C. U. SHAH UNIVERSITY, WADHWAN CITY.

Faculty of: **Sciences and Life Sciences**
Course: **Bachelor of Science (Physics)**
Semester**: II**
Subject Code**: MDC202-1C**
Subject Name:**Fundamentals of Spectroscopy**

Sr. No	Category	Subject Code	Subject Name	Teaching hours/ Week			Credit hours	Credit Points	Evaluation Scheme/ Semester								
									Theory				Tutorial / Practical				Total
									Continuous and Comprehensive Evaluation		End Semester Exams		Internal Assessment		End Semester Exams		
				Th	Tu	Pr			Marks	Marks	Marks	Duration	Marks	Duration	Marks	Duration	
4	MDC	MDC202-1C	Fundamentals of Spectroscopy	3	-	2	5	4	10 10 05	Assignment Quiz Attendance	50	2	25	1	-	-	100

AIM

- The aim is to enable students to acquire a specialized understanding of how light interacts with molecules and materials.
- Different methods of optical spectroscopy and their use to examine chemical and physical properties are addressed at an advanced level.

COURSE CONTENTS

Course Outline for Theory

UNIT	COURSE CONTENT	TEACHING HOURS
I	**Definition of the spectrum** - Electromagnetic radiation - quantization of different forms ofenergies in molecules (translational, rotational, vibrational, and electronic) - Born Oppenheimerapproximation. **Microwave Spectroscopy** - theory of microwave spectroscopy - selection rule - Calculation ofmoment of inertia and bond length of diatomic molecules.	9
II	**UV - Visible Spectroscopy** - Absorption laws. Calculations involvingBeer Lambert's law -instrumentation - photo colorimeter and spectrophotometer- block diagrams with descriptionof components - theory - types of electronic transitions - chromophore andauxochromes -Absorption bands and intensity -factors governing absorption maximum and intensity	9
III	**I. R. Spectroscopy** – principle - modes of vibration of diatomic, triatomic linear (CO_2), andnonlinear triatomic molecules (H_2O) -stretching and bending vibrations - selection rules.Expression for vibrational frequency (derivation not needed).	9
IV	**X-ray Diffraction**: Diffraction geometry: Bragg's law, Diffraction Intensity: Scattering from atoms, from the contents of a unit cell; structure factor function, Application to polycrystal diffraction: powder diffraction and crystal structure determination., Diffractometer measurements\	9
V	**Basics of TEM** TEM instrumentation: electron sources; electromagnetic lenses; geometric and wave	9

	optics applied to TEM; lens aberrations and resolution, Interaction between fast electron and thin crystal (TEM sample), TEM sample preparation	

Course Outline for Practical

SR. NO	COURSE CONTENT
1	Applications and Uses of Electromagnetic Radiation in the real world.
2	Demonstrative experiments on Microwave Spectroscopy
3	Demonstrative experiments on UV Visible Spectroscopy
4	Demonstrative experiments of IR Spectroscopy
5	Demonstrative experiments on X-ray diffractions
6	Demonstrative experiments of TEM

TEACHING METHODOLOGY

- Conventional method (classroom blackboard teaching)
- ICT Techniques
- Teaching through the classroom, laboratory work
- variety of learning styles and tools (PowerPoint presentations, audio-visual resources, e-resources, seminars, workshops, models)

LEARNING OUTCOME

- Basic understanding of light as electromagnetic radiation, their parameters, and interaction with matter
- To learn about various spectroscopy and their applications in the real world.
- Understanding various parts of instruments, sampling methods, and analysis in given spectroscopic techniques

ARRANGEMENT OF LECTURE DURATION AND PRACTICAL SESSION AS PER DEFINED CREDIT NUMBERS

Units	Lecture Duration (In Hrs.)		Calculation of Credits (In Numbers)		Total Lecture Duration	Credit Calculation
	Theory	Practical	Theory	Practical	Theory+ Practical	Theory+ Practical
Unit – 1	15	30	3	1	45+30	4
Unit – 2	15					
Unit – 3	15					
TOTAL	**45**	**30**	**3**	**1**	**75**	**4**

EVALUATION

Theory Marks	Practical Marks	Total Marks
75	**25**	**100**

REFERENCE BOOKS

1 Elements of Analytical Chemistry — R. Gopalan, P.S. Subramanian, K. Rengarajan

2	Fundamentals of Analytical Chemistry	D.A. Skoog and D.M. West
3	Principles of Instrumental Methods of Analysis	D.A Skoog and Saunders
4	Instrumental Methods of Analysis	Willard Merit Dean and Settle
5	"Elements of X-Ray Diffraction	Cullity, B.D., and Stock, R.S
6	Advanced Techniques for Materials Characterization	Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S.,
7	Molecular Spectroscopy	Jeanne J. McHale
8	X-Ray diffraction-A practical approach	C. Suryanarayana and M. Grant Nortan
9	Spectroscopy: Fundamentals and Data Interpretation	N K Fuloria, S Fuloria
10	In Situ Transmission Electron Microscopy Experiments	Renu Sharma, Springer