



KANNUR UNIVERSITY
കണ്ണൂർ സർവകലാശാല

(Abstract)

FYUG Life Science (Zoology) & Computational Biology Programme in Affiliated colleges - Fifth to Eighth semester Syllabus - Approved and implemented with effect from 2024 Admission-- Orders - Issued

ACADEMIC C SECTION

ACAD C/ACAD C1/23339/2024

Dated: 16.03.2026

- Read:-1. U O No. ACAD C/ACAD C1/23339/2024 Dated: 26.11.2024
2. U O No. ACAD C/ACAD C1/23339/2024 Dated: 14.08.2025
3. E mail dated 18.10.2025 from Dr. Sinosh Skariyachan, Assistant Professor, Department of Microbiology, St. Pius X College, Rajapuram.
4. Email dated 25.01.2026 from the Dean, Faculty of Science.
5. Orders of Vice Chancellor in the file of even No.dated 11.02.2026
6. Minutes of the meeting of the Standing Committee of the Academic Council held on 21.02.2026
7. Orders of Vice Chancellor in the file of even No. dated 16.03.2026

ORDER

1. As per the paper read as (1) above, the Scheme and the First and Second Semester syllabus of the FYUG Life Science (Zoology) & Computational Biology Programme in affiliated colleges under Kannur University were implemented with effect from the 2024 admission. The Syllabus of the Third & Fourth semesters were implemented as per the paper read as (2) above.
2. In the absence of a Board of Studies for B.Sc Life Sciences (Zoology) & Computational Biology, Dr.Sinosh Skariyachan, Assistant Professor, Department of Microbiology, St. Pius X College, Rajapuram, who was entrusted with preparing the syllabus of the programme, submitted the Fifth to Eighth Semester syllabus of the B.Sc. Life Sciences (Zoology) & Computational Biology Programme with effect from the 2024 admission for approval and further necessary action, vide the paper read as (3) above.
3. Subsequently, as ordered, the syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme was forwarded to the Dean, Faculty of Science, for verification.
4. The Dean, Faculty of Science, vide the paper read as (4) above, recommended the approval of the Fifth to Eighth Semester syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme with effect from the 2024 admission.
5. Considering the matter, the Vice Chancellor ordered to place the Fifth to Eighth Semester syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme to be implemented with effect from the 2024 admission, before the Standing Committee of the



Academic Council for consideration, vide the paper read as (5) above.

6. The Standing Committee of the Academic Council, held on 21.02.2026, vide the paper read as (6) above, considered the Fifth to Eighth Semester syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme to be implemented with effect from the 2024 admission and recommended approval of the same.
7. The Vice Chancellor, after considering the recommendation of the Standing Committee of the Academic Council, and in exercise of the powers of the Academic Council conferred under Section 11(1), Chapter III of the Kannur University Act, 1996, and all other enabling provisions read together with it, approved **the Fifth to Eighth Semester syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme in affiliated colleges under Kannur University and accorded sanction to implement the same with effect from the 2024 admission**, subject to reporting to the Academic Council.
8. The Fifth to Eighth Semester syllabus of the FYUG Life Sciences (Zoology) & Computational Biology Programme in affiliated colleges under Kannur University with effect from the 2024 admission is appended herewith.

Orders are issued accordingly.

Sd/-

Bindu K P G

DEPUTY REGISTRAR (ACADEMIC)

For REGISTRAR

- To:
1. The Controller of Examinations (Through PA to CE)
 2. Dr. Sinosh Skariyachan, Assistant Professor, Department of Microbiology, St. Pius X College, Rajapuram.
 3. The Principals of all affiliated Colleges.

- Copy To:
1. The Examination Branch (Through PA to CE)
 2. PS to VC/ PA to R
 3. DR/AR (Academic)
 4. JR (Exam)
 5. The Computer Programmer
 6. Web Manager (For uploading on the website)
 7. SF/DF/FC



Forwarded / By Order


SECTION OFFICER



Semester V



KU5DSCZCB301- DEVELOPMENTAL BIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC A8	300-399	KU5DSCZCB301	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course aims to elucidate various concepts in Developmental Biology and raise awareness about the cellular events during embryonic development. Students will be able to compare the properties of adult cells with those of embryonic cells. Additionally, they will learn about stem cells and the impact of differential gene expression on development

Course Prerequisite: Basic knowledge in Biology gained during at Plus Two level

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand and compare different developmental events among Animals	E
CO2	Explore the major cellular and molecular events during development	An
CO3	Interpret the effect of gene expression on embryonic development	E
CO4	Apply the knowledge in developmental biology for human welfare	A

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓



CO 4	✓		✓		✓	✓	✓	✓
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COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Early Processes in Developmental Biology		
1	Gametes and gametogenesis- Egg, Oogenesis, Structure of a typical egg(frog), Classification of egg based on the amount of yolk(micro, meso & macrolecithal),the distribution (iso, centro & telolecithal),Presence or absence of shell (cleidoic & non-cleidoic), the development (determinate & indeterminate) with examples. Egg membranes (primary, secondary and tertiary). Structure of sperm, Spermatogenesis. Early development- Cleavage:Types of cleavage with examples based on planes (meridional, vertical, equatorial and latitudinal); Based on the amount of yolk (Holoblastic, Meroblastic) ; Based on Development (Determinate & Indeterminate); Based on Pattern (Radial & Spiral). Blastulation: Different types of blastula: Coeloblastula, Stereoblastula, Discoblastula & Blastocyst. Morphogenetic movements: Emboly (Invagination, involution, convergence, divergence, infiltration, delamination & ingression), Epiboly. Potency, totipotency, pluripotency. Cell differentiation-differentiation, dedifferentiation, redifferentiation. Genomic equivalence, Metaplasia.	15
Development in Amphioxus, Chick, and Mammals (Human)		
2	Development of Amphioxus- Fertilization, Cleavage, blastulation, gastrulation, Neurulation Chick development- Structure of egg, Fertilization, cleavage, blastulation & gastrulation. Salient features of chick embryo at 18, 24 & 48-hour stage (Torsion and flexion). Human development- Structure of Graafian follicle, Brief account of events in the menstrual cycle, Ovulation, Capacitation, fertilization, acrosomal reaction, Prevention of polyspermy, Cleavage, blastulation, implantation, gastrulation, Gestational changes(trimesters), Parturition, Lactation. write the same paragraph in structured manner.	10
Organogenesis, Parthenogenesis, and Regeneration		
3	Organogenesis- Development of brain in amphibians, Eye development in amphibians. Parthenogenesis and its types, Regeneration: Types of regeneration- stem cell- mediated, epimorphosis, morphallaxis, and compensatory regeneration (Brief account), Affecting factors Extra embryonic membranes, In chick amnion, chorion and allantois Placentation: Types of placenta, Experimental embryology- Work of Hans Spemann: constriction experiments (importance of grey crescent and the potency of nuclei), Organizers in amphibian development (primary, secondary & tertiary). Cloning- Creating Dolly the sheep. Cell lineage studies in Planocera. Fate map (example frog). Methods of fate map construction: Natural marking, Artificial methods: Vital staining, carbon particle marking and radiolabeling, Assisted reproduction: Fertility medications, Assisted Reproductive Technologies (ART)-IVF (steps), IUI, ICSI, GIFT, ZIFT, PROST. Teratology: Influence of alcohol, retinoic acid, thalidomide, DES and BPA.	15



Practicals in Zoology		
4	<ol style="list-style-type: none"> 1. Identification of chick blastula 2. Identification of chick gastrula 3. Identification of different types of cleavage using pictures 4. Identification of fertilized egg 5. Identification of sperm and ovum 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Balinsky, B. I. (1981). An Introduction to Embryology. Saunders College Publishing.
2. Gilbert, S. F. (2016). Developmental Biology (11th ed.). Oxford University Press.
3. Wolpert, L. (1994). Principles of Development (3rd ed.). Oxford University Press.
4. Verma, P. S., & Agarwal, V. K. (2010). Chordate Embryology. Chand Publications.
5. Carlson, B. M. (2013). Human Embryology and Developmental Biology (5th ed.). Elsevier.

Suggested Readings:

1. Slack, J. M. W. (2012). Essential Developmental Biology (3rd ed.). Wiley-Blackwell.
2. Sadler, T. W. (2018). Langman's Medical Embryology (14th ed.). Wolters Kluwer.
3. Moody, S. A. (2014). Principles of Developmental Genetics (2nd ed.). Academic Press.
4. Gilbert, S. F., & Barresi, M. J. F. (2019). Developmental Biology (12th ed.). Sinauer Associates.
5. Schoenwolf, G. C., Bleyl, S. B., Brauer, P. R., & Francis-West, P. H. (2014). Larsen's Human Embryology (5th ed.). Churchill Livingstone.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation L		50
Continuous Evaluation L		25
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	5
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5



g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU5DSCZCB302- MOLECULAR MODELING AND INTERACTION PREDICTION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC A9	300-399	KU5DSCZCB302	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

Molecular modeling and interaction are pivotal disciplines in computational chemistry and molecular biology, providing critical insights into the structure, function, and behavior of molecules. This course offers a comprehensive exploration of the principles and applications of molecular modeling and interaction, focusing on the computational techniques used to predict molecular structures, study molecular interactions, and simulate dynamic processes. By combining theoretical knowledge with practical skills, students will learn to utilize molecular modeling tools to address complex problems in chemistry, biology, and materials science.

Course Prerequisite: A foundational understanding of molecular biology, chemistry, and basic computational techniques is required to effectively engage with molecular modeling and interaction concepts.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Able to understand various structural organization and conformations of proteins for biomolecular modelling studies	U
CO2	Able to understand the scope of computational biology in predicting primary, secondary and tertiary structures of proteins	U
CO3	Able to apply different force fields for evaluation of protein structures by relevant bioinformatics approaches.	U/A
CO4	Able to implement simulation studies for various proteins and analyse their structural aspects for functional studies.	U/A
CO5	Able to design and develop models for unknown protein structures using various computational biology tools.	A/C

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓					
CO 2	✓	✓		✓			✓	
CO 3		✓	✓	✓				
CO 4		✓	✓	✓	✓			
CO 5		✓	✓	✓	✓	✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Biomolecular Structure and modeling		
1	<ol style="list-style-type: none"> Historical perspective, Introduction to Molecular Modeling, Roots of Molecular modeling in Molecular mechanics. Introduction to X-Ray crystallography and NMR spectroscopy. Introduction to PDB and 3D Structure data, PDB format and other 3D structural format. Introduction to Protein Structure Hierarchy & Classes in protein architecture. 	15
Molecular modeling		
2	<ol style="list-style-type: none"> Homology Modelling and ab initio /threading prediction methods. Generation of 3D Coordinates Crystal data, Fragment libraries, and conversion of 2D Structural data into 3D form. Force fields, and Geometry optimization. Energy minimizing procedures - Use of Charges, Solvent effects and Quantum Mechanical methods. Computational biology tools for force filed analysis. Computational tools for Molecular modeling. Methods of Conformational analysis - Systematic search procedures, Monte Carlo and molecular dynamics methods. Determining features of proteins - Interaction potential, Molecular electrostatic potential, molecular interaction fields. 	10
Introduction to molecular dynamics		
	<ol style="list-style-type: none"> Basic MD algorithm, its limitations, treatment of long-range forces. Statistical mechanics for MD, Newtonian and Mote Carlo 	15



3	<p>approach, Energy minimization, Constant temperature, MD simulations, Brownian dynamics MD simulations, Molecular dynamics packages- AMBER, CHARMM, GROMOS, GROMACS, Energy calculations for complex interaction potentials, Molecular dynamics simulation of small molecule and macromolecules and their complexes, Free energy calculations.</p> <p>2. Membrane protein simulations: Membrane proteins and their importance, Membrane protein environments in vivo and in vitro. Modeling a complex environment - Simulation methods for membranes, Membrane protein systems, Complex solvents, Detergent micelles, Lipid bilayers, Self-Assembly and Complex systems.</p>	
Practicals in computational biology		
4	<ol style="list-style-type: none"> 1. Phylogenetic and evolutionary analysis of molecular sequences- Phylogenetic tree building and evaluation 2. Identification of functional sites in genes 3. Prediction of secondary structures of proteins and disordered regions 4. Prediction of secondary structures and folding of RNA 5. Prediction of post transnational modifications of proteins 6. Prediction of three-dimensional structure of proteins-homology modelling 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan. Molecular Modeling, Gerd Folkers, 2008.
2. Alberte Pullman. Modeling of Bimolecular Structures and Mechanisms, Joshua Jortner, 1995.
3. Jill P. Mesirov, Klaus Schulten, De Witt L. Sumners. Mathematical Approaches to Biomolecular Structure and Dynamics by, 1996.
4. Peter T. Cummings, Phillip R, Westmorland, Brice Carnahan Foundations of Molecular Modeling and Simulation by, Published by American Institute of Chemical Engineers, 2001.

Suggested Readings:

1. Nicolas Claude Cohen, Guidbook on molecular modeling in drug design Academic Press. Elsevier, 1996.
2. Tamar Schlick. Molecular Modeling and Simulation: An Interdisciplinary Guide: An Interdisciplinary Guide. Second Edition, Springer. 2010.
3. Tamar Schlick, Innovations in Biomolecular Modeling and Simulations, Volume 2, RSC Publishing. 2012.



4. Timothy J. Barth, Michael Griebel, David E. Keyes, Risto M. Nieminen, Dirk Roose, Tamar Schlick. *New Algorithms for Macromolecular Simulation* by, Published by Springer, 2006.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU5DSCZCB303- GENETICS & MOLECULAR BIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSC A10	300-399	KU5DSCZCB303	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course provides an in-depth exploration of the fundamental principles governing the structure, function, and regulation of biological molecules at the molecular level. Topics covered include DNA replication, transcription, translation, gene expression regulation, and mechanisms of genetic variation. Human Genetics is an introductory course aimed at examining the fundamental principles that govern the inheritance and variability of traits in humans. Through lectures, discussions, and laboratory exercises, students will explore the molecular mechanisms that dictate human heredity, genetic disorders, population genetics, and the ethical considerations surrounding genetic research and technologies.

Course Prerequisite: Basic knowledge of Biology at the Higher Secondary (Plus Two) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Acquire a thorough grasp of foundational principles in molecular biology.	E
CO2	Employ this understanding of molecular biology to conduct biological research and tackle complex biological issues.	An
CO3	Cultivate a comprehension of Mendelian principles and develop proficiency in solving associated genetic problems.	E
CO4	Grasp the concepts of genetic linkage, crossing over, and sex-linked inheritance in animals.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓



CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Molecular Biology		
1	Early experiments proving DNA as the genetic material: Griffith's experiment (Bacterial transformations), Avery, McLeod and McCarthy Hershey and Chase Experiments. Concept of Gene: Classical concepts (one gene one enzyme hypothesis, one gene one polypeptide hypothesis), Modern concept of genes, split genes, overlapping genes, pseudogenes, jumping genes, cryptic genes, housekeeping genes. Gene action: Central dogma of molecular biology and central dogma reverse (Brief Account only). Mention Genome and non-coding DNA, C-Value Paradox.	10
DNA Replication		
2	Meselson and Stahl experiment, Semi-conservative and semi-discontinuous mode of DNA replication, chemistry of DNA synthesis (Role of 3' OH and 5'PO4) , Role of RNA primase in E. coli , Role of RNaseH , DNA polymerases (types in prokaryotes and few types in eukaryotes). Direction of DNA synthesis, leading and lagging strands primer removal and joining of Okazaki fragments, Simultaneous synthesis on leading and lagging strands, Enzymes involved in DNA replication (Helicase, Topoisomerase, Ligase, DNA polymerase, Primase, RNase), Other proteins involved in DNA replication (Sliding clamps, clamp loaders, SSBP).	15
Gene Expression and Regulation		
3	Genetic code- properties of the genetic code, Concept of wobble Transcription- RNA polymerases of eukaryotes and prokaryotes, promoters, terminators, enhancers and silencers, Initiation, elongation and termination of transcription, Post-transcriptional modification of the primary transcript – hnRNA, capping, polyA-tailing and splicing, spliceosomes. Translation- Activation of amino acids and aminoacyl tRNA synthetases, structure of tRNA, Structure of ribosome, Initiation, elongation and termination of translation, Post translational modification of the peptide chain: cleavage, formation of disulfide-bridges, acetylation, glycosylation, myristoylation, sulphation,	15



	hydroxylation, prenylation, nitrosylation, ubiquitination and SUMOylation, Protein folding and role of molecular chaperones.	
Mendelian Principles & Linkage and Crossing over		
4	Monohybrid and Dihybrid Experiments, Interactions of Genes, Incomplete dominance and Co-dominance, complementary genes, supplementary genes and duplicate genes, Multiple alleles with examples: coat colour in rabbit. Human blood group inheritance: ABO, RhO factor, Chromosomal theory of Linkage and Types of Linkage, Crossing over and types, Mechanism of Crossing over. Cytological detection of Crossing over, significance of Crossing over. Sex determination in Man and Drosophila melanogaster., epistasis and its type. Gene and chromosomal mutations.	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Brooker, R. J. (Latest Edition). Genetics: Analysis and Principles. McGraw-Hill Education.
2. Snustad, D. P. & Simmons, M. J. (Latest Edition). Principles of Genetics. Wiley.
3. Lewis, R. (Latest Edition). Human Genetics: Concepts and Applications. McGraw-Hill Education.
4. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (Latest Edition). Introduction to Genetic Analysis. W.H. Freeman and Company.
5. Gupta, P. K. (2018). Molecular Biology and Biotechnology, 3rd Reprint. Rastogi Publications.

Suggested Readings:

1. Cowell, J. K. (2001). Molecular Genetics of Cancer. BIOS Scientific Publishers.
2. Ehrlich, M. (2000). DNA Alterations in Cancer. Eaton Publishing.
3. Gersen, S. L. & Keagle, M. B. (1999). Principles of Clinical Cytogenetics. Humana Press.
4. Johnson, M. H. & Everitt, B. J. (Latest Edition). Essential Reproduction. Wiley-Blackwell.
5. Pasternak, J. J. (2005). An Introduction to Molecular Human Genetics, 2nd Edition. Fitzgerald Science Press.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70



Continuous Evaluation L		30
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	10
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU5DSEZCB301- GENERAL PARASITOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEZCB301	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course addresses a broad spectrum of subjects concerning parasites, their vectors, the diseases they cause, and techniques for controlling vectors and preventing disease transmission. It offers a thorough understanding of parasitology and medical entomology, essential fields for comprehending and managing infectious diseases.

Course Prerequisite: Basic knowledge in Biology gained during in previous semesters of this programme.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand basic concepts about parasitic animals.	U
CO2	Differentiate between various ectoparasites and endoparasites.	E
CO3	Apply vector management strategies in preventing vector-borne diseases.	A
CO4	Evaluate mechanisms involved in the transmission of zoonotic diseases.	E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓



CO 4	✓		✓		✓	✓	✓	✓
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COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
General Concepts of Parasitology & Parasitic Protists		
1	Introduction to Parasitology: Definitions of parasites, parasitoids, hosts. Basic concepts: parasitism, symbiosis, commensalism, mutualism. Types of parasites and hosts, host-parasite relationships, modes of parasite transmission. Parasitic Protists: Study of morphology, life cycle, prevalence, epidemiology, pathogenicity, diagnosis, prophylaxis, and treatment of: <ul style="list-style-type: none"> • <i>Entamoeba histolytica</i> • <i>Giardia intestinalis</i> • <i>Trypanosoma gambiense</i> • <i>Leishmania donovani</i> • <i>Plasmodium vivax</i> 	10
Parasitic Platyhelminthes		
2	Parasitic Trematodes -Study of Morphology, Life Cycle, prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- <i>Fasciola hepatica</i> , <i>Schistosoma haematobium</i> . Parasitic Cestodes- Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- <i>Taenia solium</i> , <i>Hymenolepis nana</i> .	15
Parasitic Nematodes		
3	Intestinal Nematodes: <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> Tissue-dwelling Nematodes: <i>Wuchereria bancrofti</i> , <i>Loa loa</i> . For each: Morphology, life cycle, prevalence, epidemiology, pathogenicity, diagnosis, prophylaxis, and treatment.	15
Parasitic Arthropods & Vertebrates		
4	Parasitic Arthropods: Biology, importance, and control of: <ul style="list-style-type: none"> • <i>Boophilus</i> (tick), <i>Sarcoptes</i> (mite) • <i>Pediculus humanus</i> (head and body louse) • <i>Xenopsylla cheopis</i> (rat flea) • <i>Cimex lectularius</i> (bed bug) Parasitic Vertebrates: Biology, importance, and parasitic behavior of: <ul style="list-style-type: none"> • Cookiecutter shark • Hood mockingbird • Vampire bat 	15



5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Arora, D.R. & Arora, B. (2001). Medical Parasitology, 2nd Edition. CBS Publications.
2. Parija, S. C. Textbook of Medical Parasitology, Protozoology & Helminthology (Text and Colour Atlas), 2nd Edition. All India Publishers & Distributors, Chennai & Delhi.
3. Paniker, C.K.J., Ghosh, S. [Ed.] (2013). Paniker's Textbook of Medical Parasitology. Jaypee Brothers, New Delhi.
4. Chatterjee, K.D. (2009). Parasitology: Protozoology and Helminthology, 13th Edition. CBS Publishers.
5. Roberts, L.S. & Janovy, J. (2009). Foundations of Parasitology, 8th Edition. McGraw-Hill.

Suggested Readings:

1. Noble, E.R. & Noble, G.A. (1982). Parasitology: The Biology of Animal Parasites, 5th Edition. Lea & Febiger.
2. Bogitsh, B.J. & Cheng, T.C. (2000). Human Parasitology, 2nd Edition. Academic Press, New York.
3. Meyer, Olsen & Schmidt. Essentials of Parasitology, by Murray, D. Dailey. W.C. Brown Publishers.
4. Gunn, A. & Pitt, S.J. (2012). Parasitology: An Integrated Approach. Wiley-Blackwell.
5. Ahmed, N., Dawson, M., Smith, C. & Wood, Eds. (2007). Biology of Disease. Taylor and Francis Group.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU5DSEZCB302- PHARMACOINFORMATICS- THE GENETIC BLUEPRINT OF PERSONALIZED THERAPY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEZCB302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

Pharmacoinformatics: The Genetic Blueprint of Personalized Therapy offers a comprehensive exploration of how genetic information can be harnessed to optimize drug therapies. By integrating genetic data with pharmacological knowledge, students will be equipped to contribute to the future of personalized medicine. This course empowers students to not only understand the current landscape but also to innovate and drive advancements in therapeutic strategies tailored to individual genetic profiles. The course will provide an in-depth exploration of chemoinformatics and medicinal chemistry, focusing on how computational techniques can be applied to understand and manipulate chemical systems, and ultimately, to design new pharmaceuticals.

Course Prerequisite: Fundamentals of Pharmacoinformatics course should have a basic understanding of genetics and an introductory knowledge of pharmacology and data analysis.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the fundamental principles of Pharmacoinformatics and its role in drug discovery and development.	U
CO2	Acquire knowledge of drug design and development processes, including target identification, virtual screening, and lead optimization.	U/A
CO3	Master the application of bioinformatics tools and databases for drug discovery and development.	A
CO4	Comprehend the principles of pharmacogenomics and personalized medicine, including genetic variations and their impact on drug response.	U
CO5	Analyze the role of pharmacokinetics and pharmacodynamics in drug development and optimization.	An/A



CO6	Evaluate the ethical, legal, and social implications pharmacogenomics and personalized medicine.	E
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***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
CO 1	✓	✓						
CO 2	✓	✓	✓	✓				✓
CO 3		✓		✓			✓	
CO 4	✓	✓		✓				
CO 5	✓	✓		✓				
CO 6				✓			✓	

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Pharmacoinformatics		
1	<ol style="list-style-type: none"> 1. Definition and Scope: Understanding Pharmacoinformatics as the intersection of pharmacology and information science. 2. Historical Perspective: The evolution of Pharmacoinformatics from drug discovery to personalized medicine. 3. Role of Bioinformatics: Integration of bioinformatics tools and databases in Pharmacoinformatics. 4. Challenges and Opportunities: Overcoming hurdles in data integration, standardization, and privacy concerns. 	10
Drug Discovery and Development		
2	<ol style="list-style-type: none"> 1. Drug Discovery Process: Target identification, validation, and drug design. 2. High-Throughput Screening (HTS): Principles, applications, and limitations. 3. Virtual Screening: Structure-based and ligand-based approaches. 4. Computational Drug Design: Quantitative structure-activity 	15



	<p>relationship (QSAR), de novo drug design, and molecular docking.</p> <p>5. Pharmacokinetics (PK) and Pharmacodynamics (PD): Basic concepts and their role in drug development.</p> <p>6. Drug Metabolism and Pharmacokinetics (DMPK): Importance of ADMET properties in drug discovery.</p>	
Pharmacogenomics and Personalized Medicine		
3	<p>1. Pharmacogenomics: Definition and its impact on drug response.</p> <p>2. Genetic Variations: Single nucleotide polymorphisms (SNPs), copy number variations, and their influence on drug efficacy and toxicity.</p> <p>3. Pharmacogenetics: The study of genetic variations affecting drug response.</p> <p>4. Personalized Medicine: Concept, benefits, and challenges.</p> <p>5. Biomarkers: Role of biomarkers in predicting drug response and toxicity.</p> <p>6. Clinical Implementation: Strategies for implementing personalized medicine in healthcare.</p>	15
Bioinformatics Tools and Databases in Pharmacoinformatics		
4	<p>1. Databases and Repositories: DrugBank, PubChem, ChEMBL, and other relevant databases.</p> <p>2. Data Mining and Knowledge Discovery: Techniques for extracting valuable information from large datasets.</p> <p>3. Cheminformatics: Chemical structure representation, similarity searching, and virtual libraries.</p> <p>4. Bioinformatics Tools: Sequence alignment, phylogenetic analysis, and protein structure prediction.</p> <p>5. Systems Biology Approaches: Network analysis and modeling for drug discovery and development.</p> <p>6. Data Integration and Standards: Interoperability of data sources and standardized data formats.</p>	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Cannon, J.G., 1996. An Introduction to Medicinal Chemistry By Graham L. Patrick. Oxford University Press, New York. 1995. 336 pp. ISBN 0-19-855872-4.
2. Gasteiger, J. and Engel, T. eds., 2006. Chemoinformatics: a textbook. John Wiley & Sons.
3. Goldstein, A., Aronow, L. and Kalman, S.M., 1970. Principles of drug action. The basis of pharmacology. Journal of Medicinal Chemistry, 13(2), pp.337-337.
4. Jones, N.C. and Pevzner, P.A., 2004. An introduction to bioinformatics algorithms. MIT press.



5. Jiawei, H. and Micheline, K., 2006. Data mining: concepts and techniques. Morgan kaufmann.

Suggested Readings:

1. Shin, J., Kayser, S.R. and Langae, T.Y., 2009. Pharmacogenetics: from discovery to patient care. American Journal of Health-System Pharmacy, 66(7), pp.625-637.
2. Nyola, N., Jeyablan, G., Kumawat, M., Sharma, R., Singh, G. and Kalra, N., 2012. Pharmacoinformatics: A tool for drug discovery. Am J Pharm Tech Res, 2(3).
3. Ginsburg, G.S. and Willard, H.F., 2009. Genomic and personalized medicine: foundations and applications. Translational research, 154(6), pp.277-287.
4. Ma, J.D., Lee, K.C. and Kuo, G.M., 2012. Clinical application of pharmacogenomics. Journal of pharmacy practice, 25(4), pp.417-427.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU5DSEZCB303- GENERAL ENTOMOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	DSE	300-399	KU5DSEZCB303	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

Entomology is the scientific study of insects, encompassing their development, diversity, and practical applications. This field of study emerged in the early 19th century as a distinct discipline. Entomology covers the study of all terrestrial and aquatic insects within the phylum Arthropoda. Insects represent the largest group of animals, making up 75% of all living animal species. With over one million known species worldwide and many more yet to be discovered, insects were the first creatures to achieve flight and remain the only flying invertebrates. They are the most successful animals, thriving in every possible ecological niche.

Course Prerequisite: A fundamental understanding of Biology at the Higher Secondary level is required.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Demonstrate understanding of insect morphology and classification.	U
CO2	Analyze structural modifications across diverse insect species.	An
CO3	Identify and differentiate various groups of insects.	E
CO4	Explain adaptive strategies of insects in different environments.	E
CO5	Assess the significance of economically important insects.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓



CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
External Morphology		
1	General morphology of the head – Opisthognathous, Hypognathous, Prognathous Head skeleton – sutures, sclerites, Tentorium Cephalic appendages Thorax – segmentation, skeleton, Endothorax, thoracic appendages Modifications of thoracic legs Wings – structure, venation Abdomen – segmentation, skeletal composition, pregenital & postgenital segments Abdominal appendages External genitalia – male and female	10
Insect Classification		
2	Introduction to classification: Apterygota, Exopterygota, Endopterygota, Hemimetaboly, Holometaboly Apterygota – Diagnostic features of Orders: Collembola, Protura, Diplura, Thysanura Exopterygota – Diagnostic features of Orders: Ephemeroptera, Odonata (dragonflies & damselflies), Isoptera (castes), Phasmida, Blattaria, Mantoidea, Orthoptera, Hemiptera, Thysanoptera, Psocoptera, Phthiraptera, Dermaptera, Plecoptera, Embioptera, Zoraptera Endopterygota – Diagnostic features of Orders: Coleoptera, Lepidoptera, Hymenoptera, Diptera, Siphonaptera, Strepsiptera, Neuroptera, Mecoptera, Megaloptera, Raphidioptera, Trichoptera	15
Ecology of Insects		
3	Aquatic insects – factors influencing aquatic life, food capture, respiration, anchorage, locomotion, adaptations of swimming forms Gall-forming insects – definition, features, common gall pests, gall as dwelling place, adaptations for gall-making habits Leaf-mining insects – definition, identification, forms of leaf mines, feeding habits, frass disposal.	15



Behaviour of Insects		
4	Social insects – organization and caste differentiation in Termites, Honey bees, and Ants Communication–acoustic, visual, tactile, and chemical methods (pheromones) Co-evolution – insect–plant co-evolution	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Borror, D.J., Triplehorn, C.A. & Johnson, N.F. (1989). *An Introduction to the Study of Insects* (6th ed.). Saunders College Publishing, Philadelphia.
2. Gillott, C. (2005). *Entomology* (3rd ed.). Springer, Dordrecht.
3. Richard, W. & Davies, R.G. (1977). *Imm’s General Textbook of Entomology* (10th ed.). Chapman & Hall, London.
4. Snodgrass, R.E. (1935). *Principles of Insect Morphology*. McGraw-Hill Book Company, New York.
5. Nayar, K.K., Ananthkrishnan, T.N. & David, B.V. (1976). *General and Applied Entomology*. Tata McGraw-Hill, New Delhi

Suggested Readings:

1. Ananthkrishnan, T.N. (1992). *Dimensions of Insect–Plant Interactions*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Cardé, R.T. & Bell, W.J. (1995). *Chemical Ecology of Insects* (Vol. 2). Chapman & Hall, New York.
3. Wilson, E.O. (1971). *The Insect Societies*. Belknap Press of Harvard University Press, Cambridge, MA.
4. Romoser, W.S. & Stoffolano, J.G. (1994). *The Science of Entomology* (3rd ed.). Wm. C. Brown Publishers, Oxford.
5. Wigglesworth, V.B. (1964). *The Life of Insects*. Weidenfeld & Nicolson, London.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation L		70
Continuous Evaluation L		30
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	10
d)	Seminar	10



e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		100

Any components from the above table can be taken for CE not exceeding 30 Marks



**KU5SECZCB301- STRUCTURAL BIOINFORMATICS AND PROTEIN
STRUCTURE PREDICTION**

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
V	SEC	300-399	KU5SECZCB301	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	15L+10P	35L+15P	75	1.5

COURSE DESCRIPTION:

This skill-enhanced course is designed to provide an in-depth understanding of structural bioinformatics and protein structure prediction. The course integrates theory with practical applications, offering students both foundational knowledge and hands-on experience in predicting and analyzing protein structures. By covering key concepts and employing advanced computational tools, students will gain the skills needed to tackle real-world challenges in structural biology.

Course Prerequisite: NIL

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the fundamental concepts of structural bioinformatics, protein structure hierarchy, and utilize bioinformatics tools for structure analysis and visualization.	U/A
CO2	Master protein structure prediction techniques including homology modeling, threading, and ab initio methods, while ensuring model quality through refinement and validation.	U/A
CO3	Acquire knowledge of protein domain analysis, protein-protein interactions, and structure-based drug design principles.	U
CO4	Develop practical skills in using bioinformatics tools for protein structure analysis, prediction, and drug design.	A/C
CO5	Appreciate the significance of structural bioinformatics in understanding biological processes and its applications in drug discovery.	E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓	✓	✓					
CO 2	✓	✓	✓	✓				
CO 3	✓	✓	✓	✓				
CO 4	✓	✓	✓	✓	✓		✓	
CO 5	✓		✓	✓		✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Structural Bioinformatics		
1	<ol style="list-style-type: none"> 1. Introduction to bioinformatics and structural bioinformatics 2. Importance of protein structure in biological function 3. Protein structure hierarchy (primary, secondary, tertiary, quaternary structure) 4. Protein structure databases (PDB, SCOP, CATH, Pfam) tools (e.g., PyMOL, Chimera) used for structural bioinformatics. 5. Techniques for Protein Structure Prediction 6. Homology modeling: principles, steps, and limitations 7. Threading methods: concept, advantages, and disadvantages 8. Ab initio protein structure prediction: challenges and recent advancements 9. Structure refinement and validation: energy minimization, molecular dynamics simulations 10. Homology modeling using SWISS-MODEL 11. Model quality assessment (PROCHECK) using Ramachandran plot and other validation tools. 	15
Protein Structure Analysis and Function Prediction		
2	<ol style="list-style-type: none"> 1. Protein domain analysis and functional annotation 2. Protein-protein interactions: types, prediction methods, and databases 	10



	<ol style="list-style-type: none"> Protein-ligand interactions: docking, virtual screening, and drug design Structure-based drug design: principles and applications 	
Practicals		
3	<ol style="list-style-type: none"> Database Exploration: Hands-on exercises using PDB and other databases to retrieve and analyze protein structures. Visualization Skills: Practical sessions in PyMOL or Chimera to visualize and interpret different levels of protein structure. Basic protein structure analysis (secondary structure prediction) Protein domain identification using Pfam or InterPro Protein-protein interaction prediction using docking tools (ZDOCK, ClusPro). 	30
4	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

- Lesk, A. M. (2014). Introduction to computational biology: A problem-solving approach. Oxford University Press.
- Mount, D. W. (2004). Bioinformatics: sequence and genome analysis. Cold Spring Harbor Laboratory Press.
- Goodsell, D. S. (2001). The machinery of life. Springer Science & Business Media.
- Branden, C., & Tooze, J. (1999). Introduction to protein structure. Garland Science.
- Sali, A., & Honig, B. (1998). Computational methods for protein structure prediction. Annual review of biophysics and biomolecular structure, 27(1), 539-565.
- Altschul, S. F., Madden, T. L., Schäffer, A. A., Zhang, J., Zhang, Z., Miller, W., & Lipman, D. J. (1997). Gapped BLAST and PSI-BLAST: a new generation of protein database search programs. Nucleic acids research, 25(17), 3389-3402

Suggested Readings:

- Sali, A., & Overington, J. P. (1994). A systematic analysis of protein folds. Journal of molecular biology, 233(1), 375-400.
- Branden, C., & Tooze, J. (1999). Introduction to protein structure. Garland Science.
- Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry: Life at the molecular level. Wiley.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular biology of the cell. Garland Science.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	35
Continuous Evaluation L	15
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	5
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	50

Any components from the above table can be taken for CE not exceeding 15 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks





Semester VI

KU6DSCZCB304- DATA-DRIVEN DRUG DISCOVERY: THE EVOLUTION OF CHEMOINFORMATICS & MEDICINAL CHEMISTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC A11	300-399	KU6DSCZCB304	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This advanced course is designed specifically for students in Computational Biology, aiming to integrate computational methods with chemistry for the advancement of drug discovery and development. The course will provide an in-depth exploration of chemoinformatics and medicinal chemistry, focusing on how computational techniques can be applied to understand and manipulate chemical systems, and ultimately, to design new pharmaceuticals.

Course Prerequisite: Basic Chemistry, introductory Biology, fundamental Mathematics and Statistics, and basic computer literacy are required.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Able to understand the importance cheminformatics in drug discovery process	U
CO2	Able to understand the applications of databases and computational biology tools in various exercises in cheminformatics	U
CO3	Able to understand Pharmacokinetics and Pharmacodynamics aspects in Computational medicinal chemistry	U
CO4	Able to implement models for drug likeliness and ADMET predictions for various small molecules	U/A
CO5	Equipped with knowledge of various kinds of small molecules and drugs used in computational medicinal chemistry	U/An

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓	✓					✓	
CO 2		✓						
CO 3			✓					
CO 4				✓	✓			
CO 5						✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Chemoinformatics		
1	<ol style="list-style-type: none"> 1. Fundamental concepts - molecular descriptors and chemical spaces, chemical spaces and molecular similarity, modification and simplification of chemical spaces. Compound classification and selection. Chemoinformatics Databases- Need and scope. 2. Types of small molecules databases, Small molecules structure creation, drawing programs, optimization, Database search methods: Chemical indexing, Proximity searching, 2D and 3D Structure and Substructure searching. Similarity searching: Structural queries and Graphs, Pharmacophores, Fingerprints. 	15
Introduction to Medicinal Chemistry		
2	<ol style="list-style-type: none"> 1. Basics concepts: Introduction to Medicinal Chemistry, History of Medicinal Chemistry, Classification of drugs, Important Terminology used in Medicinal Chemistry, Pharmacokinetics: Introduction to drug absorption, disposition, drug metabolism, elimination, toxicity, important pharmacokinetic parameters in defining drug disposition and in therapeutics, mention of uses of pharmacokinetics in drug development process, concept of pro drug and soft drug. 2. Pharmacodynamics: Introduction, principles of drug action, mechanisms of drug action, introduction to the concept of receptors and drug receptor interactions, Dose-response relationships, drug potency and efficacy, combined effect of drugs. Drug Design & Development: History and development of SAR and QSAR, Physicochemical parameters, Lipophilicity, electronic parameters, 	10



	steric parameters. Classical SAR/QSAR.	
Computational virtual screening		
3	<ol style="list-style-type: none"> 1. Classification and SAR of various drugs: Antibiotics: Introduction, classification, mode of action of various antibiotics, Antimalarial agents, Antifungal agents. Natural molecules from plants, microorganisms and marine sources (brief). Application of computational biology with case studies. 2. Computational virtual screening: Introduction. "Drug-Likeness" and compound filters. Structure-based virtual screening and prediction of ADMET Properties. Various statistical models, Combinatorial Chemistry and Library Design: Introduction. Diverse and Focused libraries. Library enumeration. Combinatorial library design strategies. 3. Molecular docking: Overview and principles, Types of docking, docking process. 	15
Practicals in Computational Biology		
4	<ol style="list-style-type: none"> 1. Prediction of the three-dimensional structure of the protein by ab initio prediction and fold recognition methods 2. Model refinement, validation and energy minimization of the hypothetical model 3. Creation of the structure of lead molecules and optimization and analysis of 3D structures of the lead molecules 4. Prediction of drug likeliness features and ADMET properties of lead molecules. 5. Prediction of the binding sites of the protein target 6. Study of protein-protein docking-rigid body docking 7. Study of receptor ligand interaction-Flexible body docking 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Sehgal SA, Mirza AH, Tahir RA, Mir A. Quick Guideline for Computational Drug Design. Bentham Science Publishers, 2018.
2. Leach AR, Gillet VJ. An Introduction to Chemoinformatics, Springer, 2007.
3. Young D. C. Computational Drug Design: A Guide for Computational and Medicinal Chemists, Wiley-Interscience, 2009.
4. Povl Krosgaard-Larsen, Tommy Liljefors, Ulf Madsen. Textbook of drug design and discovery, Published by Taylor & Francis, 2002.
5. Camille. G. Wermuth. The Practice of Medicinal Chemistry, 3rd Edition, Academic Press, 2008.



6. Graham & Patrick. Introduction to Medicinal Chemistry (3rd edn.) OUP (2005)

Suggested Readings:

1. Alexandros Makriyannis, Diane Biegel, Marcel Dekker. Drug Discovery Strategies and Methods, 2004.
2. Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale Lippincott. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Williams & Wilkins, 2010.
3. Patrick. G.L. An introduction to medicinal chemistry, 5th edition, Oxford University Press, New York.
4. Varnek A, Tropsha A. Chemoinformatics Approaches to Virtual Screening, Royal Society of Chemistry, 2008.

Assessment Rubrics:

		Theory	
Evaluation Type		Marks	
End Semester Evaluation L		50	
Continuous Evaluation L		25	
a)	Test Paper- 1	5	
b)	Test Paper-2	5	
c)	Assignment	5	
d)	Seminar	10	
e)	Book/ Article Review	-	
f)	Viva-Voce	5	
g)	Field Report	-	
Total L		75	

Any components from the above table can be taken for CE not exceeding 25 Marks

		Practicals	
Evaluation Type		Marks	
End Semester Evaluation P		15	
Continuous Evaluation P		10	
a)	Test Paper- 1	5	
b)	Test Paper-2	5	
c)	Record	5	



d)	Lab skill	10
e)	Regularity	5
f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU6DSCZCB305- ANIMAL PHYSIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC A12	300-399	KU6DSCZCB305	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course serves as an introductory study of animal biology, focusing on essential topics such as animal size, homeostasis, osmoregulation, sensory systems, and locomotion. It covers the structure and function of tissues, organs, and organ systems, while introducing students to the concepts of homeostasis, heat exchange in animals, osmoregulation, and locomotory structures such as muscles and the skeleton. In addition, the course addresses important topics including animal coloration, integument, nerve impulse transmission, memory, and sensory organs.

The course also explores the physiological processes of animals, including nutrition, respiration, circulation, excretion, nerve function, and muscle activity. Through theoretical study and practical application, students will gain an understanding of how animals maintain homeostasis and adapt to diverse environments.

Course Prerequisite: Basic knowledge of Biology at the higher secondary level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Identify and explain the basic physiological processes that allow animals to survive in different habitats.	U
CO2	Apply the scientific method to studies of animal physiology by conceiving and designing an experimental approach for studying specific physiological processes.	A
CO3	Improve scientific literacy by critically evaluating scientific literature and articulating key questions, hypotheses, methods, results, and conclusions.	An
CO4	Evaluate and compare different approaches for applying physiological principles to practical applications in the lab and field to answer physiological questions.	E



CO5	Connect physiological principles to other scientific disciplines (e.g., ecology, behaviour, morphology).	C
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***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Digestion, Respiration, and Circulation		
1	<p>Constituents of a normal diet and their daily requirements; balanced diet (human perspective).</p> <p>Malnutrition: Protein–Energy Malnutrition (PEM), obesity.</p> <p>Digestion of carbohydrates, proteins, and lipids – role of salivary glands, liver, pancreas, and intestinal glands.</p> <p>Absorption of carbohydrates, lipids, amino acids, water, electrolytes, vitamins, and minerals in the gastrointestinal tract (GIT).</p> <p>Movements of the GIT (brief description of histology expected).</p> <p>Role of hormones (Gastrin, Enterogastrin, Cholecystokinin, Serotonin) and neurotransmitters (Acetylcholine, Adrenaline) in digestion and gastrointestinal motility.</p> <p>Physiological anatomy and histology of respiratory passages and lungs.</p> <p>Mechanism of pulmonary ventilation (inspiration and expiration).</p> <p>Gas exchange; role of surfactant in alveolar expansion.</p> <p>Pulmonary volumes and capacities.</p>	15



	<p>Transport of oxygen and carbon dioxide (Haldane effect, Bohr effect); oxygen dissociation curve. Neural and chemical regulation of respiration. Blood: composition and functions. Structure and conducting system of the human heart. Cardiac cycle and electrocardiogram (ECG): principle and applications. Blood clotting mechanism (extrinsic and intrinsic pathways); anticoagulants. Functions of lymph and lymphatic system.</p>	
Excretion and Muscle Physiology		
2	<p>Components (normal and abnormal) and characteristics of urine. Urine formation: glomerular filtration, tubular reabsorption, and tubular secretion. Mechanism of urine concentration – countercurrent system (multiplier and exchanger). Ornithine cycle. Hormonal control of urine formation. Renal regulation of acid–base balance. Physiology of micturition. Neuromuscular junction. Biochemistry of contractile proteins; physiology of skeletal muscle. Actomyosin complex; sources of energy for muscle contraction (Cori cycle). Sliding filament theory – mechanism of muscle contraction and relaxation. Role of calcium in contraction. All-or-none law; muscle fatigue.</p>	10
Nerve Physiology and Endocrinology		
3	<p>Membrane physiology: transport across cell membranes – diffusion, active transport, ionic pumps (Na⁺–K⁺ pump, calcium channels); uniports, symports, and antiports; co-transport by symporters and antiporters. Physiology of the neuronal system: neurons, membrane potential, propagation of action potential across myelinated and non-myelinated nerve fibers. Synaptic transmission; nerve impulse transmission; neurotransmitters. Histology and functions of endocrine glands and their hormones. Placental hormones. Hormonal control of the menstrual cycle.</p>	15
Practicals in Zoology		



4	<ol style="list-style-type: none"> 1. Qualitative tests for identification of ammonia, urea, and uric acid (nitrogenous excretory products). 2. Study of permanent histological sections of mammalian endocrine glands (pituitary, thyroid, pancreas, adrenal gland). 3. Estimation of haemoglobin using Sahli's haemoglobinometer. 4. Differential count of WBCs using haemocytometer. 5. Total RBC count using haemocytometer. 6. Human blood smear preparation. 	30
5	<p>Teacher Specific Module</p> <p>Suggested Activities:</p> <ul style="list-style-type: none"> • Effect of pH and temperature on salivary amylase activity. • Estimation of total protein by Lowry's method. <p><i>Directions</i></p>	5

Essential Readings:

1. Guyton, A.C. & Hall, J.E. (2011). Textbook of Medical Physiology (12th Edition). Harcourt Asia Pvt. Ltd./W.B. Saunders Company.
2. Tortora, G.J. & Derrickson, B.H. (2009). Principles of Anatomy and Physiology (12th Edition). John Wiley & Sons, Inc.
3. Widmaier, E.P., Raff, H. & Strang, K.T. (2008). Vander's Human Physiology (11th Edition). McGraw Hill.
4. Hoar, W.S. (1983). General and Comparative Physiology. Prentice Hall.
5. Prosser, C.L. (1978). Comparative Animal Physiology. W.B. Saunders Co.
6. Schmidt-Nielsen, K. (1994). Animal Physiology: Adaptation and Environment. Cambridge University Press.

Suggested Readings:

1. Bear, M.F. et al. (2007). Neuroscience: Exploring the Brain. Lippincott Williams & Wilkins.
2. Kandel, E.R. et al. (2000). Principles of Neural Science (4th Edition). McGraw Hill.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25



a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	5
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type		Marks
End Semester Evaluation P		15
Continuous Evaluation P		10
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Record	5
d)	Lab skill	10
e)	Regularity	5
f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU6DSCZCB306- VIRTUAL SCREENING AND COMPUTER-AIDED DRUG DESIGN

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC A13	300-399	KU6DSCZCB306	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course provides a comprehensive introduction to the principles and applications of Computer-Aided Drug Design (CADD), with a particular focus on Virtual Screening (VS). Students will gain a solid understanding of the computational methods and tools used to accelerate and optimize the drug discovery process. Students who successfully complete this course will have a strong foundation in CADD and VS, enabling them to contribute to drug discovery projects and make informed decisions in the pharmaceutical industry. They will be equipped with the skills to apply computational methods to identify and optimize potential drug candidates.

Course Prerequisite: Basic knowledge of biology, chemistry, and computational biology (as covered up to the previous semesters).

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the concept of molecular modelling in computational drug discovery.	U
CO2	Understand Virtual Screening Methods: Demonstrate proficiency in various virtual screening techniques, including ligand-based, structure-based, and pharmacophore-based methods.	U
CO3	Understand the concept of chemo-informatics and computational medicinal chemistry in structure-based drug discovery.	U
CO4	Apply the theoretical aspects and relevance of computer assisted drug discovery in pharmaceutical industry.	A
CO5	Inspect the utility of computational virtual screening and molecular docking studies in the success of modern drug discovery approaches.	An/E



CO6	Evaluate the scope of molecular dynamic simulation and quantitative structure activity relationship towards molecular modelling and drug discovery pipelines.	E
CO7	Develop innovative solutions to current challenges in drug discovery using computational approaches.	C

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓	✓	✓					
CO 2		✓	✓					
CO 3		✓		✓		✓	✓	
CO 4				✓	✓	✓	✓	
CO 5		✓			✓	✓		
CO 6			✓		✓	✓		
CO 7						✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Computational drug Discovery		
1	<ol style="list-style-type: none"> 1. Drug discovery and development process, Rational approaches in drug discovery, Second generation approaches, Molecular mimicry, Chemical intuition. Industrial perspectives: New lead discovery strategies. Composition of drug discovery teams, Current Practice of CADD in the pharmaceutical industry, Management structures of CADD groups, Contributions and achievements of CADD groups, Limitations of CADD support. 2. Introduction to molecular modeling in drug discovery. Molecular superposition and structural alignment, Energy minimization approaches. Model visualization, Pharmacophore modeling, 	10



	Receptor mapping. Computational biology tools for molecular modeling and model refinement. Case studies of small molecular modeling work- Nicotinic ligands, Sigma selective ligands, Antimalarial compounds.	
Computer aided Virtual screening in drug discovery		
2	<ol style="list-style-type: none"> 1. Computational virtual screening- Structure based virtual screening. Drug likeliness, ADMET Studies, Computational biology tools for prediction of ADMET-Variou statistical models 2. Molecular docking in Computational drug discovery: Molecular docking: Overview and principles, Types of docking, docking process-Preparation of ligand and receptor, Search algorithms, scoring functions, binding site analysis and setting the bounding box, Running the docking calculations. Docking with known and unknown three-dimensional structures of the receptors, Major docking programs and utilities. 	15
Molecular dynamic simulations		
3	<ol style="list-style-type: none"> 1. Force field and Overview of MD simulation, Computational requirements, Process of MD simulation, validation of force field and programs - MM, AMBER, NAMD, CHARMM, GROMOS, GROMACS. Methods of molecular energy calculations - ab initio, semi-empirical, density functional analysis 	15
QSAR Modelling in Computational drug discovery		
4	<ol style="list-style-type: none"> 1. QSAR-Overview, 2D/3D/4D/5D QSAR, Deriving a QSAR equation. Simple and multiple linear regressions. Designing a QSAR experiment. Principal components regression, Partial least squares. Molecular Field Analysis (CoMFA, CoMSIA). Application of QSAR modeling in drug discovery, Case studies. 	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Grover, A. ed., 2017. Drug Design: Principles and Applications. Springer.
2. Sehgal SA, Mirza AH, Tahir RA, Mir A. Quick Guideline for Computational Drug Design. Bentham Science Publishers, 2018.
3. Leach AR, Gillet VJ. An Introduction to Chemoinformatics, Springer, 2007.
4. Cohen NC, Guidebook on molecular modeling in drug design Academic Press. Elsevier, 1996.
5. Cummings PT, Phillip R, Westmorland, Carnahan B. Foundations of Molecular Modeling and Simulation by, Published by American Institute of Chemical Engineers, 2001.



Suggested Readings:

1. Cavasotto CN. In Silico Drug Discovery and Design: Theory, Methods, Challenges, and Applications. CRC Press. 2015
2. Merz KM, Ringe D, Reynolds CH. Drug Design: Structure- and Ligand-Based Approaches. Cambridge University Press. 2010
3. Patrick. G.L. An introduction to medicinal chemistry, 5th edition, Oxford University Press, New York.
4. Varnek A, Tropsha A. Chemoinformatics Approaches to Virtual Screening, Royal Society of Chemistry, 2008.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU6DSEZCB304- MEDICAL PARASITOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEZCB304	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course provides a comprehensive understanding of medical parasitology, focusing on the biology, epidemiology, and diagnosis of parasitic infections. It covers different types of parasites and the diseases they cause, including parasitic protists and parasitic vertebrates. Students will also learn various clinical diagnostic techniques, including modern molecular methods, for identifying different parasites.

Course Prerequisite: Basic knowledge of Biology acquired in previous semesters.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand various diseases caused by parasites.	U
CO2	Apply the most suitable diagnostic technique to identify infections, based on symptoms or available data.	An
CO3	Employ immune assays or serological techniques for laboratory diagnosis of endoparasites using marker molecules.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓



COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Medical Entomology		
1	Vectors and their morphological adaptations. Vector-borne diseases: Mosquito-borne: Chikungunya, Dengue fever Flea-borne: Plague, Flea-borne typhus Lice-borne: Relapsing fever, Epidemic typhus Tick-borne: Tick-borne encephalitis Mite-borne: Lyme disease, Rocky Mountain spotted fever	10
Vector Control Measures		
2	Mechanical control Ecological control Chemical control Biological control Genetic control Integrated Pest Management (IPM) Host and vector competence	15
Zoonotic Diseases		
3	Rabies Nipah SARS MERS COVID-19	15
Medical Diagnosis and Clinical Parasitology		
4	Examination of blood and faeces Examination of tissues Diagnosis of parasitic diseases: traditional and modern approaches Advantages and disadvantages of molecular diagnosis Immunoassay and serological techniques for laboratory diagnosis of endoparasites using marker molecules such as: <i>Giardia intestinalis</i> <i>Entamoeba histolytica</i> <i>Leishmania donovani</i> Malarial parasites (using ELISA, RIA, PCR)	15
5	Teacher Specific Module	5
	<i>Directions</i>	



Essential Readings:

1. WHO – Vector Control Strategies
2. Vector Control Research Centre (ICMR)
3. Indian Council of Medical Research (ICMR) – Main Portal
4. Journal of Parasitology
5. Journal of Medical Parasitology

Suggested Readings:

1. International Journal of Parasitology
2. Journal of Parasitic Diseases
3. Journal of Entomological Research
4. Additional WHO technical reports and guidelines on neglected tropical diseases and parasitic infections
5. Selected research articles and review papers on advances in molecular diagnosis and vector control

Assessment Rubrics:**Theory**

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU6DSEZCB305- BIOINFORMATICS IN PLANT BREEDING AND GENETICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEZCB305	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

Bioinformatics has become an indispensable tool in plant breeding and genetics, facilitating the advancement of crop improvement and the understanding of plant genomics. This course provides a comprehensive exploration of how bioinformatics integrates with plant breeding and genetics to enhance crop productivity, resilience, and quality. Over the duration of the course, students will gain a deep understanding of bioinformatics tools and techniques and their application in the field of plant science.

Course Prerequisite: Basic knowledge of genetics, plant biology, molecular biology, and introductory bioinformatics.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the fundamental principles of bioinformatics and its applications in plant sciences.	U
CO2	Acquire knowledge of plant genome structure, function, and evolution and how bioinformatics can be used to study them.	U/A
CO3	Master the use of bioinformatics tools and databases for analyzing biological data related to plants.	A
CO4	Develop skills in designing and conducting bioinformatics analyses to address questions in plant breeding and genetics.	C/A
CO5	Comprehend the application of bioinformatics in molecular marker development, QTL mapping, and marker-assisted selection.	A/E
CO6	Gain insight into the role of bioinformatics in modern plant breeding strategies and crop improvement.	An/E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓							
CO 2	✓	✓						
CO 3		✓						
CO 4		✓	✓	✓	✓			✓
CO 5		✓		✓		✓		
CO 6		✓		✓		✓	✓	

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Bioinformatics and Plant Genomics		
1	<ol style="list-style-type: none"> 1. Definition of bioinformatics, its scope, and applications in biology 2. Biological databases: NCBI, GenBank, PDB, Swiss-Prot, their structure, and search strategies 3. Sequence formats (FASTA, GenBank, EMBL) and their significance 4. Sequence alignment: Basic concepts of pairwise and multiple sequence alignment, algorithms (Needleman-Wunsch, Smith-Waterman, BLAST), and their applications 5. Phylogenetic analysis: Basic concepts, tree construction methods (UPGMA, NJ, ML), and interpretation 6. Plant genome structure: Eukaryotic genome organization, gene content, repetitive elements, and heterochromatin 7. Genome size and complexity: C-value paradox and its implications 	10
Molecular Markers and Marker-Assisted Selection		
2	<ol style="list-style-type: none"> 1. Molecular markers: Types (RFLP, RAPD, SSR, SNP, InDel), principles, and applications 2. Marker development: Techniques for marker development and polymorphism detection 3. Linkage analysis: Concept of linkage, linkage maps, and their construction 4. QTL mapping: Definition, methods (interval mapping, composite interval mapping), and applications 	15



	<p>5. Marker-assisted selection (MAS): Principles, advantages, and limitations</p> <p>6. Association mapping: Population structure, linkage disequilibrium, and GWAS</p>	
Bioinformatics in Plant Breeding		
3	<p>1. Genome-wide association studies (GWAS): Design, analysis, and interpretation of GWAS data</p> <p>2. Genomic selection: Concept, methods (GS models), and its application in breeding</p> <p>3. Bioinformatics tools for breeding data management: Databases for germplasm, pedigree, phenotype, and genotype data</p> <p>4. Marker-assisted breeding strategies: MAS, marker-assisted backcrossing, genomic selection</p> <p>5. Bioinformatics in crop improvement: Applications in yield, quality, and stress tolerance improvement</p>	15
Bioinformatics in Plant Biotechnology		
4	<p>1. Bioinformatics in transgenic plant development: Gene identification, vector design, and transformation.</p> <p>2. Gene editing technologies and bioinformatics: CRISPR-Cas9 system, off-target effects, and bioinformatics tools for design.</p> <p>3. Bioinformatics for metabolic engineering: Pathway analysis, flux balance analysis, and metabolic engineering strategies</p> <p>4. Systems biology and plant modeling: Concept of systems biology, network analysis, and modeling approaches.</p>	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Jones, N.C. and Pevzner, P.A., 2004. Bioinformatics algorithms.
2. Edwards, D. ed., 2008. Plant bioinformatics: methods and protocols (Vol. 406). Springer Science & Business Media.
3. Staub, J.E., Serquen, F.C. and Gupta, M., 1996. Genetic markers, map construction, and their application in plant breeding. HortScience, 31(5), pp.729-741.
4. Acquaah, G., 2015. Conventional plant breeding principles and techniques. Advances in plant breeding strategies: Breeding, biotechnology and molecular tools, pp.115-158.
5. Somerville, C. and Somerville, S., 1999. Plant functional genomics. Science, 285(5426), pp.380-383.

Suggested Readings:

1. Kahl, G. and Meksem, K. eds., 2008. The handbook of plant functional genomics: concepts and protocols. John Wiley & Sons.



2. Zhang, Q. and Wing, R.A. eds., 2013. Genetics and genomics of rice (Vol. 5). Springer Science & Business Media.
3. Setlow, J.K. ed., 2012. Genetic engineering: principles and methods (Vol. 13). Springer Science & Business Media.
4. Gomez-Casati, D.F., Busi, M.V., Barchiesi, J., Peralta, D.A., Hedin, N. and Bhadauria, V., 2018. Applications of bioinformatics to plant biotechnology. Current issues in molecular biology, 27(1), pp.89-104.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU6DSEZCB306- AGRICULTURAL ENTOMOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEZCB306	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

Agricultural Entomology, a branch of entomology, deals with the study of insect pests and beneficial insects associated with field crops, fruits, and vegetables. The course aims to provide students with knowledge of insect biology and their roles in agricultural systems, while also equipping them with the skills to identify major crop pests and adopt appropriate management technologies to reduce crop losses.

Course Prerequisite: Basic knowledge of Biology at the +2 level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Gain knowledge about the biology and status of different types of insect pests.	U
CO2	Identify various pest species.	U/A
CO3	Apply suitable pest control measures without harmful side effects.	A

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓



COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Insect Pests		
1	<p>Types of damage to plants by insects: Injury caused by chewing insects Injury caused by piercing and sucking insects Injury by internal feeders Injury by subterranean insects Damage to stored products Indirect effects of feeding</p> <p>Classification of insect pests: Regular pests Occasional pests Seasonal pests Persistent pests Sporadic pests Major pests Minor pests Potential pests Key pests</p> <p>Causes of pest outbreaks</p>	10
Insect Pests of Crops		
2	<p>Identification, life history, nature of damage, and control of major pests of:</p> <p>(a) Major Grains: Paddy (5 major pests including stem borers, army worm, Brown Planthopper, rice hispa, rice earhead bug)</p> <p>(b) Pulses and Vegetables: Pulses (2 pests: Gram pod borer, Blue butterflies) Common vegetables (3 pests: Pumpkin beetle, Tomato fruit borer, Dacus cucurbitae)</p> <p>(c) Oil Yielding Crops: Coconut (4 pests: Rhinoceros beetle, Red palm weevil, Black-headed caterpillar, Coconut mite)</p> <p>(d) Fruit Trees and Spices: Mango (2 pests: Nut weevil, Stem borer) Cashew (2 pests: Tree borers, Tea mosquito bug) Banana (2 pests: Rhizome weevil, Banana skipper) Pepper (2 pests: Pollu beetle, Marginal gall thrips)</p> <p>(e) Stored Products: Rice weevil Pulse beetle Red flour beetle Rice moth</p>	15



Principles of Insect Pest Management		
3	<p>Curative or Direct Methods: Cultural methods Mechanical methods Physical methods Legal methods Chemical Control: Explanation with examples: Synthetic insecticides: Organochlorines (DDT), Organophosphates (Parathion), Carbamates (Carbaryl) Inorganic compounds (Arsenic compounds) Fumigants (HCN) Botanical insecticides (Pyrethroids) Disadvantages of chemical control Biological Control: History of biological control Ecological basis of biological control Natural enemies (Parasites, Parasitoids, Predators) Feasibility of biological control Advantages and disadvantages of biological control Integrated Pest Management (IPM): Definition IPM in agroecosystems Guidelines for developing IPM Tactics in IPM Advantages and disadvantages of IPM</p>	15
Insecticide Formulation and Appliances		
4	<p>Insecticide Formulations: Emulsifiable concentrates Water-miscible liquids Wettable powders Water-soluble powders Oil solutions Flowable powders Aerosols Granules Fumigants Ultra-low volume concentrates Fogging concentrates Dusts Poison baits Slow-release insecticides Insecticide Appliances: Various sprayers, dusters, and fumigation equipment Insect Traps Used for Pest Control</p>	15



5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Ananthkrishnan, T.N. (1977). Insect and Host Specificity. McMillan Co. India Ltd.
2. Atwal, A.S. (1993). Agricultural Pests of India and South East Asia. Kalyani Publishing, New Delhi.
3. Dent, D. (1991). Insect Pest Management. CAB International, UK.
4. Hill, D.S. (1987). Agricultural Entomology. Timber Press.
5. Metcalf, R.L. & Luckman, W.H. (1982). Introduction to Insect Pest Management (3rd Ed.). John Wiley & Sons.

Suggested Readings:

1. Ananthkrishnan, T.N. (1992). Emerging Trends in Biological Control of Phytophagous Insects. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Brown, A.W.A. (1978). Ecology of Pesticides. John Wiley & Sons, New York.
3. Edwards, C.A. (1973). Persistent Pesticides in the Environment. CRC Press.
4. Matsumura, F. (1975). Toxicology of Insecticides. Plenum Press.
5. Metcalf, G.L. & Flint, W.P. (1962). Destructive and Useful Insects: Their Habits and Control. Tata McGraw Hill Publishing Co. Ltd., New York.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation L		70
Continuous Evaluation L		30
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	10
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU6DSEZCB307- GENETIC ENGINEERING AND BIOINFORMATICS OF GMOS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSE	300-399	KU6DSEZCB307	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course provides a comprehensive exploration of the principles, techniques, and applications of genetic engineering as applied to the development of genetically modified organisms (GMOs). It delves into the intricate relationship between genetic engineering and bioinformatics, emphasizing the computational tools and methodologies essential for understanding and manipulating genetic information. Students will gain a solid foundation in the theoretical underpinnings of these disciplines and develop practical skills in analyzing and interpreting genetic data.

Course Prerequisite: Basic knowledge of molecular biology, genetics, and introductory bioinformatics gained in earlier semesters.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the core concepts and techniques of genetic engineering, apply various gene-editing tools, and evaluate the effectiveness of different transformation methods.	U/A
CO2	Gain proficiency in using bioinformatics tools for genetic data analysis, interpret complex biological data, and integrate various types of omics data for comprehensive insights.	U/An
CO3	Understand the applications of GMOs in agriculture, assess their benefits and challenges, and evaluate their environmental and nutritional impacts.	U/E
CO4	Gain insights into the medical applications of GMOs, understand the mechanisms and benefits of gene therapy and pharmaceutical production, and evaluate the impact of genetic engineering on personalized medicine.	U/E
CO5	Explore advanced and emerging topics in genetic engineering and bioinformatics, understand the latest research trends and technologies,	U/A/C



	and apply integrative approaches to address complex biological challenges.	
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***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓					✓		
CO 2		✓		✓				
CO 3	✓				✓			
CO 4	✓					✓		
CO 5		✓		✓				✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Principles and Techniques of Genetic Engineering		
1	1. Recombinant DNA Technology: Introduction to the principles of recombinant DNA technology, including the creation of recombinant vectors and the use of restriction enzymes and ligases.	10
Bioinformatics Tools in GMO Research		
2	1. Use of genome databases for identifying target genes in plants and microbes 2. Sequence alignment and homology searches for selecting candidate genes for genetic modification 3. Gene annotation and functional prediction for trait improvement 4. Use of molecular markers (SNPs, SSRs) for GMO characterization 5. Comparative genomics in studying natural vs. transgenic varieties	15
Molecular Characterization of GMOs		



3	<ol style="list-style-type: none"> 1. In silico design of vectors and constructs for gene transfer 2. Bioinformatics-based identification of promoter regions and regulatory elements 3. Protein modeling and structural prediction of transgenic proteins 4. Codon optimization tools for expression in heterologous systems 5. Database resources for GMO gene and protein sequences (NCBI, EMBL, UniProt, GMDD). 	15
Bioinformatics in GMO Safety Assessment		
4	<ol style="list-style-type: none"> 1. Allergenicity prediction of novel proteins using allergen databases (AllergenOnline, AllerTOP, AlgPred) 2. Toxicity prediction using computational tools (ToxinPred, ProTox-II) 3. Off-target effect prediction in genome-edited crops using CRISPR/Cas bioinformatics platforms (CRISPOR, CHOPCHOP) 4. Comparative transcriptomics and proteomics for GMO vs. non-GMO organisms. Applications of GMOs (Brief Outline). 	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Primrose, S. B., & Twyman, R. (2019). Principles of Gene Manipulation and Genomics (8th ed.). Wiley-Blackwell.
2. Brown, T. A. (2016). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Wiley-Blackwell.
3. Campbell, P. N., Reece, J. B., & Urry, L. A. (2020). Biology (12th ed.). Pearson Education.
4. Lesk, A. M. (2017). Introduction to Bioinformatics (5th ed.). Oxford University Press.
5. Gupta, P. K. (2018). Molecular Biology and Genetic Engineering. Rastogi Publications.

Suggested Readings:

1. Gassmann, A. J., & Kennedy, G. G. (2019). *Genetically Modified Crops and Insect Resistance Management*. Springer.
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene* (7th ed.). Pearson.
3. Christou, P., Klee, H., & Kahl, G. (2019). *Plant Biotechnology and Genetics: Principles, Techniques and Applications*. Wiley-Blackwell.
4. Alvarez, M. A. (2016). *Genetically Modified Organisms in Food: Production, Safety, Regulation and Public Health*. Elsevier.
5. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis* (2nd ed.). Cold Spring Harbor Laboratory Press.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



**KU6SECZCB302- ORNAMENTAL FISH FARMING AND AQUARIUM
MANAGEMENT**

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	SEC	300-399	KU6SECZCB302	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	15L+10P	35L+15P	75	1.5

COURSE DESCRIPTION:

This course introduces students to the fascinating realm of ornamental fishes and fish keeping. Ornamental fish farming can serve as a viable income source, offering an alternative livelihood for rural populations. The training provided will equip students with the skills to effectively maintain aquariums and properly care for fishes. Additionally, the course covers various types of fish feed, ornamental fish diseases, and their treatments.

Course Prerequisite: Basic knowledge in Biology gained during a +2 level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand different ornamental fish culture methods	U/A
CO2	Learn about aquarium management and apply the knowledge to keep fishes.	An
CO3	Learn about different fish feed types.	U
CO4	Evaluate the challenges related to ornamental fish-related business.	An
CO5	Prepare a proposal for ornamental fish-related business and become adept in funding avenues.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓



CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Ornamental Fish Culture and Species Diversity		
1	Status of ornamental fish culture – Indian and International scenario Ornamental fish keeping systems Differences between freshwater and marine aquaria Ornamental fish culture as a hobby Ornamental fish characteristics Indigenous and exotic ornamental fishes Freshwater and marine ornamental fishes Classification of ornamental fishes Live bearers (any two suitable examples) Egg layers (any two suitable examples) Commercially important ornamental fishes	10
Aquarium Management and Ornamental Fish Trade		
2	Aquarium Management Different types of aquaria Water quality management Stock management Design and construction of aquarium tanks Decoration of aquaria Aeration and heating Types of filtration systems Feed types and feed management Live feed development Feed preparation Common aquarium fish diseases and management Ornamental Fish Trade International and Indian scenario Ornamental fish trade in Kerala Economic analysis of ornamental fish breeding and rearing Economics of ornamental fish retail outlets	15



	Governmental agencies supporting ornamental fish trade/business Government-assisted financial schemes for starting ornamental fish business	
Practicals		
3	1. Identification of ornamental fishes: <i>Poecilia reticulata</i> , <i>Carassius auratus</i> , <i>Oreochromis niloticus</i> , <i>Koi carp (Cyprinus rubrofuscus)</i> 2. Effect of pH on fish growth and survival 3. Effect of temperature on fish growth and survival 4. Study of aquarium setting and maintenance	30
4	Teacher Specific Module <i>Directions</i> Ornamental fish culture and trade as a profession. Common aquarium plant species.	5

Essential Reading

1. Sinha, A., & Pandey, P. K. (2023). Breeding and Culture of Freshwater Ornamental Fish. CRC Press.
2. Anikuttan, K. K., Nazar, A. K. A., Jayakumar, R., Johnson, B., Tamilmani, G., Sakthivel, M., Ramesh Kumar, P., & Sankar, M. (2019). Handbook on Marine Ornamental Fish Seed Production. ICAR-Central Marine Fisheries Research Institute.
3. Tlusty, M. F., Rhyne, A. L., Kaufman, L., Hutchins, M., Reid, G. M., Andrews, C., Boyle, P., Hemdal, J., & Dowd, S. (2013). Opportunities for public aquariums to increase the sustainability of the aquatic animal trade. *Zoo Biology*, 32(1), 1–12.

Suggested Readings

1. Jayasree, T., & Arumugam, T. (2015). Home Aquarium and Ornamental Fish Culture. Daya Publishing House.
2. Ghosh, A., Mahapatra, B. K., & Datta, N. C. (2003). Ornamental fish farming—successful small scale aqua business in India. *Aquaculture Asia*, 8(3), 14–16.
3. Satam, S. B., & Sawant, M. S. (2010). Marine Ornamental Fishes of Lakshadweep Islands: Prospects for Aquarium Fishery and Culture. Central Marine Fisheries Research Institute.
4. Dawes, J. (2001). Ornamental Fish: Their Culture and Management. Blackwell Science.
5. Murthy, L. N. (2012). Freshwater Ornamental Fishes of India. Narendra Publishing House.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	35
Continuous Evaluation L	15
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	5
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	50

Any components from the above table can be taken for CE not exceeding 15 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



Semester VII



KU7DSCZCB401- INNOVATIONS IN HEALTH INFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC A14	400-499	KU7DSCZCB401	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course introduces the fundamentals of health informatics, emphasizing its scope, applications, and innovative role in modern healthcare. Students will gain hands-on experience in using computational tools and databases for modeling health information systems, with a focus on integrating computational biology approaches. The course explores applications of computational immunology, including epitope mapping and prediction, to highlight how informatics can transform diagnostics, therapeutics, and personalized medicine. Through conceptual learning and practical implementation, students will develop the skills to apply innovative informatics solutions in healthcare and immunology.

Course Prerequisite: Knowledge of bioinformatics, molecular biology, basic computer applications, and biostatistics.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the fundamental concepts of health informatics and its scope and application.	U
CO2	Implement the modelling framework of health informatics with the aids of computational tools and databases.	A
CO3	Analyze the scope and applications of computational biology tools and databases in health care information systems.	An
CO4	Understand and critically evaluate telemedicine technologies, internet-based medical systems, and point-of-care information systems.	U
CO5	Apply acquired knowledge to design and create effective solutions in health informatics, including the implementation of Electronic Health Records (EHRs) and telecare systems.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓					✓	✓	
CO 2	✓		✓	✓		✓	✓	
CO 3		✓		✓	✓	✓	✓	✓
CO 4		✓		✓	✓	✓	✓	✓
CO 5		✓		✓	✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Health care informatics		
1	1. An interaction between health care and information systems. Acquisition, storage, retrieval, and use of information in health and biomedicine. Tools and techniques. Information systems in Medicine.	15
Building blocks of Health care informatics		
2	1. Standards, types of standards. Modeling – principles of modeling for healthcare. Architecture of Health care system – models, sub systems, packages and components. 2. Modeling framework for health care. generic health care information model. Unified modeling language. Modeling methodologies in healthcare systems. Databases, types, and applications.	10
Tools and techniques in Health Informatics		
3	1. Introduction, conditions for telemedicine development, applications, access techniques in telecare and Internet technologies in medical systems: Requirement of Medical systems in the internet environment, internet medical architectures, and internet based telemedical services, next generation point of care information systems, internet access technologies in Telecare. 2. Electronic Health records (EHR): characteristics of good EHR, HER Standards and Scope.	15



Practicals in computational biology		
4	<ol style="list-style-type: none"> 1. Exploring Electronic Health Records (EHR) with OpenEMR 2. Designing a Simple Healthcare Database 3. Healthcare Data Modeling with UML 4. Practice clinical coding with standard terminologies. 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Shortliffe, E. H., & Cimino, J. J. (Eds.). (2014). Biomedical Informatics: Computer Applications in Health Care and Biomedicine (4th ed.). Springer. ISBN: 9781447144748
2. Hoyt, R. E., & Yoshihashi, A. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals (6th ed.). Informatics Education. ISBN: 9781304791109
3. Haux, R., Lehmann, C. U., & Marx, G. (Eds.). (2021). Health Information Systems: Concepts, Methodologies, Tools, and Applications. Springer. ISBN: 9783030646309.
4. Dewan, N. A., Luo, J., & Lorenz, N. M. (2010). Information technology essentials for behavioral health clinicians. Routledge.
5. Zielinski, K., & Duplaga, M. (2006). Technology solutions for healthcare. Springer.
6. Conrick, M. (2006). Health informatics: Transforming healthcare with technology. Cengage Learning.

Suggested Readings:

1. Haux, R., Winter, A., Ammenwerth, E., & Brigl, B. (2004). Strategic information management in hospitals: An introduction to hospital information systems. Springer.
2. Nelson, R., & Staggers, N. (2017). Health informatics: An interprofessional approach (2nd ed.). Elsevier.
3. Benson, T., & Grieve, G. (2016). Principles of health interoperability: SNOMED CT, HL7 and FHIR (3rd ed.). Springer.
4. Kuhn, K. A., Knoll, A., & Marc, D. (2015). Biomedical informatics for cancer research. Springer.
5. Ball, M. J., Weaver, C. A., & Kiel, J. M. (2010). Healthcare information management systems: Cases, strategies, and solutions. Springer.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU7DSCZCB402- ADVANCE CELL & MOLECULAR BIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC A15	400-499	KU7DSCZCB402	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This advanced course explores the complexities of cellular and molecular biology, providing a deep understanding of fundamental principles and modern concepts. Major topics include the intricate details of cell structure and function, mechanisms of gene regulation, cellular signaling pathways, membrane trafficking, and the molecular basis of diseases such as cancer. The course also highlights cellular aging, apoptosis, stem cell biology, and cutting-edge research methodologies. Students will be equipped with the knowledge and skills required for higher academic pursuits and research in the discipline.

Course Prerequisite: Basic knowledge of Biology at the Higher Secondary level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Gain insight into the detailed structure of cells and the diverse mechanisms governing their interaction and maintenance.	An
CO2	Interpret data regarding cellular structure and genetics to differentiate between normal and cancerous conditions.	E
CO3	Interpret chromosomal spreads and distinguish between stages of cell division.	U
CO4	Comprehend and assess various mechanisms involved in gene regulation.	E
CO5	Describe the significance of precise diagnosis and risk assessment in genetic counseling.	E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Cell Cycle, Apoptosis & Cancer		
1	<p>Cell Cycle: Phases and regulation, role of protein kinases, checkpoints, Cdk inhibitors, M-phase (mitosis & meiosis), genetic recombination during meiosis.</p> <p>Cellular Aging: Factors affecting aging, mechanisms of programmed cell death (extrinsic & intrinsic apoptosis), necroptosis, and cell survival signaling.</p> <p>Cancer Biology: Properties of cancer cells, causes, genetics of cancer, oncogenes, tumor suppressor genes (RB, TP53, others), mutant DNA repair genes, role of mitochondria, immunotherapy, cancer stem cells.</p> <p>Stem Cells: Types and significance.</p>	15
Cell Signaling, Cytoskeleton & Membrane Trafficking		
2	<p>Cell Signalling Pathways: Extracellular messengers, receptors, G-protein coupled receptors (GPCRs), second messengers, insulin receptor signaling, Ras-MAPK pathways, GPCRs in sensory perception, protein-tyrosine phosphorylation.</p> <p>Cytoskeleton: Functions, microtubules, motor proteins (kinesins, dyneins), MTOCs, cilia & flagella, intermediate filaments, actin & myosin.</p> <p>Membrane Trafficking: Endomembrane system, ER (glycosylation, protein quality control), ER-to-Golgi transport, Golgi complex, vesicle transport, protein sorting, lysosomes, endocytosis, phagocytosis.</p> <p>Extracellular Matrix (ECM) and Cell Interactions: Structure, components, adherens junctions, desmosomes, tight junctions, gap junctions, plasmodesmata.</p>	10



Gene Regulation and DNA Repair		
3	<p>DNA Structure & Genome Organization: Supercoiling, organelle genomes, transposons, chromosomes, chromatin (euchromatin, heterochromatin), centromeres, telomeres, histones, cohesins, condensins, C-value paradox.</p> <p>Control of Gene Expression: Prokaryotes: Operons (lac, trp, arabinose), riboswitches. Eukaryotes: Nuclear pore complexes, RNA transport, promoters, coactivators (e.g., glucocorticoid receptor), transcriptional activation/repression, RNA processing, translational control, microRNAs, post-translational regulation. Small RNAs & Gene Editing: miRNAs, piRNAs, RNA silencing, CRISPR, telomerase function. DNA Polymerase & DNA Repair: Structure, domains, roles in replication and repair pathways.</p>	15
Practicals in Zoology		
4	<ol style="list-style-type: none"> 1. Study of mitosis and cell cycle using onion root tip (identify major phases). 2. Preparation of blood smear and identification of blood cells. 3. Preparation of buccal epithelium smear and observation of cells. 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Karp, G., Iwasa, J., & Marshall, W. (2020). Karp's Cell and Molecular Biology. John Wiley & Sons.
2. Watson, J. D. (2014). Molecular Biology of the Gene (7th Ed.). Pearson.
3. Alberts, B., Johnson, A., Lewis, J., et al. (2002). Molecular Biology of the Cell (4th Ed.). Garland Science.

Suggested Readings:

1. Cooper, G.M. (2000). The Cell: A Molecular Approach (2nd Ed.). Sinauer Associates.
2. Brown, T.A. (2002). Genomes (2nd Ed.). Wiley-Liss.
3. Lodish, H., Berk, A., Matsudaira, P., et al. (2005). Molecular Cell Biology (5th Ed.). W.H. Freeman.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation L		50
Continuous Evaluation L		25
a)	Test Paper- 1	5



b)	Test Paper-2	5
c)	Assignment	5
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type		Marks
End Semester Evaluation P		15
Continuous Evaluation P		10
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Record	5
d)	Lab skill	10
e)	Regularity	5
f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU7DSCZCB403- FRONTIERS OF IMMUNOINFORMATICS AND COMPUTATIONAL VACCINOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC A16	400-499	KU7DSCZCB403	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course equips students with a comprehensive understanding of the immune system and its computational analysis. By integrating classical immunology with modern bioinformatics and computational approaches, students will gain the ability to predict epitopes, design vaccines, and analyze immune repertoire sequencing data. The course emphasizes hands-on learning through practical applications of immunoinformatics tools, enabling students to bridge theoretical concepts with real-world biomedical research and therapeutic design.

Course Prerequisite: Students should have prior knowledge of Molecular Biology, Bioinformatics, and Basic Immunology. Familiarity with sequence analysis, databases, and molecular modeling software will be an added advantage.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand and explain the fundamentals of innate and adaptive immunity, antigen-antibody interactions, and clinical aspects of immune dysfunction.	U
CO2	Utilize immunoinformatics databases and tools (e.g., IEDB, IMGT, AntigenDB, IPD) for exploring immune-related data.	U
CO3	Apply computational methods for epitope prediction, antigen analysis, and vaccine candidate identification.	A
CO4	Perform practical computational experiments such as antigen-antibody interaction modeling and immune repertoire sequencing analysis.	An/A
CO5	Develop problem-solving and research skills in computational immunology with direct applications in vaccine design and immunotherapy.	E/C

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓	✓				
CO 2		✓				✓		
CO 3		✓	✓			✓		✓
CO 4		✓	✓		✓	✓		
CO 5					✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Basics of the Immune System		
1	<ol style="list-style-type: none"> Overview of innate and adaptive immunity; cellular and organ components of the immune system; antigens, epitopes, haptens; immunoglobulins including classes and subclasses. Major Histocompatibility Complex (MHC): polymorphism, antigen processing and presentation via cytosolic and endocytic pathways. Immunopathology and clinical applications: immune system dysfunctions including autoimmunity, immunodeficiency, and hypersensitivity reactions; immunotherapeutic interventions such as vaccines (various types), monoclonal antibody production, immunomodulators including cytokines and checkpoint inhibitors, and their clinical relevance. 	15
Basics of Immunoinformatics		
2	<ol style="list-style-type: none"> Definition, scope, and significance of immunoinformatics in understanding immune system function and disease mechanisms. Databases, computational tools, and web resources for immunoinformatics, including the International ImMunoGeneTics information system (IMGT), AntigenDB, the Immune Epitope Database (IEDB), and the Immuno Polymorphism Database (IPD). 	10
Computational Approaches in Vaccine Design		



3	<ol style="list-style-type: none"> 1. Rationale for computational vaccine design: advantages of in silico approaches and case studies of successful computational vaccine development. 2. Epitope mapping and prediction methodologies: B-cell and T-cell epitope prediction strategies. 3. Role of immunogenomics and immunoproteomics in vaccine development, including reverse vaccinology and peptide modeling techniques. 	15
Practicals in computational biology		
4	<ol style="list-style-type: none"> 1. Epitope prediction and analysis using computational tools. 2. Identification of vaccine candidates employing reverse vaccinology workflows. 3. Modeling and analysis of antigen–antibody interactions using molecular modeling software. 4. To analyze and interpret immune repertoire sequencing data using bioinformatics tools. 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Kuby, J. (2021). Immunology (9th Edition). W.H. Freeman and Company.
2. Janeway, C.A., et al. (2017). Immunobiology (9th Edition). Garland Science.
3. Lodish, H., Berk, A., et al. (2016). Molecular Cell Biology (8th Edition). W.H. Freeman.
4. Paterson, Y. & Leclerc, C. (2019). Computational Vaccinology: Methods and Protocols. Springer.
5. Vita, R., Mahajan, S., Overton, J.A., et al. (2021). The Immune Epitope Database (IEDB): Tools for Epitope Prediction and Analysis. Nucleic Acids Research.

Suggested Readings:

1. De Groot, A.S., & Moise, L. (2007). Immunoinformatics: Predicting Immunogenicity In Silico. Springer.
2. Flower, D.R. (2007). Bioinformatics for Vaccinology. Wiley.
3. Schmidt, F., et al. (2020). Reverse Vaccinology and Systems Immunology Approaches to Vaccine Design. Frontiers in Immunology.
4. Huang, H., et al. (2015). Immunogenomics: Computational Tools and Resources for Understanding Immune Repertoires. Springer.
5. Rappuoli, R., & Pizza, M. (2016). Reverse Vaccinology: Current Challenges and Future Directions. Elsevier.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU7DSCZCB404- RESEARCH METHODOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC 17	400-499	KU7DSCZCB404	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course provides fundamental insights into research methodology, equipping students with an understanding of the techniques and procedures employed to identify, investigate, and analyze information related to a specific research topic.

Course Prerequisite: Basic knowledge in Biology acquired at the Higher Secondary (+2) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Comprehend scientific research methodology and experimental design.	U
CO2	Facilitate the development, testing, and conclusion of hypotheses.	E
CO3	Demonstrate proficiency in data collection and management.	A
CO4	Apply various statistical methodologies effectively.	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓



CO 4	✓		✓		✓	✓	✓	✓
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COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
The Nature of Research, Hypothesis Generation, and Experimental Design		
1	<p>Introduction to Research: Definition, significance, and objectives of research.</p> <p>Selection of a Research Problem: Components of a research problem.</p> <p>Steps in Scientific Research: Identifying a problem, literature review, hypothesis formation, experimental design, data analysis, discussion, and publication.</p> <p>Types of Research: Analytical vs. descriptive, quantitative vs. qualitative, basic vs. applied, conceptual vs. empirical, survey vs. experimental.</p> <p>Research Methods vs. Methodology: Motivation and scope.</p> <p>Research Design: Formulation of a research problem. Inductive reasoning. Preparing a research design. Need and features of a good design. Concepts related to good design: observation, facts, prediction, explanation, model development. Sample design: deliberate, random, systematic, stratified, quota, cluster, area, multistage, and sequential sampling.</p> <p>Hypothesis: Definition, types, falsifiability, and hypothesis testing.</p> <p>Sampling & Data Collection: Determining sample size and sampling errors. Sampling methods. Primary vs. secondary data. Tools: observation, interviews, questionnaires, schedules. Categorization and summarization of data.</p> <p>Principles of Experimentation: Replication, randomization, and local control. Variables: Dependent and independent variables. Pilot Study and Data Recording.</p>	15
Data Interpretation and Report Writing		
2	<p>Data Processing and Analysis Strategies: Data classification and tabulation. Preparation of tables, figures, and photographs. Frequency distribution and graphical representation: histogram, pie chart, ogive curve, and polygon.</p> <p>Statistical Measures: Measures of central tendency (mean, median, mode). Measures of variation: standard deviation, standard error of mean, coefficient of variation. Tests of significance: Chi-square test, Student's t-test. Measures of dispersion, correlation, and regression.</p> <p>Data Analysis Tools: Overview of SPSS, R, and online software (brief introduction only).</p> <p>Research Report Writing: Principles of effective scientific writing: clarity, content quality, consistency, style, active voice. Biological</p>	10



	databases. Sources of scientific information: journals, reviews, monographs, bibliographies. Search tools and databases: Google Scholar, PubMed, INFLIBNET, MEDLINE, Sci-Hub, digital libraries.	
Publication and Dissemination of Research		
3	<p>Scientific Report Preparation: Technical reports and thesis writing. Title and abstract preparation. Formatting, abbreviations, scientific nomenclature, and reference writing.</p> <p>Bibliographic References: Preparing bibliographies in various journal-specific formats. Using reference management and plagiarism-checking software tools.</p> <p>Publishing Research Articles: Selection of appropriate journals. Understanding journal metrics and identifiers: ISSN, peer review, Science Citation Index, impact factor (IF), h-index, i10-index. Open-access publishing and publication charges. Major indexing services: Web of Science, Scopus, and UGC-CARE list. National vs. international journals.</p>	15
Practicals in Zoology		
4	<ol style="list-style-type: none"> 1. Formulation of research problem and hypothesis. 2. Sampling and data collection methods. 3. Data classification, tabulation and representation. 4. Statistical analysis of biological data. 5. Preparation of research report and bibliography. 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Kothari, C.R. & Garg, G. (2019). Research Methodology: Methods and Techniques (4th ed.). New Age International Publishers.
2. Creswell, J.W. & Creswell, J.D. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (5th ed.). SAGE Publications.
3. Sreejesh, S., Mohapatra, S. & Anusree, M.R. (2014). Business Research Methods: An Applied Orientation. Springer.
4. Daniel, W.W. & Cross, C.L. (2018). Biostatistics: A Foundation for Analysis in the Health Sciences (11th ed.). Wiley.
5. Day, R.A. & Gastel, B. (2012). How to Write and Publish a Scientific Paper (7th ed.). Cambridge University Press.

Suggested Readings:

1. Thyer, B.A. (2010). The Handbook of Social Work Research Methods (2nd ed.). SAGE Publications.



2. Dawson, C. (2019). Introduction to Research Methods: A Practical Guide for Anyone Undertaking a Research Project (5th ed.). Robinson.
3. Field, A. (2013). Discovering Statistics Using IBM SPSS Statistics (4th ed.). SAGE Publications.
4. Motulsky, H. (2018). Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking (4th ed.). Oxford University Press.
5. Booth, W.C., Colomb, G.G. & Williams, J.M. (2016). The Craft of Research (4th ed.). University of Chicago Press.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5



f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU7DSCZCB405- AGRIFORMATICS IN MODERN AGRICULTURE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VII	DSC A18	400-499	KU7DSCZCB405	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This course introduces the concepts, tools, and applications of agriinformatics in modern agriculture. It focuses on the integration of information technology, computational biology, and geospatial tools to address agricultural challenges. Students will gain knowledge of agricultural data types, data analysis, machine learning, GIS, and remote sensing, along with hands-on training in computational biology and decision support systems. The course emphasizes the role of digital and precision agriculture in improving productivity, sustainability, and resilience in farming systems.

Course Prerequisite: Students should have prior knowledge in life sciences, statistics, computer applications, and basic bioinformatics concepts.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Explain the role of information technology and Agriinformatics in addressing modern agricultural challenges.	U
CO2	Classify and manage agricultural data (soil, weather, crop, and farm management) for digital agriculture applications.	U/A
CO3	Apply statistical, data mining, and machine learning methods for analyzing agricultural datasets.	A/An
CO4	Utilize GIS and remote sensing tools to map, analyze, and interpret spatial data for precision agriculture.	An/A
CO5	Evaluate agricultural decision support systems (DSS) for solving real-world problems in crop, soil, and livestock management.	E
CO6	Design and create computational biology-based solutions for trait analysis, soil microbiome studies, and plant-pathogen network interactions.	C

***Remember (R), Understand (U), Apply (A), Analyze (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓			✓				
CO 2		✓				✓		
CO 3		✓			✓			
CO 4			✓	✓		✓		
CO 5					✓	✓	✓	
CO 6		✓	✓					✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Foundation of Agri informatics		
1	<ol style="list-style-type: none"> 1. Agriculture and Information Technology <ul style="list-style-type: none"> • Overview of agriculture and its challenges • Role of information technology in modern agriculture • Concept of digital agriculture and precision agriculture 2. Data in Agriculture <ul style="list-style-type: none"> • Types of agricultural data (weather, soil, crop, farm management, etc.) • Data collection methods (manual, automated, remote sensing) • Data quality and management 3. Introduction to Agri informatics <ul style="list-style-type: none"> • Definition and scope of Agri informatics • Applications of Agri informatics in different domains (crop production, livestock, fisheries, etc.) • Case studies of successful Agri informatics projects 	15
Data Analysis and Geographic Information Systems		
2	<ol style="list-style-type: none"> 1. Statistical Methods for Agriculture <ul style="list-style-type: none"> • Descriptive statistics (mean, median, mode, standard deviation, etc.) • Inferential statistics (hypothesis testing, correlation, regression) • Time series analysis 	10



	<p>2. Data Mining and Machine Learning</p> <ul style="list-style-type: none"> • Data mining techniques (clustering, association rule mining, classification) • Machine learning algorithms (supervised and unsupervised learning) • Applications of data mining and machine learning in agriculture <p>3. Introduction to GIS</p> <ul style="list-style-type: none"> • Basic concepts of GIS (maps, spatial data, coordinate systems) • GIS software (ArcGIS, QGIS, Google Earth) • Spatial data analysis (buffering, overlay, interpolation) 	
Agri informatics Tools and Applications		
3	<p>1. Remote Sensing and Image Processing</p> <ul style="list-style-type: none"> • Principles of remote sensing • Image processing techniques (image enhancement, classification, change detection) • Applications of remote sensing in agriculture <p>2. Agricultural Databases and Information Systems</p> <ul style="list-style-type: none"> • Database management systems (DBMS) • Agricultural databases (crop variety, soil, weather, etc.) • Developing agricultural information systems <p>3. Agricultural Decision Support Systems (DSS)</p> <ul style="list-style-type: none"> • Components of a DSS • Developing DSS for agricultural problems • Case studies of agricultural DSS 	15
Practicals in Computational Biology		
4	<p>1. Identify and annotate genetic markers associated with traits of interest (e.g., drought resistance, pest resistance) using bioinformatics tools.</p> <p>2. Analyze metagenomic data to understand the composition and function of soil microbiomes in agricultural fields using Bioinformatics tools.</p> <p>3. Network Analysis of Plant-Pathogen Interactions using Cytoscape.</p> <p>4. To create soil health maps using GIS software. How to use GIS tools for mapping and analyzing soil health data, which is critical for precision agriculture.</p>	30
5	Teacher Specific Module	5
	<i>Directions</i>	



Essential Readings:

1. Barnaby, C. (2019). Agri-Informatics: Data Analytics in Agriculture. CRC Press.
2. Mulla, D.J. (2013). Encyclopedia of Agricultural and Food Systems: Precision Agriculture. Academic Press.
3. Pierce, F.J., & Clay, D. (2007). GIS Applications in Agriculture. CRC Press.
4. Kaur, H., & Kaur, P. (2018). Fundamentals of Agri-Informatics and Precision Farming. New India Publishing.
5. Campbell, J.B., & Wynne, R.H. (2011). Introduction to Remote Sensing. Guilford Press.

Suggested Readings:

1. Jain, A.K., Murty, M.N., & Flynn, P.J. (1999). Data Clustering: A Review. ACM Computing Surveys.
2. Tiwari, S.P., & Ghosh, K. (2019). Agri-Informatics: An Overview. Springer.
3. Rich, P.M. (2014). Spatial Data Analysis for Natural Resource Management. Springer.
4. Balasubramanian, R., & Nirmal Kumar, J.I. (2016). GIS and Remote Sensing Applications in Agriculture. Springer.
5. Mitchell, T.M. (1997). Machine Learning. McGraw-Hill.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15



Continuous Evaluation P		10
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Record	5
d)	Lab skill	10
e)	Regularity	5
f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks





Semester VIII

KU8DSCZCB406- ECOLOGY & EVOLUTION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC 19	400-499	KU8DSCZCB406	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

The Ecology & Evolution course guides students in comprehending the processes and patterns of biological evolution across various scales, spanning from molecular alterations within genes to the diversification of species over millions of years. Furthermore, students investigate how organisms have adjusted to their surroundings through natural selection, genetic drift, mutation, and other mechanisms, resulting in the remarkable diversity of life on Earth. The course also provides a detailed examination of ecological principles, including interactions among organisms, population dynamics, community structure, ecosystem processes, and the impact of human activities on the environment. Emphasis is placed on biodiversity, sustainability, and the application of ecological knowledge to conservation.

Course Prerequisite: Basic knowledge in Biology acquired at the Higher Secondary (+2) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Recall fundamental concepts and terminology pertinent to evolution and ecology.	An
CO2	Students will be able to analyze the interdependence of organisms and their environment to evaluate patterns of energy flow, nutrient cycling, and ecological balance.	E
CO3	Apply evolutionary principles to analyze and interpret particular behaviors or traits in organisms, assessing their role in enhancing survival and reproductive success.	U
CO4	Critically assess scientific literature and experimental data concerning evolution and ecology.	E
CO5	Identifying strengths, weaknesses, and gaps in research methodology and conclusions.	E



*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Evolution		
1	Modern ideas on the origin of life: Naked gene hypothesis, RNA world theory; Research on extra-terrestrial life; Post-Darwinian biology – Modern synthesis and beyond; From genetics to genomics and evolution; Genetic basis of evolution, genetic drift, Hardy-Weinberg equilibrium, and punctuated equilibrium; Molecular evolution – Neutral theory of Kimura, concept of molecular clock, mitochondrial Eve and Y-chromosomal Adam; Molecular phylogeny, selfish genes, C-value paradox; Long-term experimental evolution projects with E. coli; Epigenetics; Evo-devo (Evolutionary developmental biology); Ancient DNA (aDNA); Horizontal gene transfer; Isolation and isolating mechanisms of speciation; Mimicry and evolution; Microevolution and macroevolution; Human evolution.	15
Ecosystem and Biogeochemical Cycles		
2	Concept of ecosystem; Trophic levels and trophic structure; Food chain and food web; Ecosystem energetics: Energy flow in ecosystems and Lindeman's model of energy flow; Concept of productivity: Primary and secondary productivity; Pyramids of energy, numbers, and biomass; Biogeochemical cycles: Gaseous (nitrogen and carbon cycles) and sedimentary (phosphorus and sulfur cycles); Law of limiting factors; Population ecology: Properties of populations and population dynamics; Population interactions; Community ecology.	10



Habitat Ecology and Global Environmental Issues		
3	Types of ecosystems: Aquatic ecosystems (freshwater and marine) and terrestrial ecosystems (forest, grassland, desert, tundra, and cave biomes); Ecological succession; Concept of ecotone and niche; Global environmental issues: Ozone depletion, greenhouse effect, acid rain, biomagnification, eutrophication.	15
Practicals in Zoology		
4	1. Estimation of dissolved oxygen using Winkler's method. 2. Estimation of dissolved carbon dioxide in water. 3. Measurement of water pH using pH paper. 4. Study of mutualism (Hermit crab and sea anemone), commensalism (Echeneis and shark), parasitism (Sacculina on crab), and predation (snake and rat). 5. Problems using Hardy-Weinberg equilibrium.	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Veer Bala Rastogi. Organic Evolution. MedTech (A division of Scientific International).
2. Andrews, M.I., & Joy, K.P. (2003). Environmental Biology, Evolution, Ecology, and Zoogeography. St. Mary's Press and Book Depot, Changanassery.
3. Darwin, C. (1859). On the Origin of Species (6th edition). Oxford University Press.
4. Dobzhansky, T. (1964). Genetics and the Origin of Species. Columbia University Press.
5. Boulenger, E.G. (1994). Animal Behaviour. Atlantic Publishers & Distributors.

Suggested Readings:

1. Aubrey Manning & Richard Dawkins. (1992). An Introduction to Animal Behaviour. Cambridge University Press.
2. Ricklefs, R.E., & Miller, G.L. (2000). Ecology. W.H. Freeman & Co.
3. Krebs, C.J. (2009). Ecology: The Experimental Analysis of Distribution and Abundance (6th edition). Pearson.
4. Begon, M., Townsend, C.R., & Harper, J.L. (2006). Ecology: From Individuals to Ecosystems (4th edition). Blackwell Publishing.
5. Futuyma, D.J. (2013). Evolution (3rd edition). Sinauer Associates.

Assessment Rubrics:

Theory

Evaluation Type	Marks
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End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU8DSCZCB407- COMPUTER ASSISTED NANOTECHNOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC A20	400-499	KU8DSCZCB407	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

This paper introduces computational techniques and simulation tools applied to nanotechnology. It emphasizes theoretical foundations in classical and statistical mechanics, atomistic and mesoscopic simulation methods, and data-driven modeling approaches. Students will gain hands-on skills in molecular dynamics, Monte Carlo methods, Lattice Boltzmann techniques, and intelligent computational modeling for nanoscale systems. The course bridges life sciences, computational biology, and nanotechnology to equip students with interdisciplinary expertise.

Course Prerequisite: Students are expected to have a basic understanding of physics, chemistry, molecular biology, and introductory computational methods, including statistics and computer applications.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Explain the fundamental concepts of nanoscience and nanotechnology	U
CO2	Apply computational methods to analyze and model nanostructures.	A
CO3	Demonstrate mesoscopic simulation approaches including Lattice Boltzmann Method (LBM) and Dissipative Particle Dynamics (DPD).	A/An
CO4	Utilize visualization and molecular dynamics software for nanoscale research.	A
CO5	Evaluate biological and medical applications of nanotechnology using computational approaches.	E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓	✓						
CO 2		✓		✓		✓		
CO 3		✓	✓				✓	
CO 4		✓	✓		✓			
CO 5	✓				✓			✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Fundamentals of Nanoscience and Nanotechnology		
1	<ol style="list-style-type: none"> 1. Definition, scope, and interdisciplinary nature of nanoscience. 2. Properties of nanomaterials: quantum confinement, surface-to-volume ratio. 3. Types of nanomaterials: nanoparticles, nanotubes, nanowires, quantum dots. 4. Biological inspiration for nanostructures – biomimetics and natural nanotechnology. 5. Introduction to applications in biology and medicine. 	15
Computational Approaches in Nanotechnology		
2	<ol style="list-style-type: none"> 1. Basics of molecular modeling and visualization. 2. Force fields, energy minimization, and molecular dynamics at the nanoscale. 3. Introduction to online/open-source simulation platforms (e.g., Nanohub, Avogadro, VMD, CHARMM-GUI). 4. Mesoscopic simulation approaches: 5. Lattice Boltzmann Method (LBM): principles, biological fluid dynamics. 6. Dissipative Particle Dynamics (DPD): modeling soft matter, membranes, and polymers. 7. Case studies of nanoscale simulations in biological systems. 	10



Applications of Computer-Assisted Nanotechnology		
3	<ol style="list-style-type: none"> 1. Drug delivery systems and nanocarriers – computational modeling approaches. 2. Nano biosensors and diagnostic applications. 3. Nanotoxicology – computational risk assessment. 4. Nanotechnology in tissue engineering and regenerative medicine. 5. Emerging trends: Nanoinformatics and databases for nanotechnology. 	15
Practicals in computational biology		
4	<ol style="list-style-type: none"> 1. To visualize nanostructures using bioinformatics molecular visualization tools. 2. To perform a basic molecular dynamics simulation of nanoparticles using computational approaches. 3. To carry out online simulations of Nanosystems using bioinformatics tools. 4. To simulate biological system flows using COPASI. 5. To model membrane systems using bioinformatics simulation tools. 	30
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Ratner, M. & Ratner, D. (2003). Nanotechnology: A Gentle Introduction to the Next Big Idea. Pearson.
2. Goodsell, D. S. (2004). Bionanotechnology: Lessons from Nature. Wiley.
3. Leach, A. R. (2001). Molecular Modelling: Principles and Applications. Pearson.

Suggested Readings:

1. Bhushan, B. (2017). Springer Handbook of Nanotechnology. Springer.
2. Niemeyer, C. M., & Mirkin, C. A. (2004). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
3. Allen, M. P. & Tildesley, D. J. (2017). Computer Simulation of Liquids. Oxford University Press.
4. Succi, S. (2001). The Lattice Boltzmann Equation for Fluid Dynamics and Beyond. Oxford.
5. Hoogerbrugge, P. J., & Koelman, J. M. V. A. (1992). Simulating Microscopic Hydrodynamic Phenomena with DPD. EPL.



Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5
c) Record	5
d) Lab skill	10
e) Regularity	5
f) Viva-Voce	5
g) Report writing	5
Total	25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU8DSCZCB408- ENVIRONMENTAL SCIENCE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSC 21	400-499	KU8DSCZCB408	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	25L+10P	50L+15P	100	1.5

COURSE DESCRIPTION:

The Environmental Science course aims to provide a comprehensive understanding of the structure and functioning of the environment, ecological concepts, biodiversity, and natural resource management. The course highlights the interrelationships between organisms and their physical surroundings, emphasizing both local and global environmental issues. Students will learn about ecosystem services, biodiversity conservation, environmental laws, policies, and international protocols. The course also addresses major environmental challenges such as pollution, global climate change, and disasters, along with strategies for sustainable management of natural resources.

Course Prerequisite: Basic knowledge in Biology acquired at the Higher Secondary (+2) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand ecological principles, biodiversity concepts, and environmental resources.	U
CO2	Analyze ecosystem structure, functions, and global environmental issues.	An
CO3	Apply ecological indices and field methods to study biodiversity and habitat ecology.	A
CO4	Evaluate the effects of pollution, climate change, and human activities on ecosystems.	E
CO5	Interpret environmental laws, policies, conventions, and propose conservation strategies.	C

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓		✓	✓		✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Environmental Concepts		
1	Structure and components of the environment – Atmosphere, Hydrosphere, Lithosphere, and Biosphere interactions. Ecosystem services and environmental resources. Biodiversity: Levels, types, values, threats, and conservation strategies. Species diversity indices: Shannon–Wiener Index, Simpson’s Diversity Index, Evenness, and Species Richness. Zoogeographical Realms.	15
Global Environmental Issues & Disaster Management		
2	Causes, effects, and remedial measures of: Air, Water, Noise, Radioactive, Solid Waste, and Pesticide Pollution. Ozone depletion, Greenhouse effect, Global warming, Acid rain, Oil spills. Impact of sand mining and wetland reclamation. Rainwater harvesting methods. Disaster-prone regions in India. Floods, Earthquakes, Cyclones, Tsunami, Landslides, and Drought – causes and mitigation measures. Government efforts towards disaster management.	10
Environmental Conservation and Policies		



3	<p>Natural Resource Management: Forests, Water, Land, Fisheries, and Energy resources.</p> <p>Environmental Acts (India): Wildlife Protection Act, 1972 Water (Prevention and Control of Pollution) Act, 1974 Air (Prevention and Control of Pollution) Act, 1981 Environment Protection Act, 1986 Biological Diversity Act, 2002 Forest Conservation Act, 1980</p> <p>Policies & Institutions: National Green Tribunal (NGT) Central & State Pollution Control Boards</p> <p>International Conventions & Protocols: Ramsar Convention (Wetlands) CITES (Convention on International Trade in Endangered Species) CBD (Convention on Biological Diversity) Kyoto Protocol, Paris Agreement (Climate Change) Stockholm Conference (1972), Rio Earth Summit (1992), Agenda 21 Montreal Protocol (Ozone Protection)</p> <p>Role of Environmental Institutions: NBA, SBB Brief account of PBR, BMC, and ABS.</p>	15
Practicals in Zoology		
4	<ol style="list-style-type: none"> 1. Test pH of different water samples using pH paper. 2. Measure turbidity using a Secchi disc. 3. Determine dissolved oxygen (DO) using the Winkler’s method. 4. Study zoogeographical realms and animal distribution using maps. 5. Demonstrate water conservation methods (rainwater harvesting model). 6. Calculate species richness (count) and evenness (relative numbers). 7. Apply Shannon–Wiener and Simpson diversity indices using simple field data. 	30
5	<p>Teacher Specific Module</p> <hr/> <p><i>Directions</i></p>	5

Essential Readings:

1. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Saunders Co., USA. ISBN 10: 0721669417
2. Sharma, P.D. (2008). Ecology and Environment (7th Edition). Rastogi Publications. ISBN 10: 8171335810
3. Miller, T.G. Jr. (2008). Environmental Science. Wadsworth Publishing Co. ISBN 9781111988937



4. Townsend, C., Harper, J., & Begon, M. Essentials of Ecology. Blackwell Science. ISBN 1-40510-328-0
5. Chapman, J.L. & Reiss, M.J. Ecology: Principles and Applications. Cambridge University Press.

Suggested Readings:

1. Agarwal, K.C. (2008). Environmental Biology. Nidi Publishers, Bikaner. ISBN-13: 978-8189153021
2. Aravind Kumar. Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
3. Arora, S. (1995). Fundamentals of Environmental Biology. Kalyani Publishers, New Delhi.
4. Bhaskaran, K.K. (2015). Environmental Biology and Wildlife Conservation. Manjusha Publications.
5. Misra, S.P. & Pandey, S. (2009). Essential Environmental Studies. Ane Books India.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	50
Continuous Evaluation L	25
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	5
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	75

Any components from the above table can be taken for CE not exceeding 25 Marks

Practicals

Evaluation Type	Marks
End Semester Evaluation P	15
Continuous Evaluation P	10
a) Test Paper- 1	5
b) Test Paper-2	5



c)	Record	5
d)	Lab skill	10
e)	Regularity	5
f)	Viva-Voce	5
g)	Report writing	5
Total		25

Any components from the above table can be taken for CE not exceeding 10 Marks



KU8DSEZCB401- HUMAN GENETICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEZCB401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This elective course provides a comprehensive understanding of human genetics, focusing on fundamental principles, inheritance patterns, and the molecular basis of genetic traits and disorders. Students will learn Mendelian principles and problem-solving approaches related to genetic crosses, explore genetic linkage, crossing over, and sex-linked inheritance in animals, and develop skills in pedigree analysis and genetic counseling. The course also emphasizes in-depth knowledge of various human genetic disorders, including their biochemical, chromosomal, and multifactorial bases. By the end of the course, students will be equipped to critically analyze genetic data, understand population-level genetic patterns, and apply theoretical concepts to practical and clinical scenarios in genetics.

Course Prerequisite: Basic knowledge in Biology acquired at the Higher Secondary (+2) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand Mendelian principles and solve related genetic problems.	U/A
CO2	Understand genetic linkage, crossing over, and sex-linked inheritance in animals.	U
CO3	Develop the capability for pedigree analysis and genetic counseling.	An/A
CO4	Possess in-depth knowledge of various genetic disorders in humans.	U/E

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
CO 1	✓				✓	✓		



CO 2	✓			✓		✓		
CO 3		✓			✓	✓		✓
CO 4	✓				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Mendelian Principles		
1	Monohybrid and dihybrid experiments. Interactions of genes: <ul style="list-style-type: none"> • Incomplete dominance and co-dominance • Complementary, supplementary, and duplicate genes Multiple alleles with examples: coat color in rabbits Human blood group inheritance: ABO system and Rh factor	10
Linkage and Crossing Over		
2	Chromosomal theory of linkage and types of linkage Crossing over: types, mechanisms, and cytological detection Significance of crossing over Sex determination in Humans and <i>Drosophila melanogaster</i>	15
Human Cytogenetics		
3	Modern concepts of the gene: split gene, fine structure (cistron, muton, recon), Human karyotype and banding techniques, Gene mutation and mutagenesis (physical and chemical mutagens), Chromosomal aberrations	15
Genetic Disorders and Population Genetics		
4	Sex-linked traits in humans Genetic disorders: autosomal, sex-linked, and multifactorial Biochemical genetics: phenylketonuria, albinism, alkaptonuria Polymorphism: phenotypic and genotypic, transient and balanced polymorphisms. Uses and effects of inbreeding in farm animals, genetic consequences, and causes	15
5	Teacher Specific Module	5
	<i>Directions</i>	



Essential Readings:

1. Brooker, R.J. (2014). Genetics: Analysis and Principles (5th Edition). McGraw-Hill Education.
2. Snustad, D.P., & Simmons, M.J. (2015). Principles of Genetics (7th Edition). John Wiley & Sons.
3. Lewis, R. (2019). Human Genetics: Concepts and Applications (12th Edition). McGraw-Hill Education.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., & Doebley, J. (2015). Introduction to Genetic Analysis (11th Edition). W.H. Freeman & Company.
5. Cowell, J.K. (2001). Molecular Genetics of Cancer. Bios Scientific Publishers.

Suggested Readings:

1. Hamerton, J.L. Human Cytogenetics (Vols. I & II). Academic Press.
2. Ford, E.H. Human Chromosomes. Academic Press.
3. Vogel, F., & Motulsky, A.G. (2010). Human Genetics: Problems and Approaches (5th Edition). Springer.
4. Thorson, M.W., Meinees, R.R., & Willard, H.F. (2007). Genetics and Medicine. Saunders/Elsevier.
5. Mange, E.J., & Mange, A.P. (2000). Basic Human Genetics (5th Edition). Jones & Bartlett Learning.

Assessment Rubrics:**Theory**

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



Integration of Genomics and Transcriptomics		
4	Multi-Omics Data Integration: Combining Genomic, Transcriptomic, and Proteomic Data Gene Co-expression Networks: Weighted Gene Co-expression Network Analysis (WGCNA) Applications in Systems Biology: Pathway Analysis, Biomarker Discovery Case Studies: Chronic Kidney Disease, Cancer Genomics	15
5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

6. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.
7. Korpelainen, E., et al. (2014). RNA-Seq Data Analysis: A Practical Approach. CRC Press.
8. Brown, S. M. (2015). Next Generation DNA Sequencing Informatics. Springer.
9. Higgins, D., & Taylor, W. (2008). Genomics: Essential Methods. Wiley-Blackwell.
10. Mardis, E. R. (2017). Next-Generation Sequencing: Methods and Protocols. Humana Press.

Suggested Readings:

6. Li, H., & Durbin, R. (2009). Fast and accurate short read alignment with Burrows-Wheeler Transform. Bioinformatics, 25(14), 1754–1760.
7. Trapnell, C., et al. (2012). Differential gene and transcript expression analysis of RNA-seq experiments with TopHat and Cufflinks. Nature Protocols, 7, 562–578.
8. Anders, S., Pyl, P. T., & Huber, W. (2015). HTSeq – A Python framework to work with high-throughput sequencing data. Bioinformatics, 31(2), 166–169.
9. Conesa, A., et al. (2016). A survey of best practices for RNA-seq data analysis. Genome Biology, 17, 13.
10. Li, H., et al. (2009). The Sequence Alignment/Map format and SAMtools. Bioinformatics, 25(16), 2078–2079.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5



b)	Test Paper-2	5
c)	Assignment	10
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU8DSEZCB403- PROTEOMICS AND METABOLOMICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEZCB403	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This elective course introduces students to the principles, technologies, and computational analysis of proteomics and metabolomics. Students will study the structure, function, and interactions of proteins and metabolites and understand how large-scale profiling can reveal insights into cellular processes, disease mechanisms, and systems biology. The course integrates experimental techniques, data analysis pipelines, and bioinformatics applications, emphasizing modern research trends in multi-omics.

Course Prerequisite: Basic knowledge in Molecular Biology, Biochemistry, Bioinformatics

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand the concepts and workflows of proteomics and metabolomics	U
CO2	Describe experimental techniques for protein and metabolite analysis	U
CO3	Interpret and critically analyze proteomics and metabolomics data	An
CO4	Integrate multi-omics data to extract biological insights	An
CO5	Evaluate current literature and research in proteomics and metabolomics	E
CO6	Apply knowledge of omics to conceptualize research approaches in life sciences	A

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs



	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓		✓					
CO 2	✓		✓				✓	
CO 3		✓	✓	✓				
CO 4		✓	✓	✓				
CO 5				✓	✓			✓
CO 6	✓		✓	✓				✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Proteomics and Metabolomics		
1	Definition, scope, and historical perspective Functional relevance of proteins and metabolites in cells Proteome and metabolome complexity, diversity, and dynamics Applications: drug discovery, disease biomarker identification, nutrition, environmental stress studies Ethical, safety, and regulatory considerations in omics research	10
Techniques in Proteomics		
2	Protein extraction, purification, and quantification Electrophoretic techniques: SDS-PAGE, 2D-PAGE Mass spectrometry: MALDI-TOF, LC-MS/MS, tandem MS Protein microarrays and antibody arrays Protein-protein interactions: Yeast two-hybrid, Co-immunoprecipitation Post-translational modifications: phosphorylation, glycosylation, acetylation Emerging techniques: single-cell proteomics, top-down proteomics	15
Techniques in Metabolomics		



4. Patti, G. J., Yanes, O., & Siuzdak, G. (2012). Metabolomics: The apogee of the omics trilogy. *Nature Reviews Molecular Cell Biology*, 13, 263–269.
5. Link, A. J., & Eng, J. K. (2010). Proteomics and metabolomics: Approaches to functional biology. *Methods*, 50, 240–248.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



KU8DSEZCB404- WILDLIFE CONSERVATION AND MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VIII	DSE	400-499	KU8DSEZCB404	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

COURSE DESCRIPTION:

This course provides a comprehensive exploration of wildlife conservation and health management, with a specific focus on India. Students will examine the diversity of wildlife, its economic significance, and the challenges associated with its conservation. The course also equips students with skills in diagnosing and treating both infectious and non-infectious diseases in wildlife. Practical training in habitat assessment, GIS, and remote sensing prepares students for fieldwork in conservation. Modern concepts such as wildlife forensics and toxicology are included. Through case studies and projects, students will apply their learning to address real-world conservation challenges.

Course Prerequisite: Basic knowledge in Biology acquired at the Higher Secondary (+2) level.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Develop a comprehensive understanding of the significance and extent of wildlife in India	U
CO2	Attain proficiency in diagnosing and treating both infectious and non-infectious diseases in wildlife	An
CO3	Analyze and evaluate various wildlife management strategies and their effectiveness in conservation	U
CO4	Gain awareness of modern concepts and practices in wildlife conservation	U

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**



Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	✓			✓			✓	
CO 2	✓				✓	✓		
CO 3	✓			✓	✓	✓		✓
CO 4	✓			✓		✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Scope and Importance of Wildlife of India		
1	<ul style="list-style-type: none"> • Definition of Wildlife • Economic Importance of Wildlife • Causes of Wildlife Depletion • Need for Wildlife Conservation • Rare, Endangered, Threatened, and Endemic Species in India • Basic Concepts of Human-Wildlife Conflicts: Reasons and Mitigation • Identification of Damages Caused by Wild Animals and Control Measures • Case Studies: Elephant, Tiger, Leopard • Translocation of Wild Animals: Principles, Methods, and Applications • Ecotourism: A Sustainable Approach to Wildlife Exploration • Definition and Principles of Ecotourism • Ecotourism as a Tool for Wildlife Conservation and Community Development • Case Studies of Successful Ecotourism Initiatives Worldwide • Biogeographic Zones of India 	10
Principles & Techniques of Wildlife Management		
2	<ul style="list-style-type: none"> • Concepts of Population Ecology in Wildlife Management: Natality, Mortality, Carrying Capacity, Population Regulation • Wildlife Census Techniques: <ul style="list-style-type: none"> ▪ Direct Counts: Total Counts, Line Transects, Point Counts ▪ Indirect Counts: Pugmarks, Pellet Count, Camera Traps ▪ Modern Techniques: Radio Telemetry, Drones, GIS Mapping 	15



7. Giles, R.H. Jr. (Ed.) (1984). Wildlife Management Techniques (3rd Edition). The Wildlife Society, Washington, D.C.
8. Hosetti, B.B. (1997). Concepts in Wildlife Management. Daya Publishing House, Delhi.

Suggested Readings:

1. Lillesand, T.M., & Kieffer, R.W. Remote Sensing and Image Interpretation. John Wiley & Sons.
2. Negi, S.S. (1993). Biodiversity and Its Conservation in India. Indus Publishing Co., New Delhi.
3. Prater, S.H. The Book of Indian Animals. BNHS / Oxford.
4. Rodgers, W.A. (1991). Techniques for Wildlife Census in India.
5. Singh, S.K. (2005). Textbook of Wildlife Management. IBDC, Lucknow.
6. Ranjitsinh, M.K. Wildlife Conservation in India.
7. Choudhary, R.K. Wildlife Management and Conservation in India.
8. Bisen, P.S., Gupta, N.K., & Sawarkar, V.B. Conservation Biology: Principles and Practice of Wildlife Management in India

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks



	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO8
CO 1	✓		✓				✓	
CO 2	✓		✓		✓	✓	✓	
CO 3		✓				✓		
CO 4		✓	✓		✓	✓		✓
CO 5							✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
Introduction to Medical Biotechnology		
1	<ol style="list-style-type: none"> 1. Concept and scope of medical biotechnology; integration of biology and technology in medicine. 2. Molecular basis of human diseases: genetic disorders, cancer, infectious diseases, complex traits. 3. Recombinant DNA technology in medicine: vectors, cloning, transgenic approaches. 4. Therapeutic molecules: monoclonal antibodies – production, types (chimeric, humanized, fully human), therapeutic applications. 5. Vaccine technology: conventional vaccines, recombinant subunit vaccines, DNA and RNA vaccines, reverse vaccinology. 6. Gene therapy: principles, strategies (ex vivo, in vivo), viral and non-viral vectors, CRISPR/Cas applications. 7. Stem cells and regenerative medicine: embryonic vs. adult stem cells, induced pluripotent stem cells, tissue engineering. 8. Recent advances: nanomedicine, biosimilars, targeted therapeutics. 	10
Molecular Diagnostics and Genomics		
2	<ol style="list-style-type: none"> 1. Nucleic acid–based diagnostics: PCR, RT-PCR, qPCR, multiplex PCR, LAMP, CRISPR-based tests. 2. Hybridization methods: FISH, microarrays. 3. Next Generation Sequencing (NGS): principles, platforms, clinical applications. 	15



5	Teacher Specific Module	5
	<i>Directions</i>	

Essential Readings:

1. Brown, T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell.
2. Primrose, S.B., & Twyman, R.M. (2018). Principles of Gene Manipulation and Genomics. Wiley-Blackwell.
3. Lesk, A.M. (2019). Introduction to Bioinformatics. Oxford University Press.
4. Gupta, P.K. (2017). Medical Biotechnology. PHI Learning.
5. Rastogi, S.C., Mendiratta, N., & Rastogi, P. (2020). Bioinformatics: Methods and Applications. PHI Learning.

Suggested Readings:

1. Lodish, H., et al. (2021). Molecular Cell Biology. W.H. Freeman.
2. Campbell, M.K., & Farrell, S.O. (2020). Biochemistry. Cengage Learning.
3. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Wiley-Blackwell.
4. Baxevanis, A.D., & Ouellette, B.F.F. (2019). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley.
5. Fischetti, V.A. (2020). Medical Biotechnology: Concepts and Applications. Elsevier.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation L		70
Continuous Evaluation L		30
a)	Test Paper- 1	5
b)	Test Paper-2	5
c)	Assignment	10
d)	Seminar	10
e)	Book/ Article Review	-
f)	Viva-Voce	5
g)	Field Report	-
Total L		100

Any components from the above table can be taken for CE not exceeding 30 Marks



Blackwell.

5. Choffnes, E.R., Relman, D.A., & Mack, A. (2006). Globalization, Biosecurity, and the Future of the Life Sciences. National Academies Press.

Assessment Rubrics:

Theory

Evaluation Type	Marks
End Semester Evaluation L	70
Continuous Evaluation L	30
a) Test Paper- 1	5
b) Test Paper-2	5
c) Assignment	10
d) Seminar	10
e) Book/ Article Review	-
f) Viva-Voce	5
g) Field Report	-
Total L	100

Any components from the above table can be taken for CE not exceeding 30 Marks

