The outgoing signal from the other end is 40 mW. What is the loss in dB? | CO4 | BTL 2    | Understanding |
| 19.  | Mention the different attenuation mechanisms in optical fibers.                                                                            | CO4 | BTL 2    | Understanding |
| 20.  | What is intermodal dispersion?                                                                                                             | CO4 | BTL 1    | Remembering   |
| 21.  | Differentiate between active and passive fiber optic sensors.                                                                              | CO4 | BTL 1    | Remembering   |
| 22.  | Write any two merits of fiber optic communication over radio wave communication.                                                           | CO4 | BTL 2    | Understanding |
| 23.  | How would you define an endoscope?                                                                                                         | CO4 | BTL 1    | Remembering   |
| 24.  | Give any two medical applications of fiber optic endoscopy.                                                                                | CO4 | BTL 2    | Understanding |

| PART – B |                                                                                                                                                                                                                                          |             |            |              |                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|--------------|------------------------|
| 1.       | Explain the principle and propagation of light through optical fibre. Derive an expression for acceptance angle and numerical aperture of an optical fibre.                                                                              | (16)        | CO4        | BTL4         | Analyzing              |
| 2.       | (i) Derive the expression $\sin \theta_0 = \sqrt{n_1^2 - n_2^2}$<br>(ii) A silica optical fiber has a core refractive index of 1.51 and a cladding refractive index of 1.48. Determine the critical angle at the core-cladding interface | (13)<br>(3) | CO4<br>CO4 | BTL4<br>BTL4 | Analyzing<br>Analyzing |
| 3.       | Deduce an expression for the numerical aperture and acceptance angle of optical fiber in terms of refractive index of the core and cladding.                                                                                             | (16)        | CO4        | BTL3         | Applying               |
| 4.       | Derive an equation relating the numerical aperture and acceptance angle of optical fiber in terms of refractive index of the core and cladding.                                                                                          | (16)        | CO4        | BTL3         | Applying               |
| 5.       | (i) Explain the phenomenon of total internal reflection using a suitable diagram.<br>(ii) Derive an expression for acceptance angle in terms of numerical aperture.                                                                      | (4)<br>(12) | CO4<br>CO4 | BTL3<br>BTL3 | Applying<br>Applying   |
| 6.       | Classify fibers based on material, modes of propagation and index profile.                                                                                                                                                               | (16)        | CO4        | BTL4         | Analyzing              |
| 7.       | Give a detailed classification of the optical fiber-based on material, mode and refractive index.                                                                                                                                        | (16)        | CO4        | BTL4         | Analyzing              |
| 8.       | Explain in detail the losses in optical fiber with a basic attenuation mechanism.                                                                                                                                                        | (16)        | CO4        | BTL3         | Applying               |
| 9.       | List and summarize the various losses in using optical fiber.                                                                                                                                                                            | (16)        | CO4        | BTL4         | Analyzing              |
| 10.      | (i) Discuss the Scattering, Bending and Absorption loss in optical fibers.<br>(ii) The optical power after propagating through a fiber of 1.5 km length is reduced to 25% of its original value. Compute the fiber loss in dB/km.        | (13)<br>(3) | CO4<br>CO4 | BTL4<br>BTL4 | Analyzing<br>Analyzing |
| 11.      | Describe the fibre optic communication with neat block diagram and discuss its advantages.                                                                                                                                               | (16)        | CO4        | BTL4         | Analyzing              |
| 12.      | (i) Discuss optical fibre based communication system.<br>(ii) What are the advantages of fiber optics in communication over conventional communication system?                                                                           | (12)<br>(4) | CO4<br>CO4 | BTL4<br>BTL4 | Analyzing<br>Analyzing |
| 13.      | With a neat sketch, discuss the transmission and reception of information signals and their propagation in a Fiber communication system.                                                                                                 | (16)        | CO4        | BTL4         | Analyzing              |
| 14.      | Describe the pressure and the displacement sensors with neat diagrams.                                                                                                                                                                   | (16)        | CO4        | BTL4         | Analyzing              |
| 15.      | Explain the construction and working<br>(i) pressure sensor.<br>(ii) displacement sensor.                                                                                                                                                | (8)<br>(8)  | CO4<br>CO4 | BTL4<br>BTL4 | Analyzing<br>Analyzing |
| 16.      | List the different types of fiber optic sensors. Explain the working of any two sensors.                                                                                                                                                 | (16)        | CO4        | BTL4         | Analyzing              |

|     |                                                                             |      |     |      |           |
|-----|-----------------------------------------------------------------------------|------|-----|------|-----------|
| 17. | Describe the working of a fiber optic medical endoscope with a neat sketch. | (16) | CO4 | BTL4 | Analyzing |
|-----|-----------------------------------------------------------------------------|------|-----|------|-----------|

## UNIT V - QUANTUM PHYSICS

Black body radiation and energy distribution spectrum - Planck's theory of radiation - matter waves - de- Broglie wavelength in terms of energy, voltage and temperature - Electron diffraction - G.P.Thomson experiment - wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - Particle in a one-dimensional box- Normalization of wave function - Quantum Tunnelling - Scanning Tunnelling Microscope.

### PART – A

| Q.No | Questions                                                                                                              | CO  | BT Level | Competence    |
|------|------------------------------------------------------------------------------------------------------------------------|-----|----------|---------------|
| 1.   | State the meaning of black body radiation.                                                                             | CO5 | BTL 1    | Remembering   |
| 2.   | List any two characteristics of the black body radiation spectrum.                                                     | CO5 | BTL 1    | Remembering   |
| 3.   | State Planck's law of radiation.                                                                                       | CO5 | BTL 1    | Remembering   |
| 4.   | Write any two postulates of Planck's quantum theory of black body radiation.                                           | CO5 | BTL 2    | Understanding |
| 5.   | What is meant by de Broglie wavelength?                                                                                | CO5 | BTL 1    | Remembering   |
| 6.   | Enumerate the properties of matter waves.                                                                              | CO5 | BTL 1    | Remembering   |
| 7.   | How would you define the dual nature of matter?                                                                        | CO5 | BTL 2    | Understanding |
| 8.   | Write de-Broglie wavelength in terms of temperature and explain the terms in it.                                       | CO5 | BTL 2    | Understanding |
| 9.   | Consider a stone of mass 0.1 kg moving at a speed of 1 m/s. Calculate its de-Broglie wavelength.                       | CO5 | BTL 2    | Understanding |
| 10.  | Calculate the de-Broglie wavelength of the orbital electron of hydrogen atom given that its energy is 13.6 eV.         | CO5 | BTL 2    | Understanding |
| 11.  | An electron is accelerated by a potential difference of 150 V. Calculate the wavelength of that electron wave.         | CO5 | BTL 2    | Understanding |
| 12.  | What do you understand by the term wave function?                                                                      | CO5 | BTL 1    | Remembering   |
| 13.  | What is the physical significance of a wave function?                                                                  | CO5 | BTL 2    | Understanding |
| 14.  | Write the condition for finding a particle in a particular region.                                                     | CO5 | BTL 2    | Understanding |
| 15.  | List any two applications of the Schrodinger wave equation.                                                            | CO5 | BTL 1    | Remembering   |
| 16.  | The ground state energy cannot be zero for a free particle moving within a one-dimensional potential box. Justify.     | CO5 | BTL 2    | Understanding |
| 17.  | Mention the condition for normalization of the wave function.                                                          | CO5 | BTL 2    | Understanding |
| 18.  | What are Eigen values and Eigen functions?                                                                             | CO5 | BTL 2    | Understanding |
| 19.  | Calculate the minimum energy of the particle moving in one dimension in an infinitely high potential box of width 1 Å. | CO5 | BTL 2    | Understanding |
| 20.  | Evaluate the energy of a particle of mass 10 g confined in a box of width 10 cm for the first excited state.           | CO5 | BTL 2    | Understanding |
| 21.  | Write the expression for Eigen energy and wave function for a particle in a one-dimensional potential box.             | CO5 | BTL 1    | Remembering   |
| 22.  | What is meant by quantum tunneling?                                                                                    | CO5 | BTL 1    | Remembering   |

|     |                                                            |     |       |             |
|-----|------------------------------------------------------------|-----|-------|-------------|
| 23. | Write the principle of scanning tunneling microscope.      | CO5 | BTL 1 | Remembering |
| 24. | Give any two applications of quantum tunneling microscope. | CO5 | BTL 1 | Remembering |

| PART – B |                                                                                                                                                                                           |                   |                   |                      |                                  |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|----------------------|----------------------------------|
| 1.       | (i) Write the hypothesis of Planck's quantum theory of radiation.<br>(ii) Derive an equation for energy density of Planck's radiation law.                                                | (3)<br>(13)       | CO5<br>CO5        | BTL4<br>BTL4         | Analyzing<br>Analyzing           |
| 2.       | Derive an equation for Planck's quantum theory of black body radiation based on the quantum concepts.                                                                                     | (16)              | CO5               | BTL3                 | Applying                         |
| 3.       | Write the Planck's hypothesis. Derive Planck's formula for the distribution of energy in black body radiation.                                                                            | (16)              | CO5               | BTL3                 | Applying                         |
| 4.       | Explain the concept of wave particle duality and obtain an expression for wavelength of matter waves in terms energy, voltage and temperature.                                            | (16)              | CO5               | BTL4                 | Analyzing                        |
| 5.       | (i) Derive an equation for de-Broglie's wavelength in terms of energy<br>(ii) Describe the experiment that supports the existence of matter waves.                                        | (6)<br>(10)       | CO5<br>CO5        | BTL4<br>BTL 4        | Analyzing<br>Analyzing           |
| 6.       | (i) Derive an expression for the wavelength of matter waves.<br>(ii) Explain the experimental setup and observations of the G.P. Thomson experiment proving the wave nature of electrons. | (6)<br>(10)       | CO5<br>CO5        | BTL3<br>BTL4         | Applying<br>Analyzing            |
| 7.       | Derive an expression for the de-Broglie wavelength of matter waves in terms of<br>(i) Energy<br>(ii) Voltage<br>(iii) Temperature                                                         | (6)<br>(5)<br>(5) | CO5<br>CO5<br>CO5 | BTL3<br>BTL3<br>BTL3 | Applying<br>Applying<br>Applying |
| 8.       | Deduce an expression for de-Broglie wavelength in terms of velocity, temperature and energy.                                                                                              | (16)              | CO5               | BTL3                 | Applying                         |
| 9.       | (i) Write the physical significance of wave function.<br>(ii) Derive an expression for Schrodinger's time-dependent wave equation.                                                        | (4)<br>(12)       | CO5<br>CO5        | BTL3<br>BTL4         | Applying<br>Analyzing            |
| 10.      | Starting with the classical wave equation associated with moving particles; formulate the Schrodinger's time-independent wave equation.                                                   | (16)              | CO5               | BTL4                 | Analyzing                        |
| 11.      | Derive an expression for Schrodinger's time-independent wave equation.                                                                                                                    | (16)              | CO5               | BTL4                 | Analyzing                        |
| 12.      | Obtain time-dependent Schrodinger's wave equation for a free particle of mass m and energy E.                                                                                             | (16)              | CO5               | BTL4                 | Analyzing                        |
| 13.      | Derive an expression for Schrodinger's time-dependent wave equation.                                                                                                                      | (16)              | CO5               | BTL4                 | Analyzing                        |
| 14.      | Solve time-independent Schrodinger's wave equation for a particle trapped in a potential well and obtain Eigen functions and Eigen values for the particle.                               | (16)              | CO5               | BTL3                 | Applying                         |
| 15.      | Using Schrodinger's wave equation, deduce an expression for the wave function and energy of the particle confined in a one-dimensional potential box.                                     | (16)              | CO5               | BTL3                 | Applying                         |
| 16.      | Draw a neat diagram of scanning tunneling electron microscope and also explain the principle, construction and working of scanning tunneling electron microscope.                         | (13)              | CO5               | BTL 3                | Applying                         |

|     |                                                                                                             |      |     |      |          |
|-----|-------------------------------------------------------------------------------------------------------------|------|-----|------|----------|
| 17. | Discuss with neat diagram the working of scanning tunneling electron microscope and write its applications. | (16) | CO5 | BTL3 | Applying |
|-----|-------------------------------------------------------------------------------------------------------------|------|-----|------|----------|

