Dr Sumeet Kr Sharma (17) 30/11/2022

National Institute of Technology Hamirpur

Department of Materials Science and Engineering

End-Term Examinations (Odd Sem ; 2022-23)

Characterization of Materials (MS-311)

Total Marks: 50 **Time duration:** 3 hrs

Instructions:

i. Write Name, Roll No, Subject Name, Subject Code on top of First Sheet.
ii. Draw Schematic Diagram wherever it is required.
iii. Answers should be in your own words.

1) Explain the principle and working of FTIR spectroscopy? **[4]**

2) Make a comparative between contact mode and tapping mode used in AFM? What are the reasons for which we need these different modes? **[3]**

3) What do you mean by secondary, backscattered and auger electron in SEM? Which information we get from analysis of signal from such electrons? Draw neat sketches as well. **[5]**

4) What is a zone axis? Explain SAED process with respect to TEM. **[3]**

5) How DTA technique is different from DSC? How will you determine the glass transition temperature of a particular glass sample? Classify Melting, Oxidation, Crystallization, Sublimation and Reduction in terms of endothermic and/or exothermic reaction. **[5]**

6) In what ways Scanning Tunnelling Microscope (STM) is different from Atomic Force Microscope (AFM)? What was the need of AFM when Scanning Electron Microscope (SEM) was available? **[5]**

7) Explain the principle of NMR spectroscopy with a neat sketch? **[4]**

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(18)

8) What do you infer from the term etching? What is the purpose of etching the specimen before using the specimen for imaging in Optical Microscope? How can you determine the grain size from the optical microspic image of a metallic specimen? **[4]**

9) How do we calculate the crystallite size using the XRD data? **[3]**

10) What type of lens system is used in electron microscopes in order to focus the electron beam? **[1]**

11) With the help of energy state diagram make a comparison between different spectroscopy techniques which you have studied in this course. Discuss region of the electromagnetic spectrum involved in the respective techniques, type of transition/phenomeon, information extracted and main applications. **[6]**

12) Write the selection rules used in XRD for planes belonging to SC, BCC and FCC crystals. **[1]**

13) A crystal has a cubic unit cell of 4.2 Å. Using a wavelength of 1.54 Å at what angle (2 θ) would you expect to measure the (111) peak? (State answer with solution) **[2]**

(a) 10.6°
(b) 18.5°
(c) 43.0°
(d) 37°

14) In a simple X-ray scan, which of these affects the peak positions? (M*ore than one can be correct*) **[1]**

(a) X-ray wavelength
(b) Crystallite Size
(c) Unit cell parameter
(d) Atomic number

15) In your opinion what is the importance of studying the various material characterization techniques involved in this course? State answer in your words with some practical examples where this knowledge of techniques can be used. **[3]**