

M.Sc. DEGREE (FIVE YEAR INTEGRATED COURSE) IX SEMESTER EXAMINATION  
IN PHOTONICS, NOVEMBER 2008

CEL 2E08 LASER SPECTROSCOPY  
(New Scheme)

Time : 3 Hrs.

Maximum marks : 50

**PART – A**

(Answer any **FIVE** questions)  
(Each question carries **TWO** marks)

(5 x 2 = 10)

- I. (i) Give a comparative study of spectrometers and interferometers.  
(ii) What do you mean by quantum yield and quantum efficiency of fluorescence?  
(iii) Explain the significance of hyperfine splitting of energy levels corresponding to 3S and 5S levels of sodium based on Doppler free two photon spectroscopy.  
(iv) What is the advantage of using laser as a source in spectroscopic measurements? Give a brief account of different laser sources used for spectroscopic studies.  
(v) Explain the process of photon assisted collisional energy transfer.  
(vi) What is negative optical galvanic effect?  
(vii) Give the significance of f-f and f-d transition in rare-earth systems.  
(viii) Explain the working of Helmholtz PAS gas-microphone cell working in the resonant mode of operation.

**PART – B**

(Each question carries **TEN** marks)

(4 x 10 = 40)

- II. A Write notes on SRS, CARS and PARS. What is the significance of PARS in laser spectroscopy.  
**OR**  
B Distinguish between Rayleigh and Raman scattering. Give theoretical explanation of Spontaneous Raman Scattering and Hyper Raman Scattering.
- III. A Explain the fluorescence properties of organic dyes. What are the different types of dyes used in laser spectroscopy? With the help of energy level diagram explain the process of laser emission from organic dyes.  
**OR**  
B Give an account of general characteristics of optical spectra of  $RE^{3+}$  and  $RE^{2+}$  ions in crystals. Explain the peculiarities of the spectrum and the nature of transitions giving appropriate examples.
- IV. A What is single atom detection? Write down the significance of single atom deflection spectroscopy. Explain the different cases of photo-ionization spectroscopy which lead to single atom detection.  
**OR**  
B What are Rydberg states of an atom? How can you attain Rydberg states by OODR technique? With the help of an experimental setup explain how the Rydberg levels of an atom can be analyzed.
- V. A Explain thermal lens effect. Derive an expression for the focal length of the thermal lens. Thermal lens is a diverging lens, explain.  
**OR**  
B Discuss the design aspects of different photoacoustic cells and their resonance conditions. Explain how PA technique can be used for the thermal and physical characterization of materials.