SRI VENKATESWARA COLLEGE

Biological Science

B.Sc. (HONOURS) BIOLOGICAL SCIENCE

DISCIPLINE SPECIFIC CORE COURSE – 7:

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Physics for Biologists (BS-DSC-301)	**4**	**2**	**0**	**2**	Class XII pass with Biology and chemistry, as one of the papers in Class XII	**NA**

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce the students to the basic concepts of physics and their applications in biology.
- To empower the students to develop a basic understanding about the principles and concepts of Physics
- To enable the students to develop quantitative approaches to solve physical/biological problems
- Provide a better understanding of various biophysical processes

Learning outcomes

On successful completion of course, the student will:

- Learn about various aspects of mechanics, centrifugal forces, mechanical forces with examples.
- Understand and explain molecular theory, Gauss's law, medical significance and applications of the dielectric properties of biological materials.
- Describe simple harmonic motion, diffraction, lasers and its applications in medical science.
- Appreciate the Doppler effect and the effects of vibrations in humans with respect to physics of hearing, heartbeat etc.
- Learn to investigate the light absorption properties of molecules through spectrophotometry, for qualitative and quantitative analysis of biomolecules

SYLLABUS OF DSC-7

Unit 1: Mechanics **6 Hours**

Conservation of momentum and energy, work energy theorem, Angular momentum, Torque, motion of a particle in the central force field. Influence of mechanical forces (Pressure, shear or elongation) on bone. Viscosity and viscous force, surface tension and viscoelasticity with examples such as, biopolymers, human tissues etc.

Unit 2: Dielectrics **6 Hours**

Dielectrics: Non polar/Polar dielectrics, Molecular theory of Dielectrics, Dielectric Constant, Gauss's Law in presence of dielectric, Three electric vectors and their relations, Electric susceptibility, Energy stored in dielectrics. Behaviour of dielectric in alternating field. Medical significance and applications of the dielectric properties of biological materials.

Unit 3: Waves and Optics **14 Hours**

Simple harmonic motion, Linearity and superposition Principle. Lissajous figures with equal and unequal frequencies and their uses. Effects of vibrations in humans: physics of hearing, heartbeat. Modern Optics: Superposition of waves: Young's double slit interference, Fraunhofer diffraction: diffraction through a single slit/double slit and grating, Resolving power, Resolution of the eye, Lasers: Principle, Population inversion, He-Ne Laser, characteristics of laser, Applications of lasers in medical science, Polarization by double refraction, Nicol prism. Doppler effect.

Unit 4: Spectroscopic techniques **4 Hours**

Beer-Lambert law, light absorption and its transmittance. UV and visible spectrophotometry-principles, instrumentation and applications. Fluorescence spectroscopy, static & dynamic quenching. light scattering in biology.

PRACTICALS

TOTAL HOURS: 60 **CREDIT: 2**

1. Determination of acceleration due to gravity using Kater's pendulum.
2. Determination of the acceleration due to gravity using bar pendulum.
3. Study of Lissajous figures using CRO.
4. Determination of the frequency of an electrically maintained tuning fork by Melde's Experiment.
5. Determination of the wavelength of laser source by through diffraction of (1) Single slit (2) Double slit.
6. Comparison of capacitances using De'Sautty's bridge.
7. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method).
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of sodium/mercury light using diffraction grating.
10. Verification of Beer Law.
11. Determination of Molar Extinction coefficient.

REFERENCES

1. D. Kleppner, R. J. Kolenkow (1973). An introduction to Mechanics. McGraw Hill.
2. N. K. Bajaj (2008). The Physics of Waves and Oscillations. 5th edition. Tata McGraw Hill.
3. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill.
4. David Freifelder (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Bioogy. 2nd edition. W.H. freeman and Company.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Protein Structure and Enzymology (BS-DSC-302)	**4**	**2**	**0**	**2**	Class XII pass with Biology and chemistry, as one of the papers in Class XII	**Should have studied Chemistry of Biomolecules**

Learning Objectives

The Learning Objectives of this course are as follows:

- Designed with an aim to introduce the students to proteins, most remarkable biomolecules in terms of diversity of structure and function
- Impart knowledge regarding various techniques employed to purify and characterize proteins
- Introduce them to the world of enzymes, biological catalysts with remarkable properties
- Enable them to understand important aspects of enzyme kinetics, mechanism of enzyme action and their regulatory properties
- Introduce the role of proteins and enzymes in medicine

Learning outcomes

Upon completion of the course, the students will be able to:

- Describe the functional diversity of proteins and the different levels of structural organization of proteins
- Explain the relationship between protein structure and function.
- Appreciate and analyse the data from techniques used to purify and characterise proteins.
- Explain enzyme classification, activity, kinetics, inhibition, regulation and mechanism of action of different classes of enzymes
- Acquire knowledge about the application of enzymes in medicine and industry.

SYLLABUS OF DSC- 8

Theory

Unit I: Protein structure and folding 11 Hours

Amino acids: structure and their properties; Peptides and proteins; Diversity of proteins; Organization of protein structure- primary, secondary, tertiary and quaternary structures; Protein sequencing- Edman degradation. Peptide bond- dihedral angles; Ramachandran plot; Secondary structure elements: Helices, sheets and turns. Motifs and domains; Structures of myoglobin and Hemoglobin. Oxygen binding curves of myoglobin and hemoglobin Influence of 2,3-BPG, CO_2. Denaturation and renaturation of proteins and introduction to thermodynamics of folding. Role of chaperones in protein folding.

Unit II: Purification and analysis of proteins 4 Hours

Ammonium sulphate fractionation, dialysis. Chromatographic techniques: Ion exchange chromatography, molecular sieve chromatography. Gel electrophoresis: SDS-PAGE.

Unit III: Introduction to Enzymes and enzyme kinetics 8 Hours

Protein and non-protein nature of enzymes. Cofactor and prosthetic groups. Classification of enzymes; Fischer's lock & key and Koshland's induced fit hypothesis. Enzyme activity and specificity. Enzyme Kinetics-Michaelis-Menten equation and Lineweaver-Burk plot. Determination of Km, Vmax, Kcat. Types of enzyme inhibitions- competitive, uncompetitive, non-competitive, mixed.

Unit IV: Mechanisms of enzyme action and regulation 7 Hours

Acid-base and covalent catalysis (chymotrypsin); Allosteric regulation and feedback inhibition (ATCase); reversible covalent modification (glycogen phosphorylase); Zymogen; Multi-enzyme complex (PDH). Isoenzymes. Applications of enzymes in medicine, industry and research

PRACTICALS (60 Hours)

1. Introduction to spectrophotometer and verification of Beer law.
2. Estimation of proteins by Biuret method.
3. Estimation of proteins by Lowry's method.
4. Ammonium sulphate fractionation of crude homogenate from germinated mung beans.

5. Assay for acid phosphatase activity and specific activity.
6. Progress curve of enzyme
7. Effect of pH on enzyme activity.
8. Determination of Km and Vmax using Lineweaver-Burk plot.
9. Calculation of Ki for an enzyme

REFERENCES

1. Nelson, D.L., Cox, M.M. (2021). Lehninger: Principles of Biochemistry (8th ed.). New York, WH: Freeman and Company. ISBN: 13: 978-1319381493 / ISBN-10:1319381499.
2. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd. ISBN: 978-1-11809244-6.
3. Cooper, T. G. (2011) The Tools of Biochemistry (2nd ed.), Wiley-Interscience Publication (New Delhi); ISBN13: 9788126530168.
4. Price, N. C. and Stevens, L. (1999). Fundamentals of enzymology (3rd ed). Oxford: Oxford University Press; ISBN13: 978-0198502296

Additional Resources

1. Sheehan, D. (2013). Physical biochemistry: Principles and applications (2nd ed). Chichester: Wiley-Blackwell; ISBN13: 978-0470856024

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE –9 :

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Functional Ecology (BS-DSC-303)	**4**	**2**	**0**	**2**	Class XII pass with Biology and chemistry, as one of the papers in Class XII	**NA**

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the basic concepts in ecology and levels of organization in an ecosystem
- Obtain a basic understanding of the various aspects of a 'population' and interactions among individuals of the same as well as different species.
- To understand the structure and functions of the community and its processes.
- To comprehend the components of an ecosystem, energy flow and nutrient cycling.
- To appreciate the applied aspects required in restoration of degraded ecosystems.
- To understand trade-offs in life history characteristics of organisms and various behaviors shownby organisms.

Learning outcomes

By the end of the course, the student will be able to:

- To comprehend the principles and applications of ecology and ecosystem.
- Know about the importance of ecosystem in general and the effects of changes inecosystem.
- Understand the techniques used for the quantitative and qualitative estimation of bioticand abiotic components of an ecosystem.
- Gain knowledge about the density, frequency and diversity of species in an ecosystem.
- Understand about key interactions between organisms like competition , predation ,parasitism etc.
- Participate in citizen science initiatives from an ecological perspective

SYLLABUS OF DSC-9

Theory

Unit 1: Introduction to Ecology **03 Hours**

History of ecology, Autecology and synecology, levels of Organisation, Laws of limiting factors (Liebig's law of minimum, Shelford's law of tolerance), ecological range (Eury and Steno).

Unit 2: Population Ecology **12 Hours**

Population: Unitary and Modular populations; Metapopulation: Density, natality, mortality, life tables, fecundity tables, survivorship curves, sex ratio, age pyramids, dispersal and dispersion; carrying capacity, population dynamics (exponential and logistic growth equation and patterns), r and K selection, density-dependent and independent population regulation; Niche concept, Population interactions: Positive and negative interactions; Competition, Gause's Principle for competition with laboratory and field examples, Lotka-Volterra equation for predation.

Unit 3: Community Ecology 08 Hours

Community structure: Dominance, diversity, species richness, abundance, stratification; Diversity indices; Ecotone and edge effect; Community dynamics (succession): Primary and secondary succession, Succession on a bare rock. Climax: monoclimax and polyclimax concepts (preclimax, postclimax, disclimax etc.). Concept of keystone, indicator and flagship species with plant and animal examples.

Unit 4: Ecosystem Ecology 07 Hours

Concept, components, and types of ecosystems (example of Pond ecosystem in detail showing abiotic and biotic components), BOD, eutrophication. Energy flow (Grazing and Detritus food chain), linear and Y-shaped energy flow model, black box model, food web. Ecological pyramids and Ecological efficiencies.

PRACTICALS

CREDITS: 2 **Total weeks: 60 Hours**

1. To understand the principle and working of ecological instruments such as Anemometer, Hygrometer, Luxmeter, Rain gauge, turbidity meter, pH meter, Soil thermometer, Min-Max thermometer.
2. To study biotic interactions using specimens/ photographs/ permanent slides of Parasitic angiosperms, Saprophytic angiosperms, root nodules, velamen roots, lichens , corals
3. 3.To study plant-microbe interactions by preparing temporary stained mounts of VAM fungi / mycorrhizal roots/ root nodules.
4. Mark recapture method for determining population density of animals
5. 5.To determine a minimal quadrat area for sampling
6. To determine density, frequency and abundance of herbaceous vegetation by quadrat method
7. To estimate dissolved oxygen content of a given water sample using Winkler's method.
8. Plotting of survivorship curves from hypothetical life table data.

REFERENCES

1. Barrick, M., Odum, E. P., Barrett, G. W., (2005).*Fundamentals of Ecology*.5th Edition.Cengage Learning.
2. Smith, T. M..& Smith, R. L.(2012). *Elements of Ecology* 8th Edition. Pearson.
3. Ricklefs, R. E., & Miller, G. L., (2000).*Ecology*, 4thEdition W.H. Freeman.
4. Sharma, P. D. (2017). *Ecology and Environment*.13th Edition. Meerut: Rastogi Publications.

MOOCs

1. 'Ecology: Ecosystem Dynamics and Conservation from American Museum of Natural History on Coursera https://www.classcentral.com/course/coursera-ecology- ecosystem-dynamics-and- conservation-10618
2. https://alison.com/course/diploma-in-ecology-studies
3. https://swayam.gov.in/ Any ecology based online course that may be available during the semester, depending on its relevance to the present syllabus