

Materials Characterization

(MT 602)

Time 3hrs

Full Marks 70

Section A

(Answer all the questions in this section)

Q1. Give reasons

- (a) Auger electron spectrum is displayed in the derivative mode. (3)
- (b) Auger electron process is a three electron process and leaves atoms doubly ionized. (5)
- (c) Decrease in peak height in x-ray diffraction pattern is observed for a sample with ultrafine grained structure compared to the coarse grained structure of the sample with similar composition. (4)
- (d) In electron microscopes samples are placed under ultra high vacuum for taking high resolution images. (4)
- (e) Scanning tunneling microscopic studies can be carried out only on conducting and semiconducting samples. (4)

Q2. Explain the following

- (a) Integral breadth with respect to x-ray diffraction peak (4)
- (b) Exchange interaction with respect to ferromagnetic metals (4)
- (c) Mattheissen rule with respect to electrical resistivity (4)
- (d) Crossed nicol position with respect to polarized ray microscopy (4)
- (e) Staining with respect to transmission electron microscopy (4)

Section B

(Answer any three questions from this section)

- Q3. (a) Name the quantitative information's that can be obtained from the DTA plot. (3)
- (b) State the experimental factors which affect the results of the quantitative analysis. (4)
- (c) Comment on the accuracy and reliability of such quantitative information. (3)

- Q4. (a) "Using high intensity light, images with high resolution can be obtained in Near Scanning Field optical microscope (NSOM)". With the aid of a schematic explain how such high resolution image is obtained. (6)
- (b) Name the areas where polarized ray microscope is useful in studying the microstructure of materials. (4)

- Q5. (a) Explain why grain size determination by using single line profile analysis is more accurate compared to using Scherer equation. (4)
- (b) Fe_3O_4 is magnetic but FeCl_3 is nonmagnetic material. Give reasons. (4)
- (c) State the information's that can be obtained from the hysteresis loop of magnetic material. (2)

- Q6. (a) Back scattered electron images provide information on the variation of composition in the microstructure where as secondary electron images only provide topographic information. Explain (7)
- (b) In electron microscopes the resolution can be improved by increasing the accelerating voltage. Explain. (3)
- Q7. (a) Auger electron spectroscopy (AES) is more useful than energy dispersive spectroscopy (EDS) for identifying elements and studying the composition of corrosion product on the surface of materials. (4)
- (b) Compare the advantages and limitations of the use of Scanning tunneling microscope (STM) with the Atomic force microscope (AFM) in characterization materials. (3)
- (c) State the precautions needed in TEM powder sample preparation (3)