Syllabus of 7th and 8th semester
FYUGP Zoology (UG) Madhabdev University

Course Outline

Semester	Paper Type	Paper Code	Credit	Paper Name	Total Credit
UG 7TH	MAJ/CORE	ZOOM 701	4	Evolutionary Biology	22
	MAJ/CORE	ZOOM 702	4	Applied Zoology	
	MAJ/CORE	ZOOM 703	4	Wild life conservation and management	
	MAJ/CORE	ZOOM 704	4	Research Methodology	
	MIN/GE	ZOON 701	4	Evolutionary Biology	
	Seminar/Presentation/ Internship/Research Project		2	Seminar/Presentation/ Internship/Research Project	
UG 8TH	MAJ/CORE	ZOOM 801	4	Aquatic Biology	FOR UG DEGREE WITH RESEARCH= Total Credit 24. FOR UG DEGREE WITH HONOURS=Total Credit 22.
	MAJ/CORE	ZOOM 802	4	Histology	
	MAJ/CORE	ZOOM 803	4	Essentials of Biochemistry	
	MIN/GE	ZOON 801	4	Aquatic Biology	
	FOR UG DEGREE WITH RESEARCH				
	PROJECT	Research Proj.	8	Research Proj.	
	FOR UG DEGREE WITH HONOURS				
	Seminar/Presentation/ Internship/Research Project		**2**	Seminar/Presentation/ Internship/Research Project	
	MAJ/CORE	ZOOM 804	4	Fundamental of Bioinformatics	

Detailed syllabus of 7th semester
Title of the paper: Evolutionary Biology
Course Code: ZOOM/ZOON 701
Nature of course: Major/Minor
Total credit: 4
(60 Lectures, 52 Marks)

Course Objectives:
Understand the link between environment and evolution. Understand how we can determine whether or not a population is evolving for a specific character.

Unit1: Origin of Life: Primitive atmospheric conditions; chemogeny, biogeny and cognogeny; RNA world; origin of photosynthesis, evolution of eukaryotes
(15 lectures)

Unit2:Evidences of evolution: Evidences in favour of evolution (homology and analogy, vestigial structure, biogenetic law, missing and connecting links, molecular evidence); neutral theory of molecular evolution; molecular clock; rocks and fossils; types and formation of fossils; geological time scale; carbon dating.
(15 lectures)

Unit3:Theories of evolution: theories of evolution (Lamarckism, Darwinism,neo-Darwinism or modern synthetic theory), their evidence and criticism.Patterns of evolution (Divergent, parallel and convergent evolution): adaptive radiation (exemplified by Darwin's finches)
(15 lectures)

Unit4:Causes of evolution: variation, types of variation: heritable variation and their role in evolution; genetic basis of variation (recombination, mutation and hybridisation); natural selection and artificial selection; changes in gene frequency (genetic drift, gene flow and genetic load); Hardy –Weinberg law and its application.
(15 lectures)

PRACTICAL (18 Marks)

1. Study of homology and analogy from suitable specimens/models
2. Study of important transitional froms/connecting links: Peripatus, Neopilina, Balanoglossus, Protopterus, Chimaera, Platypus and Archaeopteryx
3. Study of important living fossils (Cyanobacteria, jellyfish, cockroach, sphenodon, opossum)
4. Study of materials/organisms of evolutionary significance;
5. Rocks(igneous,sedimentary,metamorphic)
6. Fossils(plantsandanimalsparts)

Reference book:

- Kliman, R.M.(2016). Encyclopedia of evolutionary biology. Academic Press.
- Pigliucci,M.,&Kaplan,J.(2010). Making sense of evolution: The conceptual foundations of evolutionary biology. University of Chicago Press.
- Rose,M.R.(1994).Evolutionary biology of ageing.Oxford University Press.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learning outcomes:

- Students get information about the inheritance of modern organisms from ancient ones.
- Evolution describes our origin and relations to other living things.
- Variations are produced through which offspring can adapt to a new environment. It produces species diversity.

Detailed syllabus of 7th semester
Title of the paper: Applied Zoology
Course code: ZOOM 702
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course Objective: Applied Zoology is a specialisation within zoology that uses the knowledge and methods of zoology to solve real-world problems

UNIT1:Basic concepts: Inland fisheries, Marine fisheries & Aquaculture, Sports and ornamental fishes. Problems of aquaculture: Fish parasites, identification, classification and control measure Natural breeding and induced breeding of Carps. Composite fish culture &integrated farming; Types of fish food: Natural food organisms and artificial fish feed.

(15 lectures)

UNIT2: (12 Lectures,12Marks)
Sericulture in N.E. India: Mulberry and non-mulberry silkworms, their host plants, life history and commercial culture; Diseases of silkworm-Prophylaxis, symptoms and control; Apiculture: Different species of honey bees, social organisation, Life history, Commercial culture, CommercialproductsandEconomicimportance, Diseasesofhoneybee: prophylaxis, symptoms and control

(15 lectures)

UNIT3:(12 Lectures,10Marks)
Biology of composting earthworm, methods and processing of vermicomposting, advantages of vermicompost, Life history of lac insect, cultivation of lac, composition and properties of lac, enemies of lac cultivation, economic importance of lac

(15 lectures)

UNIT4:(12 Lectures,10Marks)
Major insect pests of rice, tea and maize: Biology, damage and their control; Defoliators and borers of forest trees and their control. Pests of crops and vegetables and their control. Different groups of pesticides and their mode of action; Pest Control: Mechanical, Biological, Genetic, Pheromonal, Insect growth regulators; Integrated Pest Management: Principle and strategies

(15 lectures)

PRACTICAL (18 Marks)

1. Study of important pests of paddy, tea, vegetables and stored grains and their submission.
2. Identification of silkworms (eri, muga and mulberry), immature and adult stages.
3. Submission of life cycles of eri/muga/mulberry silkworms.
4. Identification of economically important indigenous fishes.
5. Identification of common aquatic weeds, planktons and insects.

Reference Book:

Griffiths,M.(2015).Echidnas: International Series of Monographs in Pure and Applied Biology: Zoology (Vol. 38). Elsevier.

Schmidt, D. (2003). Guide to reference and information sources in the zoological sciences. Bloomsbury Publishing USA.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

InternalExamination-10Marks

Internal Examination / Seminar Presentation -10 Marks

Group Discussion /Assignment- 5 Marks

Attendance & Others-5 Marks

Learning outcomes:

- Students will be able to integrate and analyse information across levels of organisation ranging from cells to ecosystems within the zoological sciences to formulate arguments and critically evaluate scientific claims

Detailed syllabus of 7th semester
Title of the paper: Wildlife Conservation and Management
Course code: ZOOM 703
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course Objectives:
Provide information and advice on specific wildlife management problems.

Unit1:
Introduction to wildlife conservation: values of wildlife (positive and negative); conservation ethics; importance of conservation; causes of depletion; world conservation strategies

(15 lectures)

Unit2:(12 Lectures,12Marks)
Evaluation and management of wildlife: Habitat analysis: physical parameters; topography, geology, soil and water; biological parameters; food, cover, forage, browse and estimation; standard evaluation procedure; remote sensing and GIS.

(15 lectures)

Unit3:(12 Lectures,10Marks)
Management of habitats: Setting back succession; grazing, logging; mechanical treatment; advancing the successional process; cover construction; preservation of general genetic diversity; restoration of degraded habitats

(15 lectures)

Unit4:(12 Lectures,10Marks)
Management planning of wildlife: Estimation of carrying capacity, ecotourism/ wildlife tourism in forest; concept of climax persistence; ecology of perturbence Legislations and convention on wildlife (national and international parks and wildlife sanctuaries, biosphere reserve; community reserve; important features of protected area in Assam; tiger convention in India; Management challenges in tiger reserve.

(15 lectures)

PRACTICAL (18 Marks)

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies: use, care and maintenance (compass, binoculars, spotting scope, range finders, global positioning system, various types of cameras and lenses)
3. Familiarisation and study of animal evidence in the field; identification of animals through pug marks, hoof marks, scats, pellet groups, nests, antlers, etc.
4. Demonstration of different field techniques for flora and fauna.

Reference Book:

- Krausman,P.R.,&Cain,J.W.(Eds.).(2022).Wildlife management and conservation:contemporaryprinciples andpractices. JHU Press.
- Princee, F. P. (2016). Exploring studbooks for wildlife management and conservation (Vol. 17). Cham, Switzerland: Springer.
- Silvy,N.J.(Ed.).(2020).TheWildlifeTechniquesManual: Volume1:Research. Volume 2: Management. JHU Press.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learning outcomes:

- Students will be able to identify species, characteristics, habitat requirements and life cycles of birds, fish and/or mammalian wildlife species.□
- Students will be able to apply knowledge to solve problems related to wildlife conservation and management.

Detailed syllabus of 7th semester
Title of the paper: Research Methodology
Course code: ZOOM 704
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course objective:
A research methodology provides a framework and guidelines for the students to clearly define research questions, hypotheses, and objectives. It helps researchers to identify the most appropriate research design, sampling technique, and data collection and analysis methods.

Course content:
UNIT 1: Concept and nature of research, Types of research, Significance of research, Formulation of research problem, Novelty of research in support of existing literature, Setting the hypothesis or objective, criteria of good research, problems encountered by researchers in India. (13 lectures)
UNIT 2: Definition of sampling, Sampling designs and types, Types of data collection, introduction to data presentation, statistical analysis of data and interpretation of data. (13 lectures)
UNIT 3: Different forms of scientific writing- article, reports, notes, review article; Dissertation writing format: content, writing style, drafting titles/ subtitles, chapterization, Proper description of methods and methodology, presentation of data with statistical analysis, writing results, discussion and conclusion. Bibliography and referencing style, Appendices. (18 lectures)

UNIT 4: Utility of computer/software- MS Office, Excel, PowerPoint, graphics, SPSS; Use of internet for research purposes- Email, WWW, web browsing, Use of E-journals, use of E-library. (16 lectures)

PRACTICAL (18 Marks)

1. MS Word – Preparation of a mini research article, Citation, and referencing
2. MS Excel – Statistical analysis, Graphical representation of research data
3. PowerPoint – Scientific presentation preparation
4. Searching research articles using Google Scholar and PubMed.

Reference Book:

- Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th edition.
- Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
- Research Methodology- C. R. Kothari 4. Select references from the Internet

Learning outcomes:

By studying the course, the students will have a clear idea about research, how to identify the research gap, setting the objective of the study and also will have the knowledge on how to write a dissertation or any other research article. They will also gain basic knowledge of computers and different computer applications.

Detailed syllabus of 7th semester
Title of the paper: Evolutionary Biology
Course code: ZOON 701
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course Objectives:
Understand the link between environment and evolution. Understand how we can determine whether or not a population is evolving for a specific character.

Unit1: Origin of Life: Primitive atmospheric conditions; chemogeny, biogeny and cognogeny; RNA world; origin of photosynthesis, evolution of eukaryotes

(15 lectures)

Unit2:Evidences of evolution: Evidences in favour of evolution (homology and analogy, vestigial structure, biogenetic law, missing and connecting links, molecular evidence); neutral theory of molecular evolution; molecular clock; rocks and fossils; types and formation of fossils; geological time scale; carbon dating.

(15 lectures)

Unit3:Theories of evolution: theories of evolution (Lamarckism, Darwinism,neo-Darwinism or modern synthetic theory), their evidence and criticism.Patterns of evolution (Divergent, parallel and convergent evolution): adaptive radiation (exemplified by Darwin's finches)

(15 lectures)

Unit4:Causes of evolution: variation, types of variation: heritable variation and their role in evolution; genetic basis of variation (recombination, mutation and hybridisation); natural selection and artificial selection; changes in gene frequency (genetic drift, gene flow and genetic load); Hardy –Weinberg law and its application.

(15 lectures)

PRACTICAL (18 Marks)

7. Study of homology and analogy from suitable specimens/models
8. Studyofimportanttransitionalfroms/connectinglinks: Peripatus, Neopilina, Balanoglossus, Protopterus, Chimaera, Platypus and Archaeopteryx
9. Studyofimportantlivingfossils(Cyanobacteria,jellyfish,cockroach,sphenodon, opossum)
10. Study of materials/organisms of evolutionary significance;
11. Rocks(igneous,sedimentary,metamorphic)
12. Fossils(plants and animal parts)

Reference book:

- Kliman, R.M.(2016). Encyclopediaof evolutionarybiology.Academic Press.
- Pigliucci,M.,&Kaplan,J.(2010). Making sense of evolution: The conceptual foundations of evolutionary biology. University of Chicago Press.
- Rose,M.R.(1994).Evolutionary biology of ageing.Oxford University Press.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learning outcomes:

- Students get information about the inheritance of modern organisms from ancient ones.
- Evolution describes our origin and relations to other living things.
- Variations are produced through which offspring can adapt to a new environment. It produces species diversity.

Detailed syllabus of 8th semester
Title of the paper: Aquatic Biology
Course code: ZOOM 801
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course Objectives: The Study of protection and restoration of water quality and the management of the freshwater environment.

Unit1:Aquatic biomes: Brief introduction of the aquatic biomes: freshwater ecosystems (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

(15 lectures)

Unit2:Freshwater biology:Lakes: Origin and classification, lake as an ecosystem, lake morphometry, physico-chemical characteristics: light, temperature, thermal stratification, dissolved solids, carbonate, bicarbonates, phosphates and nitrates, turbidity; dissolved gases (oxygen, carbon dioxide); nutrient cycles in lakes-nitrogen, sulphur and phosphorus. Streams: Different stages of stream development, physico-chemical environment, adaptation of hill-stream fishes.

(15 lectures)

Unit3: Marine biology: Salinity and density of seawater, continental shelf, adaptations of deep-sea organisms, coral reefs, sea weeds.

(15 lectures)

Unit4:Management of aquatic resources: Causes of pollution: agricultural, industrial sewage, thermal and oil spills, eutrophication, management and conservation (legislations), Sewage treatment, water quality assessment- Biological, mechanical and chemical.

(15 lectures)

PRACTICAL (18 Marks)

- Determine the area of a lake/pond using graphimetric and gravimetric methods.
- Identification of important macrophytes, phytoplanktons and zooplanktons present in a lake/pond ecosystem.
- Determine the amount of turbidity/ transparency, dissolved oxygen, free carbon dioxide, and alkalinity (carbonates and bicarbonates) in water collected from a nearby lake/pond/stream.
- Instruments used in limnology (Secchi disc, Van Dorn bottle, conductivity meter, turbidity meter, PONAR grab sampler) and their significance.
- A project report on a visit to a sewage treatment plant/fisheries institute.

Reference Book:

- Maitland, P.S. (2013). Biology of freshwaters. SpringerScience&Business Media.
- Stanford, L. L., & Spacie, A. (1994).Biological monitoring of aquatic systems. CRC Press.
- Fay,R.R.,&Tavolga,W.N.(Eds.).(2012). Sensory biology of aquatic animals. Springer Science & Business Media.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learningoutcomes:
Upon completion of the course, students should be able to analyse and interpret different stages of stream development and the physicochemical environment

Detailed syllabus of 8th semester
Title of the paper: Histology
Course code: ZOOM 802
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Objectives: To know the microscopic structure and organisation of animal tissues, organs and their functions.

Unit 1: Introduction to Histology: Scope, Relevance in Biomedical sciences, pathology and experimental Zoology, Tissue processing.

(15 lectures)

Unit 2: Epithelial Tissue & Connective tissues: Structural organisation, characteristics of Types, structure, location, and functions. Connective tissue Proper (extracellular matrix), Specialised Connective Tissue: Blood: Components and their functions. Blood as a buffer system; Blood groups: ABO, Rh factor, MN, Golden blood; structure types and functions of bones and cartilages

(15 lectures)

Unit 3: Muscular Tissues: Types and functions of muscles; Ultrastructure of skeletal muscle; Molecular and chemical basis of skeletal muscle contraction; isotonic and isometric contraction. Characteristics of muscle twitch; treppe, summation and tetanus; Electromyography. Nervous Tissues, Neurons: Structure, types and functions; Neuron doctrine, Classification and properties of nerve fibres 3. Glia Cells: Structure, types and functions; Synapse: Structure and types; Neuromuscular junction

(15 lectures)

Unit 4: Histology of Organs, Structural organization of the gastrointestinal tract and functions of associated glands, Structure of salivary glands, liver, pancreas and lungs, Structural organisation of the mammalian heart, histology of blood vessels, Structure of kidney and its functional unit.

(15 lectures)

PRACTICAL (18 Marks)

1. Study of permanent slides/ photo-micrographs of Mammalian skin, Cartilage, Bone, Spinal cord and brain tissue.
2. Study of permanent slide/ photo-micrographs of important organs and glands (mammalian
3. Pituitary, Pancreas, Kidney, Adrenal, Thyroid and Parathyroid, Testis, Ovary, Uterus)
4. Microtomy Procedure: Preparation of permanent slides.

Reference Book:

- Pushpalatha K and Bhat D (2022). Inderbir Singh's Textbook of Human Histology Xth. Jaypee Brothers Medical Publishers.

- Kim E. Barrett KE, Barman SM, Yuan J X.-J., Brooks H (2019). Ganong's Review of Medical Physiology, McGraw-Hill Education / Medical; 26th Edition.

- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

- Eric R. Kandel ER, Koester JD, Mack, S.H. (2021). Principles of Neural Science. VI Edition, McGraw Hill Medical

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Course Outcome: Students will be able to analyse and classify animal tissues, comprehend their functions, and apply histological techniques for research and diagnostic purposes.

Detailed syllabus of 8th semester
Title of the paper: Essentials of Biochemistry
Course code: ZOOM 803
Nature of course: Major
Total credit: 4
(60Lectures,52Marks)

UNIT 1: Types and features of biochemical reactions. Bioenergetics: redox reaction, redox potential and free energy, oxidative and photophosphorylation and their mechanism. Structure of ATPase and Chemiosmotic theory of ATP synthesis.

(15 lectures)

UNIT2: Metabolism of Carbohydrates: Regulation of Glycolysis, Krebs Cycle, HMP pathway, glycogenesis, glycogenolysis; Glyoxylate cycle.

(15 lectures)

UNIT3: Structure of proteins in relation to their biological functions, primary, secondary, tertiary, and quaternary structure, maintenance of secondary structure, Ramachandran Plot, protein folding, Metabolism of amino acids (Transamination, Deamination, Urea Cycle) (15 lectures)

UNIT4: Lipids: β-oxidation of saturated and unsaturated fatty acids, biosynthesis of saturated fatty acids, its regulation; Enzymes: Enzyme-catalysed reaction. Single and bi-substrate reactions, mechanism of action, Allosteric enzymes, Enzyme induction and inhibition (competitive, noncompetitive, and uncompetitive), Enzymes: enzyme kinetics (Michaelis-Menten equation)

(15 lectures)

PRACTICAL (18 Marks)

1. Estimation of protein and carbohydrate in biological samples.
2. Estimation of ascorbic acid (Colourimetric).
3. Separation of amino acids by Paper/Thin Layer Chromatography
4. Assay of activity of an enzyme in biological samples

Reference Book:

- Lehninger's Principles of Biochemistry, Nelson and Cox, Sixth Edition or recent edition, Macmillan Press.
- Principles of Biochemistry, Voet, Voet and Pratt, 5th edition (2012) or recent edition, Wiley.
- Harper's Illustrated Biochemistry, Murray, Granner and Rodwell, (27th Ed.), McGraw Hill, New York, USA.

- Practical Biochemistry – Principles and Techniques, Wilson and Walker, Cambridge University Press, Cambridge[Latest edition].

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learning outcomes:
After completion of the course, the students will have a deep knowledge of protein structures, their synthesis, functions and enzyme actions and their inhibitors.

Detailed syllabus of 8th semester
Title of the paper: Aquatic Biology
Course code: ZOON 801
Nature of course: Major
Total credit: 4
(60Lectures, 52Marks)

Course Objectives: The study of protection and restoration of water quality and the management of freshwater environments.

Unit1: Aquatic biomes: Brief introduction to the aquatic biomes: freshwater ecosystems (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

(15 lectures)

Unit2:Freshwater biology:Lakes: Origin and classification, lake as an ecosystem, lake morphometry, physico-chemical characteristics: light, temperature, thermal stratification, dissolved solids, carbonate, bicarbonates, phosphates and nitrates, turbidity; dissolved gases (oxygen, carbon dioxide); nutrient cycles in lakes-nitrogen, sulphur and phosphorus. Streams: Different stages of stream development, physico-chemical environment, adaptation of hill-stream fishes.

(15 lectures)

Unit3:Marine biology: Salinity and density of seawater, continental shelf, adaptations of deep-sea organisms, coral reefs, sea weeds.

(15 lectures)

Unit4:Management of aquatic resources: Causes of pollution: agricultural, industrial sewage, thermal and oil spills, eutrophication, management and conservation (legislations), Sewage treatment, Water quality assessment- Biological, mechanical and chemical.

(15 lectures)

PRACTICAL (18 Marks)

1. Determine the area of a lake/pond using graphimetric and gravimetric methods.
2. Identification of important macrophytes, phytoplanktons and zooplanktons present in a lake/pond ecosystem.
3. Determine the amount of turbidity/ transparency, dissolved oxygen, free carbon dioxide, and alkalinity (carbonates and bicarbonates) in water collected from a nearby lake/pond/stream.
4. Instruments used in limnology (Secchi disc, Van Dorn bottle, conductivity meter, turbidity meter, PONAR grab sampler) and their significance.
5. A project report on a visit to a sewage treatment plant/fisheries institute.

Reference Book:

- Maitland, P.S. (2013). Biology of freshwaters. SpringerScience&Business Media.
- Stanford, L. L., & Spacie, A. (1994).Biological monitoring of aquatic systems. CRC Press.
- Fay,R.R.,&Tavolga,W.N.(Eds.).(2012). Sensory biology of aquatic animals. Springer Science & Business Media.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Learning outcomes:
Upon completion of the course, students should be able to analyse and interpret different stages of stream development and the physicochemical environment

Detailed syllabus of 8th semester with Research
Title of the paper: Research Project
Nature of course: Major
Total credit: 4
(Six months and 100 Marks)

Course objective: The aim and objectives of a project research work for final year students provide a clear focus and direction for the study. They serve as a roadmap, guiding the research process and helping to define the scope of the project.

Learning outcomes: Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should beableto demonstrateas aresult ofacompletingacourse. The real value of project-based learning lies in its ability to enhance students' higher-orderthinking skills, such as creative thinking skills, problem-solving skills, and integrated application skills, by exploring real problems in small groups as a way to acquire the core concepts and principles of the subject.

Detailed syllabus of SEC for FYUGP 8th with Honours
Title of the paper: Fundamentals of Bioinformatics
Course code: ZOOM 804/ PZOC 204
Nature of course: SEC
Total credit: 4 (3 T + 1 Pr)
(60 Lectures, 52 Marks)

Course Objectives

The course aims to:

1. Introduce students to the fundamental concepts and scope of bioinformatics.
2. Familiarize and provide hands-on experience to students in using biological databases.
3. Develop skills in sequence analysis and sequence alignment.
4. Enable students to interpret biological information using computational approaches.
5. Introduce the relationship between protein sequence, structure, and biological function.
6. Familiarize students with protein structure prediction and visualization tools.

Syllabus:

Unit I: Basics of Bioinformatics **5**
Lectures

Introduction to bioinformatics, history and evolution, scope and applications, branches and interdisciplinary nature of bioinformatics.

Unit II: Biological Databases **20**
Lectures

Introduction to biological databases: primary, secondary and composite databases; nucleotide sequence databases (GenBank, ENA, DDBJ); protein sequence databases (UniProt, Swiss-Prot, TrEMBL); protein structural databases (PDB); specialized databases (ensemble, KEGG, BioCyc); literature databases (PubMed); Sequence data formats (FASTA, GenBank, PDBx/mmCIF); database searching and retrieval.

Unit III: Sequence Alignment and Analysis **15**
Lectures

Concept of biological sequences; pairwise and multiple sequence alignment, global and local alignment; Needleman-Wunsch and Smith-Waterman algorithms, sequence similarity, identity and homology; scoring matrices (PAM, BLOSUM). Basic Alignment tools (BLAST, EMBOSS Needle/Water).

Unit IV: Protein Structure and visualization Tool **20**
Lectures

Amino acids; peptide bonds**;** primary, secondary, tertiary and quaternary structures; Ramachandran plot; forces stabilizing protein structures; structural motifs and domains; methods of protein structure determination: X-ray crystallography, NMR spectroscopy and Cryo-EM; Protein Data Bank (PDB) and protein structure file formats (PDB and mmCIF); protein visualization, structural analysis and comparison using PyMOL, UCSF Chimera/ChimeraX, BIOVIA DSV and Mol* Viewer. Introduction to protein structure

prediction; sequence–structure relationship; Protein modeling: homology modeling (SWISS-MODEL).

Practical: Total credit: 1 (18 marks)

1. Searching and retrieval of biological information from sequence databases.
2. Sequence similarity search using BLAST.
3. Accessing, downloading and retrieving information about protein structure from PDB Database.
4. Sequence alignment using alignment tool.
5. Protein structure visualization and analysis using PyMOL.
6. Protein structure prediction using SWISS-MODEL.
7. Evaluation of protein models using Ramachandran plot.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)
InternalExamination-10Marks
Internal Examination / Seminar Presentation -10 Marks
Group Discussion /Assignment- 5 Marks
Attendance & Others-5 Marks

Course Outcome:
On completion of the course the students will be able to
CO1: Explain the fundamental concepts of phylogenetics.
CO2: Construct and validate molecular phylogenetic trees using MSA tools and MEGA software.
CO3: Execute basic Linux command-line operations and write simple shell scripts
CO4: Retrieve, visualize, and analyze protein structures using bioinformatics resources.
CO5: Perform basic protein structure prediction and evaluate model quality.

Suggested Reading:

1. Ghosh, Z., & Mallick, B. (2008). *Bioinformatics: Principles and Applications*.
2. Ignacimuthu, S. (2005). *Basic Bioinformatics*.
3. Mount. D.W. (2nd Edition). *Sequence and genome analysis.*