INTERNATIONAL CENTRE FOR APPLIED SCIENCES (Manipal University) III SEMESTER B.S. DEGREE EXAMINATIONS-OCT. / NOV. 2017 SUBJECT: ANALYTICAL METHODS & INSTRUMENTATION (CHM 234) (BRANCH: INDUSTRIAL BIOTECHNOLOGY) Monday, 6 November 2017

Time: 3 hrs.

1 A. Define wavelength, frequency, wave number, energy and intensity of electromagnetic radiation. What are characteristics of line spectrum?

B. With a neat diagram explain the working of double beam IR spectrophotometer. Give any four differences between Raman and IR spectroscopy.

C. Give reasons:

- i) CO molecule is microwave active but CO₂ molecule is not.
- ii) Asymmetric mode of vibration of CO₂ molecule is IR active but Raman inactive.

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2 A. Derive a mathematical expressions for the frequency of fundamental and overtone bands of anharmonically vibrating diatomic molecule.

B. What are the characteristics of Raman spectrum? Give important applications of Raman spectroscopy.

C. The pure rotational spectrum of gaseous molecule CN consists of series of equally spaced lines separated by 3.7978 cm⁻¹. Calculate the internuclear distance of the molecule. (The molar masses are: ${}^{12}C = 12.011$ and ${}^{14}N = 14.007$ g/mole; N=6.023×10²³mol⁻¹, c = 3× 10⁸ms⁻¹, h = 6.626 × 10⁻³⁴ J s)

3 A. Explain the classical theory of Raman Effect.

✓ Answer ANY FIVE full Ouestions.

✓ Missing data, if any, may be suitably assumed

- B. Give an account of the following:
 - i) Bolometer ii) Chemical deviation from Beer's law
- C. Write a note on carrier gas used in GLC.
- 4 A. State and derive the mathematical expressions for Beer's and Lambert's law. Show that A=2-log%T

B. Define conductance, specific conductance and equivalent conductance of an electrolyte. Explain the factors affecting the conductance of electrolytic solutions.

C. Give reasons:

- i) Sample holder made up of glass/quartz cannot be used in IR spectrophotometer.
- ii) ¹⁶O is NMR inactive whereas ¹⁷O is NMR active

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Max. Marks: 100





5 A.With a suitable example explain any two different kinds of acid-base conductometric titrations.

| B. Give an account of i) Quantum theory of NMR ii) Sources of IR radiation C. Predict the low and high resolution¹H NMR spectrums of CH₃CH₂CHO and C | H ₃ COCH ₃ 8+8+4 |
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| 6 A. Explain the principle and working of Mass spectrometer.B. Describe the working of any two kinds of detectors used in GLC.C. Write a note on combustion analysis | 8+8+4 |
| 7 A. Explain i) Principle of X-ray diffraction and ii) Production of X-rays. B. Show that for a rotating rigid diatomic molecule I =μr². Explain the effect of substitution on the energy level and rotational spectrum of CO molecule C. Why TMS is used as reference substance in ¹H NMR studies? | isotopic |
| | 8+8+4 |
| 8 A. Describe the working of GLC. What are the advantages of this technique?B. Give an account of i) X-ray Absorptiometer | |

ii) Any two pumps used in HPLC.

C. The absorption spectrum for titanium peroxide complex ion in perchloric acid showed a maximum of 350 nm. The absorbance of a 32.0 μ g/mL solution of titanium gave an absorbance of 0.56. An unknown solution treated in an identical fashion gave an absorbance of 0.651. Find out the concentration of the unknown by assuming identical cells.

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