(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2024-2025 ONLY) **SUBJECT CODE 24 PPS 3E5** **REG.NO. :**

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS : NOVEMBER – 2025
M.Sc. – PHYSICS **MAXIMUM MARKS: 75**
SEMESTER : III **TIME : 3 HOURS**

THIN FILM AND NANO SCIENCE

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS. (K1)

1. Which of the following statements best describes the nature of a thin film?
   a) A thick metallic coating applied for protection
   b) A two-dimensional layer of material with nanometer to micrometer thickness
   c) A bulk material used in structural applications
   d) A layer with thickness greater than 1 mm used in thermal insulation
2. Which of the following combinations of optical phenomena are directly used to determine the energy band gap of a thin film material?
   a) Reflection and Transmission only b) Absorption and Reflection only
   c) Absorption and Transmission d) Transmission and Refraction
3. Which of the following statements best integrate Moore's law, nanostructure classification, and quantum confinement effects?
   a) Moore's law predicts unlimited growth of chip size with 3D nanostructures.
   b) D nanostructures such as quantum dots exhibit quantum confinement in all dimensions, affecting electronic properties.
   c) 2D nanostructures do not show any confinement effect and are used to slow down Moore's law.
   d) Quantum confinement is not related to the classification of nanostructures and has no effect on device performance.
4. XRD is primarily used to……
   (a) Measure electrical conductivity (b) Study thermal properties of materials
   (c) Determine crystal structure of materials (d) Observe biological cells under a microscope
5. MEMS stands for…….
   (a) Micro-Energy Management System (b) Micro-Electrical Monitoring System
   (c) Micro-Electro-Mechanical Systems (d) Miniature-Electronic Measurement Systems

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. (K2)

6. Give one significance of epitaxy method to prepared thin film.
7. Write the significance of the band gap in thin film.
8. Give Moore's equation.
9. Write a short note on LASER induced evaporation.
10. Abbreviate MEMS.

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) Explain how the concepts of surface energy and free energy change are involved in the thermodynamics of nucleation.

(OR)

b) How do deposition parameters affect the grain size and microstructure during thin film growth? Explain with suitable examples.

(CONTD …. 2)

12. a) Explain how doping concentration and temperature affect the conductivity and resistivity of a semiconductor thin film. How would you experimentally determine these properties for a given sample?

(OR)

b) Discuss the optical properties of thin film following (i) Absorption (ii) Energy band gap.

13. a) Classify nanostructures based on their dimensionality (0D, 1D, 2D, and 3D) and give one example for each type.

(OR)

b) Describe the structure and typical properties of carbon nanoclusters. How do these properties vary with cluster size, and what applications benefit from these variations?

14. a) Explain the steps involved in the sol-gel process and how process parameters like pH, temperature, and precursor concentration affect the properties of the final gel and derived materials.

(OR)

b) Describe how a material's surface morphology is examined using SEM.

15. a) Discuss the role of material to improving sensor performance of pollutant.

(OR)

b) Discuss the uses of nanomaterials in therapeutics.

SECTION – C (5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K4 (Or) K5)

16. a) Analyze the role of complexing agents and bath temperature in controlling the film thickness and uniformity during Chemical Bath Deposition. How do these factors influence the nucleation and growth mechanisms?

(OR)

b) Examine the effects of substrate orientation, vacuum level, and source material selection on the adhesion, quality, and homogeneity of thin films made by thermal evaporation.

17. a) Explain how magnetoresistance measurements complement Hall effect studies in characterizing materials.

(OR)

b) Analyze how the interference fringes formed due to a thin film can be used to accurately measure film thickness. Discuss the factors that affect fringe visibility and spacing, and how these can be interpreted to evaluate the uniformity of the film.

18. a) Analyze how the structural variations in carbon nanotubes influence their electrical, mechanical, and thermal properties. Discuss the implications of these variations for different applications.

(OR)

b) Examine the effects on the material's thermal and structural characteristics of shrinking its dimensions to the nanoscale. Describe the causes of the differences in thermal conductivity, the change in lattice parameters, and the increasing surface-to-volume ratio.

19. a) Investigate how the ball milling parameters, such as milling time, speed, and ball-to powder ratio, affect material phase transformation and particle size reduction. Discuss the basic steps that are involved in the milling process.

(OR)

b) How can XRD be used to determine the crystal structure, phase identification, and grain size of a material? Explain the basic principles and the significance of peak positions and intensities in an XRD pattern.

20. a) Examine how a material's nanoscale characteristics impact its photocatalytic performance.

(OR)

b) Describe the operation of supramolecular and molecular switches in nanomachines.

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