Reg. No.										

MANIPAL UNIVERSITY

THIRD SEMESTER B.S. (ENGG.) DEGREE EXAMINATION – DECEMBER 2015

SUBJECT: ANALYTICAL METHODS AND INSTRUMENTATION (CHM 234)

(BRANCH: IND.BIOTECH.)

(NEW SCHEME)

Wednesday, December 16, 2015

Time: 10:00-13:00 Hrs. Max. Marks: 100

✍ **Answer any FIVE full questions.**

1A. What is spectroscopy? Explain the different types of molecular energies. How is band spectrum of molecules originated?

1B. What are the conditions required for molecules to absorb microwave radiation? Obtain the mathematical expressions for the frequency of emission lines for rotating rigid and non-rigid diatomic molecules.

1C. Give reasons:

i) Bending vibration CO_2 molecule has a lower frequency than its stretching vibrations.

ii) Water is not a suitable solvent for the preparation of sample solution for NMR studies.

(8+8+4 = 20 marks)

2A. What are fundamental and overtone IR bands? Obtain the expression for the frequency of IR spectral lines for an an harmonically vibrating diatomic molecule.

2B. Explain the techniques of sampling of solids and liquids for IR studies.

2C. Give reasons:

i) Asymmetric stretching mode of CO_2 is IR active but Raman inactive.

ii) TMS is used as a reference compound in NMR studies.

(8+8+4 = 20 marks)

3A. Discuss the theory of spectrophotometry.

3B. Give an account of sources of UV and visible radiations. Describe the working of a double beam UV-Visible spectrophotometer.

3C. 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)

(8+8+4 = 20 marks)

4A. With a schematic diagram explain the theory and working of a Mass spectrometer.

4B. What is meant by chemical shift? Discuss the factors affecting the chemical shift.

4C. Give reasons:

i) Net calorific value is less than gross calorific value of a solid fuel.

ii) Ethylene is IR inactive whereas bromoethylene is IR active.

(8+8+4 = 20 marks)

5A. What are the characteristic properties of Raman lines? Explain the classical theory of Raman Effect.

5B. What are the differences between Infrared and Raman spectrum? Give an account of the detectors of Infrared radiation.

5C. Give reasons:

i) High resolution NMR spectrum of CH_3CH_2Cl and CH_3CHDCl are different.

ii) Low and high resolution NMR spectrum of acetone contains only one signal.

(8+8+4 = 20 marks)

6A. Explain the terms bathochromic and hypsochromic shifts. Discuss the effects of conjugation and solvents on the electronic transitions of the molecules in the UV region.

6B. What is meant by resolution of a chromatographic column? Describe the technique of HPLC. What are the advantages of this technique?

6C. Give an account of the types and rules of fragmentation process of organic molecules.

(8+8+4 = 20 marks)

7A. Explain the origin of continuous and line spectra of x-rays.

7B. Give an account of various kinds of X-ray detectors.

7C. On burning 0.75 g of a solid fuel in a bomb calorimeter, the temperature of 2.5 kg of water is increased from 24°C to 28°C. The water equivalent of calorimeter and the latent heat of steam are 485 g and 587 calories/gm respectively. Specific heat of water is 4.187 kJ/kg/°C. If the fuel contains 2.5% of hydrogen, calculate its gross and net calorific values in kJ/kg.

(8+8+4 = 20 marks)

8A. With a suitable example explain four kinds of acid-base conductometric titrations.

8B. Explain the terms distribution constant and retention time used in chromatography. Discuss the factors affecting the column efficiency.

8C. Write a note on advantages and applications of Gas chromatography.

(8+8+4 = 20 marks)