752303

December 2023
M.Sc (Physics) IIIrd SEMESTER
Materials Characterization Techniques (MPM-303)

Time : 3 Hours]   [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Is there any specific sample preparation required for Raman spectroscopy? Justify your answer.   (1.5)

   (b) Why vacuum is required for X-ray generation? (1.5)

   (c) How would you analyze ceramic/insulating sample using SEM measurements?   (1.5)

   (d) What is the signature of strain in XRD spectrum? How would you quantify that?   (1.5)

   (e) What is the role of Fourier transform in FTIR? (1.5)

   (f) What is the principle behind VSM?   (1.5)

   (g) Does heating rate play an important role in DTA measurements? Why?   (1.5)

   (b) What do you understand by the term 'calibration'? When is it performed and why is it important? (5)

   (c) How surface is different from the bulk? Why is it important to have a controlled environment for surface characterization? How is it achieved typically? (5)

7. Write short notes on any *three* of the following :

   (i) Beer Lambert's law,

   (ii) Nuclear magnetic resonance,

   (iii) SQUID and

   (iv) TGA.   (15)

(h) Write one application of electron diffraction and explain. (1.5)

(i) How would you differentiate magnetic force from Vander Waal's force in Magnetic force microscopy? (1.5)

(j) What is quantum tunneling? Write any *one* characterization technique where it is used. (1.5)

PART–B

2. (a) How would you find composition of a sample using SEM? Is it possible to use secondary electrons for this analysis? What limits the resolution which can be obtained in SEM? (6)

(b) Differentiate between stoke's line and antistoke's line. (5)

(c) I have an unknown sample and I wish to study and analyse its structure. What techniques can I employ to understand it thoroughly and why? (4)

3. (a) Differentiate between Atomic Absorption spectroscopy and UV-Visible absorption spectroscopy. (5)

(b) How would you calculate crystallite size from XRD spectrum? (5)

(c) A typical DSC curve exhibits some exothermic and endothermic peaks. What information can be obtained by these and explain them briefly. (5)

4. Comment/Justify the following statements. Write specifically whether you agree to the statement given or not and why?

(i) Double beam spectrometers are more useful then single beam spectrometers in UV-Vis spectroscopy.

(ii) TEM is a destructive technique for structural analysis.

(iii) DTA is more frequently used than DSC for thermal analysis.

(iv) AFM is more versatile as compared to STM.

(v) VSM is more sensitive than SQUID. (15)

5. (a) What are the essential conditions for VSM measurements? Can we use VSM for fragile samples as well? (5)

(b) How Rayleigh scattering is different from Raman scattering (explain with the help of an energy level diagram)? Explain FTIR with the help of a schematic. (10)

6. (a) What decides the kind of probe you use for a particular characterization technique and what probe do you use in the following techniques? (5)

(i) TEM,

(ii) AFM,

(iii) FTIR,

(iv) XRD,

(v) STM.