

Sardar Patel University

M.Sc. (Nanoscience & Nanotechnology) IIIrd Semester Examination

Tuesday, Date: 04/12/2012

Time: 2:30 p m to 5:30 pm

Subject: PS03CNST03 Modern Characterization Techniques

Total Marks: 70

Note: Figures on the right indicate marks for the question.

Q-1 Multiple Choice Questions.

[8]

- 1) Which of the following techniques is based on X-ray spectroscopy?
(a) XRD (b) AFM (c) Optical Microscopy (d) EDAX
- 2) What is the range of wavelength of X-rays in electromagnetic spectrum?
(a) 10^4 \AA to 10^7 \AA (b) 10^{-2} \AA to 10^2 \AA (c) 10^6 \AA to 10^{12} \AA (d) 10^{-2} \AA to 10^{-3} \AA
- 3) The magnification power of Optical microscope is _____.
(a) 100000x (b) 1000x (c) 2kx (d) None
- 4) Which of the following techniques is used for linear coefficient of thermal expansion (CTE) measurement?
(a) Dilatometry (b) DSC (c) TGA (d) LASER Flash
- 5) X-ray diffractogram peak of amorphous material is _____.
(a) Sharp (b) Vertical line (c) Broad (d) None of these
- 6) The specific heat can be measured by _____ technique.
(a) DTA (b) DSC (c) DTG (d) DMA
- 7) Which current is measured in STM?
(a) DC (b) AC (c) Electric (d) Tunneling
- 8) Which of the following techniques do not require vacuum?
(a) SEM (b) HRTEM (c) AFM (d) STM

Q-2 Answer any Seven of the following.

[14]

- (1) What is continuous spectrum? Draw the X-ray spectrum of Molybdenum as a function of applied voltage.
- (2) What is constructive interference and destructive interference? Write down the essential condition for diffraction to occur.
- (3) Differentiate between X-ray diffraction and X-ray spectrometry.
- (4) Differentiate between magnification and resolution power. Suggest how both can be increased?

- (5) Draw the schematic of signals generated from thin specimen by impinging electron beam? Mention the generated electrons are used for which different electron microscopic techniques?
- (6) What is thermal conductivity? How it can be measured?
- (7) What is tunneling current? In which scanning probe microscopy it is measured for imaging?
- (8) Explain interatomic force vs tip to sample distance curve in Atomic Force Microscopy.
- (9) Explain effect of crystallinity on the peaks of the x-ray diffractogram.

Q-3 [a] Mention various kinds of X-ray diffraction methods. Describe any one in detail. [6]

Q-3 [b] Derive Scherrer equation for crystallite size determination. [6]

(OR)

Q-3 [b] Explain various kinds of X-ray spectrometers. How do they differ from X-Ray diffractometers? [6]

Q-4 [a] Draw the schematic of scanning electron microscope and explain the function of various components of scanning electron microscope (SEM). [6]

Q-4 [b] Explain two imaging modes of transmission electron microscopy. How resolution power can be improved by using objective lens and aperture? [6]

(OR)

Q-4 [b] Describe sample preparation methods for SEM and TEM. [6]

Q-5 [a] What is DSC technique? Describe working principle and what information can be obtained from DSC technique? [6]

Q-5 [b] What is TGA technique? Describe working principle and explain with suitable example what information can be obtained from TG curve? [6]

(OR)

Q-5 [b] What is TMA technique? Describe working principle and application of TMA for the measurement of linear CTE for anisotropic and isotropic material. [6]

Q-6 [a] What is Atomic Force Microscopy? Explain three primary imaging modes of atomic force microscopy. [6]

Q-6 [b] Draw the basic set up of scanning tunneling microscope and explain the function of piezotube. [6]

(OR)

Q-6 [b] Discuss constant current mode and constant tip height mode of Scanning Tunneling Microscope. [6]
