U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: VI**
Branch: Institutional Elective **Duration: 3 hrs.**
Course Code: 20ME6OEMAC **Max Marks: 100**
Course: Material Characterization **Date: 25.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Students are permitted to use IR spectroscopy Table for Q. No. 6(a)

UNIT - I

1 a) Describe the construction of x-ray tube and generation of x-ray with the help of relevant diagrams. **10**

b) The 2θ values for the powder diffraction peaks of Cubic substances are given below. The Patterns are obtained using Cu - Kα radiation (λ = 1.542 Å). Index the patterns, Identify the crystal structure, and determine the lattice parameter. **10**

Peak No.	1	2	3	4	5	6	7	8
2θ, deg	28.41	47.35	56.12	69.10	76.35	88.04	97.94	106.75

Permissible (h k l) reflections for Cubic Substance

Σ	*h k l* primitiv	*h k l* BCC innenzentriert	*h k l* FCC flächenzentriert
1	1 0 0	—	—
2	1 1 0	1 1 0	—
3	1 1 1	—	1 1 1
4	2 0 0	2 0 0	2 0 0
5	2 1 0	—	—
6	2 1 1	2 1 1	—
7	—	—	—
8	2 2 0	2 2 0	2 2 0
9	3 0 0 / 2 2 1	—	—
10	3 1 0	3 1 0	—
11	3 1 1	—	3 1 1
12	2 2 2	2 2 2	2 2 2
13	3 2 0	—	—
14	3 2 1	3 2 1	—
15	—	—	—
16	4 0 0	4 0 0	4 0 0
17	4 1 0 / 3 2 2	—	—
18	4 1 1 / 3 3 0	4 1 1 / 3 3 0	—
19	3 3 1	—	3 3 1
20	4 2 0	4 2 0	4 2 0

OR

2 a) State and derive Bragg's Law for constructive interference of x-ray diffracted by lattice planes. **08**

b) Obtain the structure factor (F) for BCC cell and show its permissible reflections with the help of reciprocal cell. **06**

c) Explain different diffraction methods with respect to incident wavelength (λ) and orientations (θ). **06**

UNIT - II

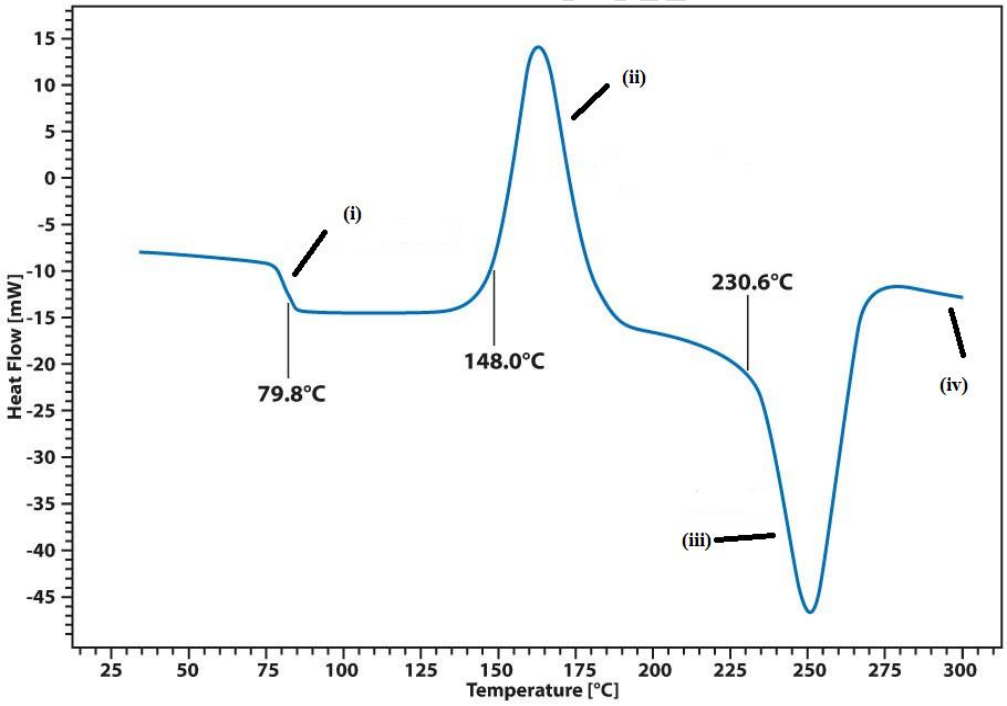
3 a) Compare the bright-field and dark-field imaging modes of transmission electron microscope with the help of relevant diagrams. **10**

b) Explain the construction and working principle of scanning electron microscope (SEM). List the most important sample preparation techniques in SEM. **10**

UNIT - III

4 a) Explain the instrumentation and working of differential thermal analyzer. **06**

b) The differential scanning calorimetry curve shows the phase change encountered for a polymeric material below: **04**



Identify the marked regions with and without temperature values in the graph.

c) With the help of schematic diagrams explain the significance of different modes of dynamic mechanical analyzer. **10**

UNIT - IV

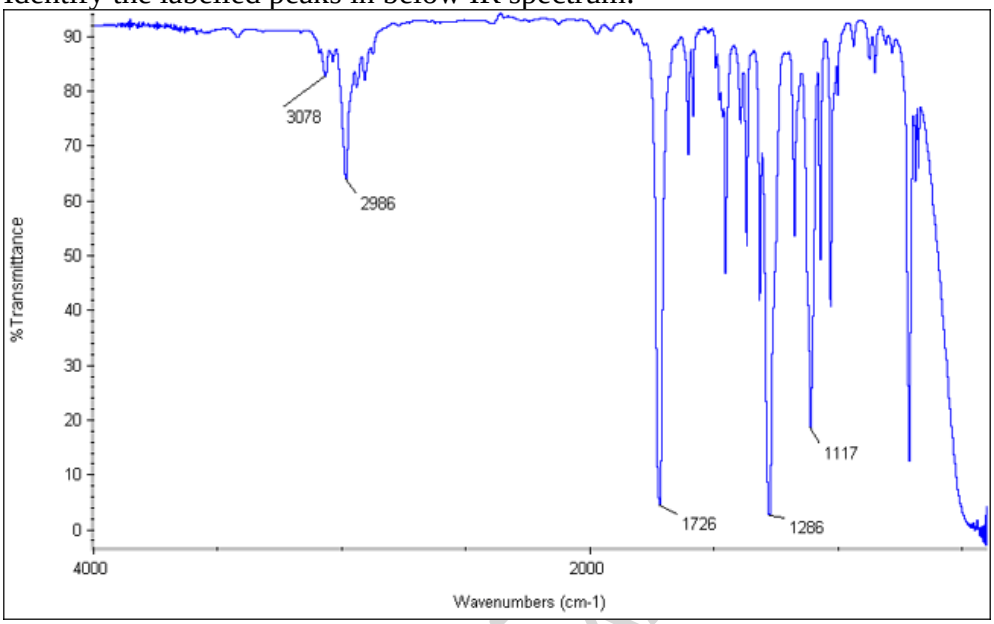
5 a) Describe with the help of schematic diagrams the possible vibrational modes of molecules which are infrared (IR) active. Mention any two examples which are IR inactive. **08**

b) Illustrate any two electronic transitions that are detectable by UV spectroscopy with relevant examples. **08**

c) The IR spectrum of CO shows a vibrational absorption band centered at 2170 cm^{-1}. If the mass of carbon atom is 1.99 x 10^{-26} kg and that of oxygen atom is 2.66 x 10^{-26} kg, what is the force constant for the CO bond? **04**

OR

6 a) Identify the labelled peaks in below IR spectrum: **08**



Comment on the plausible structure of molecule.

b) Illustrate hyperchromic shift in UV-vis spectroscopy with the help of a relevant example. **04**

c) Explain the operations of atomic absorption spectrometry (AAS) with the help of schematic diagram. Mention any two applications of ASS. **08**

UNIT - V

7 a) Explain the instrumentation and working principle of x-ray photoelectron spectroscopy with the help of schematic diagram. **10**

b) Explain the working principle of atomic force microscope (AFM). Mention any two modes of AFM. **10**

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