CO - PO MATRIX								
22PH2D2	CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	CO1	H					L	M
	CO2	H					L	M
	CO3		H				L	M

Paper – 6: APPLIED SPECTROSCOPY

Offered to: M.Sc.(PHYSICS)	Course Code: 22PH2D2
Course Type: DSE	Course: Applied spectroscopy
Year of Introduction: 2022	Year of offering: 2023
Year of Revision: 2022	Percentage of Revision:NIL
Semester: II	Credits: 4
Hours Taught: 60 hrs. per Semester	Max.Time: 3 Hours

Course Description: Applied Spectroscopy is the application of various spectroscopic methods for the detection and identification of different elements or compounds to solve problems in fields like forensics, medicine, the oil industry, atmospheric chemistry, and pharmacology.

Course Objectives:

1. To understand theprinciple and instrumentation of the Raman Spectroscopy.
2. To understand the instrumentation on Fluorescence and Phosphorescence Spectroscopy
3. To understand the importance of rare earth spectroscopy of materials.
4. To learn the high resolution spectroscopy techniques.
5. To learn the multidisciplinary and interdisciplinary areas in spectroscopy.

Course Outcomes: At the end of this course, students should be able to:

CO1: Understand the various techniques in a laboratory.

CO2: Analyze and characterize substances within a laboratory

CO3: Understand the optical and spectroscopic properties of materials.

CO4:Analyze data obtained from sophisticated equipment's.

CO5: Analyze the molecular structure using spectroscopic information.

	CO4	H	M				L	M
	CO5		H	M			L	M

Syllabus		
Unit	**Learning Units**	**Lecture Hours**
I	**Raman Spectroscopy** Introduction–Theory and instrumentation of Raman Scattering–Laser Raman Spectroscopy–Sample Handling Techniques – Polarization of Raman Scattered Light – Single Crystal Raman Spectra– Raman Investigation of Phase Transitions–Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy, Significance of confocal Raman spectrometer, Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy(CO1)	12
II	**Fluorescence and Phosphorescence Spectroscopy** Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radiative decay of fluorescent molecules–Phosphorescence and the nature of the triplet state – Population of the triplet state–Delayed Fluorescence – Excitation spectra–Experimental methods–Emission lifetime measurements– Time resolved emission spectroscopy–Applications of Fluorescence and Phosphorescence. (CO2)	12
III	**Rare Earth Spectroscopy** Introduction –Intensity of absorption and emission bands – Oscillator strengths – Intra-configurational f-f transitions –Selection rules –Electric and Magnetic dipole transitions–Judd-Ofelt theory and evaluation of Judd-Ofelt parameters – Radiative transition probabilities of excited states of rare earth ions – branching ratios, stimulated emission cross-sections –Non-radiative process –Energy transfer – Possible mechanisms of energy transfer–Resonance energy transfer– Process of IR to visible upconversion – Applications of rare earth doped luminescent materials. (CO3)	12
IV	**High Resolution Spectroscopy** Introduction – Light detectors – Single photon counting technique –Phase sensitive detectors –Laser optogalvanic spectroscopy – Matrix isolation spectroscopy – Laser cooling and its applications.(CO4)	12
V	**Two Photon Spectroscopy** Introduction – Two photon absorption spectroscopy – Selection rules – Expression for the two photon absorption cross section – Photo acoustic spectroscopy – Experimental methodology and applications to Physics, Chemistry, Biology and Medicine(CO5)	12

Text and Reference Books:

1. Spectroscopy Straughan and Walker (vol. 2 & 3, John Wiley & Sons, 1976.

2. Molecular Structure and Spectroscopy BY G. Aruldhas, Printice-Hall Pvt. Ltd. 2001.

3. Introduction to ligand fields, B. N. Figgis (Intersci. Pub. New York, 1966.

4. Laser and Excited states of Rare Earths, R. Reisfeld and C.K. Jorgnesen, Springer- Verlag, New York, 1977.

5. Optical Properties of Transparent Rare Earth compounds, S. Hufner, Acad. Press, 1978.