

Sc. (Part - II) (Semester - III) (CBCS) Examination, January - 2023

ANALYTICAL CHEMISTRY (Paper - IX)

ACH 3.1 : Advanced Analytical Techniques (New)

Sub. Code : 80489/85284

Day and Date : Thursday, 05 - 01 - 2023

Total Marks : 80

Time : 02.30 p.m. to 05.30 p.m.

- Instructions:
- 1) Attempt in all the five questions. All questions carry equal marks.
 - 2) Question No. 1 is compulsory.
 - 3) Attempt any two questions from section - I and any two from Section - II.
 - 4) Answers to all questions from should be written in one answer book.
 - 5) Figures to the right indicate full marks.

I) Answer the following questions. [16]

- a) Mass spectra can be obtained in _____ and _____ mode.
- b) Diamond and graphene are allotropes of carbon and their hybridization is _____ and _____ respectively.
- c) What are Quantum dots?
- d) Scanning electron microscopy produces _____ images.
- e) The kinetic energy of the photoelectron energies is dependent on _____ of the atom, which makes XPS useful to identify the oxide state.
- f) What is topdown approach for synthesis of nanomaterial?
- g) What is the source used in Raman spectroscopy?
- h) How are ions separated in mass spectrometry?
- i) Compare between molecular ion peak and base peak.
- j) How is sample prepared prior to SEM analysis?
- k) Why ultrahigh vacuum is required in TEM when compared to SEM?

- l) ESCA means _____.
- m) SIMS means _____.
- n) Compare between SEM and SIMS.
- o) List the types of ions observed in mass spectra.
- p) Define 1D nanomaterial.

SECTION - I

- Q2) a) What is mass analyzer? List the type of mass analyzers and explain the working of any one. [8]
- b) Explain the principle and working of MALDI-TOF. State its applications. [4]
- c) What is tandem mass spectrometry? Explain its significance in analytical chemistry. [4]

- Q3) a) Define the term nanomaterial. What are the different types of synthesis of nanomaterials? Explain one chemical method for the synthesis of nanomaterial justifying the role of the reagents used. [8]
- b) Write note on applications of nanotechnology. [4]
- c) A cube of 1 m^3 was sliced into thin nanosheets of 5 nm thickness to form a sheet of the dimensions ($1\text{ m} \times 1\text{ m} \times 5\text{ nm}$). How many sheets would be formed and what area would it cover? [4]

- Q4) a) Explain the terms in nanotechnology,
- i) agglomeration
 - ii) reducing agent
 - iii) capping agent
 - iv) size distribution.
- Describe with suitable example. [8]
- b) Elaborate the concept of hard and soft ionization in mass spectrometry. [4]
- c) Write note on the detector used in mass spectrometer. [4]

SECTION - II

- a) Write note on principle, instrumentation and application of Transmission Electron Microscope (TEM). [8]
 - b) State the applications of Raman Spectroscopy in Nanotechnology. [4]
 - c) What are the different scanning modes used in AFM? State its advantages and disadvantages. [4]
- Q6) a) Write short note on Scanning Tunneling Microscopy and its applications. [8]
- b) State the principle and applications of SIMS. [4]
 - c) Compare between X-ray Photoelectron Spectroscopy and Auger Electron Spectroscopy. [4]
- Q7) Write short note on **any four** of the following [16]
- a) Biological synthesis of nanoparticles
 - b) Chemical ionization
 - c) Analytical applications of Electron Spin Resonance Spectroscopy (ESR).
 - d) Physical synthesis of nanomaterial.
 - e) Compare between SEM and TEM.