DEPARTMENT OF CHEMISTRY
SCHOOL OF NATURAL AND APPLIED SCIENCES
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2012/2013 SESSION

COURSE CODE: CHM313   UNITS: 2
COURSE TITLE: MOLECULAR PROPERTIES
TIME ALLOWED: 2 HOURS
INSTRUCTIONS: Answer any three (3) Questions

1. (a). Briefly explain the theory of infrared absorption and hence enumerate its limitations
        as a molecular spectroscopic technique.
    (b). What are the various types of vibrations in infrared spectroscopy?
    (c) (i) Why is the total number of observed absorption bands generally different from
        the total number of fundamental vibrations?
      (ii) What are the basic components of IR dispersive spectrometer and hence explain
        the relevance of the monochromator
      (iii) What are the major advantages of Fourier Transform Spectrometers over
        dispersive instruments?
    (d). Enumerate common applications of Infrared spectroscopy.

2. (a). Briefly explain nuclear spin and splitting of energy levels in a magnetic field
    (b). Explain the following:
      (i) Resonance phenomenon
      (ii) Diamagnetic shielding
      (iii) Chemical shifts
      (iv) Calculation of transition energy
      (v) Absorption of radiation by a nucleus in a magnetic field.
    (c). Distinguish between spin-lattice and spin-spin relaxation

3.   (a). Briefly explain your understanding of Raman spectroscopy and hence give reason
        for the popular use of anti-stokes lines in molecular analysis
    (b). Write down an equation to represent the following in Roman spectroscopy:
      (i) Energy related to harmonic oscillator
      (ii) Number of peaks related to the degrees of freedom
    (c). With relevant illustrations, explain infrared, Rayleigh scattering, stokes and anti-
        stokes scattering lines
    (d). Briefly distinguish between elastic and inelastic scattering

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4. (a). Briefly explain the theory of microwave spectroscopy and explain why it is possible to determine the bond distances and bond angles in a molecule from measured rotational frequencies.

(b). What do you understand by rotational stark effect and explain its origin

(c). Give the rotational classification of molecules with respect to type, molecular and macroscopic examples.