18. (a) Derive the rotational fine structure of a electronic-vibration transition for a diatomic molecule and hence explain the P-branch and Q-branch.

Or

(b) The rotational lines of a band system of electronic vibration spectra of CN is given by $(v = 25798 + 3.85\ m + 0.068\ m^2)\ cm^{-1}$. Deduce

(i) The values of B' and B".

(ii) The position of band head.

(iii) Comment on the degradation of the band system.

19. (a) Explain the working principle of EPR spectrometer with a neat block diagram.

Or

(b) Describe the relaxation mechanism and hence derive the Bloch equations of a nuclear magnetic system.

20. (a) Describe the principle of nuclear quadrupole resonance and hence derive the frequencies of transitions of non-axially symmetric half integral spin systems.

Or

(b) Explain how Mossbauer spectroscopy is useful in understanding the molecular structure and in corrosion studies.

Reg. No. : .....

Code No. : 6120 **Sub. Code : C 33 P**

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2012.

Third Semester

Physics

SPECTROSCOPIC TECHNIQUES

(For those who joined in July 2008 and afterwards)

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer any ALL questions.

1. What are hot bands?

2. What are overtone transitions?

3. What are Stokes and anti-stokes lines?

4. What is resonance Raman effect?

5. What is hyper – Raman effect?

6. Distinguish between resonant and non-resonant two-photon absorption processes.

7. What is Nuclear Magnetic resonance?

8. What is Fermi contact interaction?

9. What is isomer shift?

10. Draw a typical Mossbauer spectrum.

PART B — (5 × 5 = 25 marks)

Answer ALL the questions choosing either (a) or (b).

11. (a) Describe the change of dipole moment in CO_2 molecules.

Or

(b) Discuss the various internal modes of a complex molecules.

12. (a) Write note on Fourier transform Raman spectrometer.

Or

(b) Single crystal Raman spectrum is more informative than powder spectrum. Explain.

13. (a) Explain sum and difference frequency generation.

Or

(b) Describe the Coherent anti-stokes Raman scattering with its experimental arrangement.

14. (a) Discuss the effect of quadrupole moment of a nucleus on the NMR spectrum.

Or

(b) A system of protons at a temperature of 25° C is placed in a magnetic field of 2T. What is the ratio of number of proton in the lower state to the number in the upper state?

15. (a) Explain recoilless emission and absorption of gamma rays.

Or

(b) The ^{14}N resonance of a compound showed 3 lines at 5.997, 3.501 and 2.496 MHz. Calculate the quadrupole coupling constant and η

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Derive the vibrational energy levels of a diatomic molecule and hence the vibrational spectrum of the molecules.

Or

(b) Describe the principle and working of a spectrophotometer.

17. (a) Describe the structure determination of molecules of XY_2 using IR and Raman spectroscopy with an example.

Or

(b) Describe the structure determination of molecules of XY_3 using IR and Raman spectroscopy with an example.