

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Foundations in Material synthesis and characterization

Program: M Sc Physics

Course Code: PHYS8024P

Semester: 3

Time : 03 hrs.

Max. Marks: 100

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Differentiate between top-down and bottom-up approaches of nanomaterial synthesis, with examples.	4	CO1
Q 2	What are the fundamental differences between SEM & AFM in context of material characterization?	4	CO3,4
Q 3	Define Sintering, calcination, and annealing processes.	4	CO2
Q 4	What is fundamental difference between SPECTROSCOPY and DIFFRACTION?	4	CO3,4
Q 5	Explain the resolution limit of a microscope. Which aberrations do you know?	4	CO3

SECTION B
(4Qx10M= 40 Marks)

Q 6	a) How can we find lattice parameters with X-ray diffraction? b) What is the difference between XRD patterns of amorphous and crystalline material?	10	CO4
Q 7	Explain the principal and methodology adopted for Raman spectroscopy characterization?	10	CO4
Q 8	a) Define the principle of the physical vapor deposition technique. b) Elaborate plasma sputtering and e-beam sputtering techniques with diagrams.	10	CO2
Q 9	Explain in detail, the condition of clusters (embryos) and nucleation mechanism. Elaborate on size condition of particle for growth. How critical radius depends on ΔG & ΔT . OR a) Explain thermal evaporation technique for thin film deposition.	10	CO1 OR CO2

	b) Point out the differences between the thermal evaporation technique and the PLD technique.		
SECTION-C (2Qx20M=40 Marks)			
Q 10	a) Draw the interaction volume and show the various signals coming out from the interaction volume during electron-specimen interaction in a scanning electron microscope. b) Explain the sample preparation process in SEM.	20	CO3
Q 11	In Atomic Force Microscopy: a) Draw and explain the schematic for the three different modes of operation in the force-displacement curve in AFM b) What are the main differences between AFM and STM? c) Explain the constant force and constant height modes. OR In context of X-ray Diffraction, a) Write the Bragg's law (equation), and describe all contained terms. b) What does that equation express and what you can calculate with the equation? c) What causes the broadening of the Bragg peaks in a diffraction pattern?	20	CO4 OR CO4