GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160414
Semester – VI
Biophysics

Type of course: Professional Elective Course

Prerequisite: Basics of Physics, Chemistry and Biotechnology

Rationale: The subject aims to provide the acquired knowledge for understanding physics and chemistry with the help of tools and techniques to apply to real life systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Contents:

Sr. No.	Topics	Teaching Hours	Module Weightage
1	**UNIT I: Laws of Physics and Chemistry** Introduction, Quantum Mechanics, The Electronic structure of Atoms, Molecular Orbitals and Covalent Bonds, Molecular Interactions, Stereochemistry and Chirality, Thermodynamics, Radioactivity, Physics of membrane potentials.	**5**	**11%**
2	**UNIT II: Physico-Chemical Techniques to Study Biomolecules** Introduction**,** Hydration of Macromolecules**,** Role of Friction, Diffusion, Sedimentation, The Ultracentrifuge, Viscosity, Rotational Diffusion, Light Scattering, Small Angle X-ray Scattering	**6**	**13%**
3.	**UNIT III: Spectroscopy** Introduction, Ultraviolet/Visible Spectroscopy, Circular Dichroism (CD) and Optical Rotatory Dispesion (ORD), Fluorescence Spectroscopy, Infrared Spectroscopy, Raman Spectroscopy. Electron Spin Resonance	**10**	**23%**
4.	**UNIT IV: Light Microscopy and Electron Microscopy** Introduction, Different types of Microscopy, Bright field Spectroscopy, Dark field Spectroscopy, Phase contrast Spectroscopy, Fluorescence Spectroscopy, Polarising Spectroscopy, Electron Optics, The Transmission Electron Microscope (TEM), The Scanning Electron Microscope (SEM), Preparation of the Specimen for Electron Microscopy, Image reconstruction, Electron Diffraction, The Tunneling Electron Microscope, Atomic Force Microscope	**8**	**18%**
5.	**UNIT V:X-ray Crystallography** Introduction**,** Crystals and Symmetries**,** Crystal Systems**,** Point Groups and Space Groups**,** Growth of Crystals of Biological Molecules**,** X-ray diffraction**,** X-ray Data Collection**,** Structure Solution**,** Refinement of the structure	**5**	**11%**

6.	**UNIT VI: NMR Spectroscopy** Introduction, Basic Principles of NMR, NMR Theory and Experiment, Classical Description of NMR, NMR Parameters, The Nuclear Overhauser Effect, NMR Applications in chemistry – biochemistry, biophysics and medicine.	**5**	**11%**
7.	**UNIT VII: Biomechanics and Neurobiophysics** Introduction, Biomechanics of Cardiovascular system, the nervous system, Sensory mechanism of eye, physical aspects of hearing	**6**	**13%**

Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	10	15	10	10	15

Legends: R=Remembrance**; U**= Understanding**; A**= Application**; N** = Analyze**;E** = Evaluate; **C** = Create and above Levels

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Biophysics by Vasantha Pattabhi and N. Gautham, Publisher : Springer Netherlands
2. Biological Spectroscopy by Campbell I. D and Dwek R. A., Publisher: Benjamin Cumins and Company
3. Physical Chemistry by Atkins P. W., Publisher: Oxford
4. Analytical Biochemistry by Keith Wilson and Walker, 3rd Edition.

Course Outcome:

After learning the course, the students should be able to:

Sr. No.	**CO Statement**	**Marks % Weightage**
CO-1	To develop basic concepts related to laws of physics and chemistry	10
CO-2	To apply knowledge of physico-chemical Techniques to Study Biomolecules; their analysis and interpretation	15
CO-3	To know about the evaluation process towards the properties of biomolecules through microscopy, crystallography and spectroscopy	60
CO-4	To get introduced to the scope of physics in neurobiology	15

List of Tutorials:

1. To study the concept of Quantum mechanics for one case study related to Biological physics.
2. To understand the mechanism of biological reactions through stereochemistry.
3. To understand the light scattering mechanism with case study.

4. To study the principle of UV – Visible spectroscopy, Infrared spectroscopy and Raman spectroscopy.
5. To understand the difference between TEM and SEM
6. Get an elaboration of Nuclear Overhauser Effect.
7. Discuss the application of NMR in medicines and biochemistry.

The use of virtual laboratory / N P T E L / SWAYAM portal is encouraged, for better experience and understanding in tutorial hours.

List of Open Source Software/learning website:

Students can refer to video lectures relevant to subject, available on the websites, including NPTEL. Students can refer to the CDs which are available with some reference books.