Semester III

KU3DSCZCB201- GENOMIC ALGORITHMS: THE ART AND SCIENCE OF BIOINFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC A3	200-299	KU3DSCZCB201	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 delves into the major algorithms used in computational biology and the statistical methods essential for analyzing biological data. Students will acquire fundamental knowledge of bioinformatics algorithms and gain practical experience in implementing scripts using BioPerl, Biopython, MATLAB, and R. The course is designed for students with a background in biology, computer science, or related fields, aiming to provide the tools necessary to address complex bioinformatics challenges and analyze sequence information of macromolecules effectively.

Course Prerequisite: A background in biology, computer science, or a related field.

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Able to gain fundamental knowledge about the major algorithms used in computational biology	U
CO2	Able to implement scripts of BioPerl and Biopython in analysis of sequence information of macromolecules	A
CO3	Able to implement MATLAB programming for bio-statistical applications	A
CO4	Able to apply R- programming concepts to extrapolating functional information of macromolecules	A
CO5	Able to understand the applications of biostatics in computational biology exercise.	U/An
CO6	Able to understand with the bivariate distributions and analyse the statistical significance of various exercises in computational biology	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	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 BioPerl & BioPython	
1	1. Major Algorithms in Computational biology: PERL Basics of Per Introduction to BioPerl and BioPerl Objects - Brief description (Seq, PrimarySeq, LocatableSeq, RelSegment, LiveSeq, LargeSeq RichSeq, SeqWithQuality, SeqI), Location objects, Interface object and Implementation objects. 2. Major Algorithms in Computational Biology-Python: Introductio to python. Python basics – Variables, Operators, Data types an Assignments. Statements – Input/output statements, flow contr Introduction to object-oriented programming in python. BioPytho in Computational biology (Brief description)	**15**
	Introduction to NCBI Tool Kit, MATLAB & R-Language	
2	1. Major Algorithms in Computational Biology- NCBI tool Kit Introduction to the NCBI C++ Toolkit: Introduction to C++ modules - CORELIB, ALGORITHM, CGI, CONNECT, CTOOL, DBAPI, GUI, HTML, OBJECT MANAGER, SERIAL and UTIL module. 2. Major Algorithms in Computational Biology-MATLAB Introduction to MatLab and molecular forces; Bioinformatic ToolBox, Statistics ToolBox, Distributed computing server, Signa Processing ToolBox. The Matlab working environment. Variable constants and reserved words. Arrays and matrices. 3. Overview of the R language: Defining the R project, Obtaining R, Generating R codes, Scripts, Text editors for R, Graphical Use Interfaces (GUIs) for R, Packages. R Objects and data structures:	**10**

	Variable classes, Vectors and matrices, Data frames and lists, Data sets included in R packages	
	Biostatistics	
3	1. Scope of biostatistics: definition, data collection, presentation o data, graphs, charts (scale diagram, histogram, frequency polygon frequency curve, logarithmic curves). Sampling & selection bia probability sampling, random sampling, sampling design Descriptive statistics: Measure of central tendency (arithmetic mean, geometric mean, harmonic mean, median, quartiles, mode Measure of dispersion (range, quartile deviation, mean deviation and standard deviation, coefficient of variation). 2. Bi-Variate Distribution: Correlation and regression analysis (simple and linear) curve fitting (linear, non-linear and exponential). Comparison of means: Test statistics; t-test, F distribution, one way and two ay ANOVA	**15**
	PracticalinComputational Biology	
4	1. Measurement and Sampling: To select a simple random sample from the population and enter these data into SPSS/Minitab/or any other statistical software. 2. Diagrammatic & Graphical representation: To plot line diagrams, bar diagram. Pie chart, Histogram and frequency distribution of the collected data. 3. Summary Statistics: To calculate and interpret summary statistics for the data in your sample. 4. Correlation: Calculation & interpretation of correlation and regression between variables. 5. Implementing t- test.	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. John Lewis, Peter Joseph DePasquale, Joseph Chase, Joe Chase. Java Foundations by Addison- Wesley, 2010.
2. D. Curtis Jamison. Perl Programming for Biologists by, Wiley-IEEE, 2003.
3. Mitchell LModel. Bioinformatics Programming Using Python by, O'Reilly Media, Inc., 2009.
4. Alain F. Zuur, Elena N. Ieno, and Erik Meesters. A Beginner's Guide to R. Use R. Springer,2009.
5. Marcello Pagano & Kimberlee Gauvreu. Principles of Biostatistics. Thompson Learning.

Suggested Readings:

1. Kaladhar D S V G K. BioJava: A Programming Guide by, 2012.
2. Jason M. Kinser. Python for bioinformatics, Jones & Bartlett Learning, 2009.
3. Curtis Jamison D. Perl Programming for Biologists, John Wiley & Sons,2003

4. James Tisdall. Mastering Perl for Bioinformatics, O'Reilly Media, Inc,2003.
5. Ronadd N Forthofer and Eun Sul Lee. Introduction to Biostatistics, Academic 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

KU3DSCZCB202: GENOMIC GUIDANCE AND PUBLIC HEALTH

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC A4	200-299	KU3DSCZCB202	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:

Have you ever wondered how traits are transferred from one generation to another? This course explores the captivating realm of genetics, delving into the fundamental principles of inheritance, advanced diagnostic methods, and the ethical issues related to genetic information.

Course Prerequisite: Knowledge gained during the previous semesters of this programme.

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Explain the principles behind Mendel's laws and their application in Predicting inheritance patterns.	An
CO2	Applyknowledge of chromosomal anomalies to identify potential genetic disorders in humans.	E
CO3	Describe the principles and applications of different cytogenetic tools	U
CO4	Analyze the advantages and limitations of various prenatal testing options.	E
CO5	Explain then importance of accurate diagnosis and risk calculation in Genetic counselling.	E

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

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Basics of Inheritance	
1	Structure and chemistry of DNA, Molecular organization of DNA Genetic Code, Mendel's laws and inheritance pattern Autosomal Dominant inheritance, Autosomal Recessive inheritance Sex linked inheritance, Co-dominance, Incomplete dominance.	**10**
	Human Karyotype and Inheritance	
2	Banding techniques, Human karyotype Chromosomal anomalies in humans- Down's syndrome, Turner's syndrome Klinefelter's syndrome In-situ Hybridization technique, Fluorescent in situ hybridization Comparative genomic hybridization.	**15**
	Molecular cytogenetics	
3	In-situ Hybridization technique, Fluorescent in situ hybridization Comparative genomic hybridization.	**10**
	Prenatal Diagnosis	

4	Prenatal diagnosis: Different methods of prenatal diagnosis, Identification of pregnancies at risk, Maternal age, Population screening, Maternal serum biochemistry (for neural tube defects, downs syndrome), Ultra sonograph Previous child with Mendelian disorder & family history of Mendelian disorders.	**20**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings

1. (Books,Journals,E-sourcesWebsites/web links)
2. Gardner,A,Howell,RT andDaviesT.,2008.VivaBooks,New Delhi
3. MangeJEandMange AP,1994.Basic Human Genetics.Sinauer Associates, Sunderland.

Suggested Readings

1. (Books,Journals,E-sourcesWebsites/web links) https://www.genome.gov/
   National Human Genome Research Institute (NHGRI): A comprehensive website with educational resources, news, and research updates on all aspects of genetics.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
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		100

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

KU3DSCZCB203: HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC B3	200-299	KU3DSCZCB203	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 is designed to give a clear idea about the various organ systems in human body and their physiological functions. It also incorporates the structure of major endocrine organs and the functions of hormones secreted by them and emphasizes their role in the regulation of the functioning the organ systems It also aims at giving an idea on the common disorders associated with the organ systems. Moreover, it gives importance to practical experiments too.

Course Prerequisite: Knowledge gained during the previous semesters of this programme.

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Understand various organ systems in human body	U
CO2	An insight into various physiological mechanisms occurring in human body	An
CO3	Comprehend the structure of various endocrine glands and the functions and regulatory role of their hormone on the organ systems	U
CO4	Explore the major disorders associated with the organ systems as well as the endocrine disorders	U
CO5	Equip the students with practical knowledge through laboratory experiments in physiology	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	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Nerves and Muscles	
1	Membranes Potential, Transmission of impulse through myelinated and non myelinated nerve fibres, All or none law, Synaptic transmission Neurotransmitters (eg., Acetylcholine, Adrenaline, GABA, Dopamine Serotonin, Glycine)Skeletal muscle: Ultra structure, Mechanism of contraction and relaxation of muscle, Mention muscle proteins, Structure and function o neuromuscular junction Mention - Triad, Motor Unit, Fatigue, Simple muscle twitch, Cardiac Muscle, Smooth Muscle.	**15**
	Endocrine System	
2	Hormones- Major classes- Steroid hormones, Peptide hormones, Amino acid derivatives, General structure and functions of Pituitary, Endocrine Pancreas Adrenal glands and Thyroid gland, Mention the functions of Pineal gland Thymus and Parathyroid glands. Gastro intestinal hormones Common endocrin disorders-Dwarfism, Gigantism, Cushing Syndrome, Addison's Disease Diabetes mellitus, Diabetes insipidus, Exophthalmic goiter.	**15**
	Hormones and Reproduction	
3	Structure of Ovum and Sperm, gametogenesis Hormonal control of menstrual cycle. Hormonal control of Gestation and Parturition. Hormonal control of Lactation.	**10**

	Practicalsin Zoology	
4	i. Cardiac Efficiency Test (Harward Method) ii. Histology- Study of Permanent slides/Pictures with neat labelled sketches and notes 1. T.S. of Nerve 2. Striated Muscle 3. Cardiac Muscle 4. Smooth Muscle 5. Sperm 6. Ovum 7. C.S. of Thyroid follicle 8. Islets of Pancreas	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings

1. Barrett KE, Barman SM, Brooks HL & Yuan J X J (2019) Ganong's Review of Medical Physiology 26th Ed. Mc Graw Hill Education.
2. Hall, J. E. & Hall, M. E. (2020) Guyton and Hall Text book of Medical Physiology,14th Ed. Elsevier.
3. Geetha, N (2022) Human Physiology Jaypee Brothers Medical Publishers
4. Sherwood L (2015) Human Physiology From Cells to Systems 9th edition, Brooks/Cole Pub.
5. Sembulingam K and Sembulingam P(2022) Essentials of Medical Physiology 9th edition, Jaypee Brothers Medical Publishers

Suggested Readings:

1. Tortora GJ & Derrickson BH (2017) Principles of Anatomy and Physiology 15th edition
2. Jain A K (2019) Textbook of Physiology Avichal Publishing Company
3. Chatterjee CC (2022) Human Physiology 14th edition, CBS Publishers & Distributers
4. Bijlani RL & Manjunatha S (2010) Understanding Medical Physiology 4th edition, Jaypee Brothers Medical Publishers
5. Marya RK: Medical Physiology (2016) 4th edition, AITBS Publishers.

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

KU3DSCZCB204- DIGITAL DNA: EXPLORING COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	DSC C3	200-299	KU3DSCZCB204	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 delves into the major algorithms used in computational biology essential for analyzing biological data. Students will acquire fundamental knowledge of bioinformatics algorithms and gain practical experience in implementing scripts using BioPerl, Biopython, MATLAB, and R. The course is designed for students with a background in biology, computer science, or related fields, aiming to provide the tools necessary to address complex bioinformatics challenges and analyze sequence information of macromolecules effectively.

Course Prerequisite: A background in biology, computer science, or a related field.

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Able to gain fundamental knowledge about the major algorithms used in computational biology	U
CO2	Able to implement scripts of BioPerl and Biopython in analysis of sequence information of macromolecules	A
CO3	Able to implement MATLAB programming for bio-statistical applications	A
CO4	Able to apply R- programming concepts to extrapolating functional information of macromolecules	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		✓						

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Introduction to BioPerl & BioPython	
1	1. Major Algorithms in Computational biology: PERL Basics of Perl Introduction to BioPerl and BioPerl Objects - Brief descriptions (Seq, PrimarySeq, LocatableSeq). 2. Major Algorithms in Computational Biology-Python: Introductio to python. Python basics – Variables, Operators, Data types an Assignments. Statements – Input/output statements, BioPython i Computational biology (Brief description)	**15**
	Introduction to NCBI Tool Kit, MATLAB	
2	1. Major Algorithms in Computational Biology- Introduction to the NCBI C++ Toolkit 2. Major Algorithms in Computational Biology-MATLAB: Introduction to MatLab and molecular forces. 3. Biostatistics- Scope of biostatistics: definition, data collection, presentation of data, Sampling & selection bias, probability sampling, random sampling, sampling designs. Descriptive statistics, Bi-Variate Distribution.	**10**
	Introduction to R language	

3	1. Overview of the R language: Defining the R project, Obtaining R Generating R codes, Scripts, Text editors for R, Graphical Use Interfaces (GUIs) for R, Packages. R Objects and data structure Variable classes, Vectors and matrices, Data frames and lists, Dat sets included in R packages.	**15**
	Practical inComputational Biology	
4	1. Retrieving and Displaying a DNA Sequence from NCBI using BioPerl. 2. Calculation of mean, median, mode, standard deviation, variance, standard error, coefficient of variation for a variable. 3. Construction of bar diagram, pie diagram, line diagram, histogram and box plot for a data.	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. John Lewis, Peter Joseph DePasquale, Joseph Chase, Joe Chase. Java Foundations by Addison- Wesley, 2010.
2. D. Curtis Jamison. Perl Programming for Biologists by, Wiley-IEEE, 2003.
3. Mitchell L Model. Bioinformatics Programming Using Python by, O'Reilly Media, Inc., 2009.
4. Alain F. Zuur, Elena N. Ieno, and Erik Meesters. A Beginner's Guide to R. Use R. Springer,2009.

Suggested Readings:

1. Kaladhar D S V G K. BioJava: A Programming Guide by, 2012.
2. Jason M. Kinser. Python for bioinformatics, Jones & Bartlett Learning, 2009.
3. Curtis Jamison D. Perl Programming for Biologists, John Wiley & Sons,2003
4. James Tisdall. Mastering Perl for Bioinformatics, O'Reilly Media, Inc,2003.

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

KU3VACZCB201- LIFE SCIENCES & BIOINFORMATICS: DECODING THE BLUEPRINT OF LIFE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
III	VAC 1	200-299	KU3VACZCB201	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	1	0	15L+10P	35L+15P	75	1.5

COURSE DESCRIPTION:

This value-added course introduces undergraduate students to computational methods for diagnosing human diseases. It covers the identification of disease-associated genes, gene prediction, pathway analysis, and network biology. Students will explore both common (e.g., cancer, diabetes) and rare genetic diseases (e.g., mitochondrial disorders) using bioinformatics tools and databases. Hands-on sessions with platforms like DisGeNET, GSEA, STRING, and GTEx will equip students with practical skills in disease gene discovery and data integration.

Course Prerequisite: Nil

COURSE OUTCOMES:

	Expected Outcome	Learning Domains
CO1	Understand and explain computational methods used to identify disease-associated marker genes in various common human diseases such as cancer, diabetes, cardiovascular diseases, and chronic kidney disease.	U
CO2	Apply gene prediction algorithms (ab-initio and homology-based) and interpret the significance of genetic variants using curated clinical databases such as ClinVar and dbSNP.	A/An
CO3	Perform gene enrichment and pathway analysis using tools like KEGG, Reactome, and GSEA to elucidate the molecular basis of rare genetic and neurodegenerative disorders.	A/An
CO4	Construct and analyze molecular interaction and gene co-expression networks using STRING, Cytoscape, and WGCNA, integrating multi-omics data for systems-level understanding of disease biology.	An/E
CO5	Develop hands-on proficiency in using publicly available databases and software platforms for expression analysis (e.g., GTEx, GEO) and disease modeling with real-world case studies, especially in mitochondrial and chronic diseases.	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	PSO8
CO 1	✓	✓		✓				
CO 2		✓	✓			✓		
CO 3		✓		✓				✓
CO 4			✓	✓	✓			✓
CO 5		✓			✓	✓	✓	

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Computational Diagnosis of Common Human Diseases	
1	1. Identification and analysis of disease-specific marker genes-: Cancer, Diabetes Mellitus, Cardiovascular Diseases (CVD), Chronic Kidney Disease (CKD). 2. Sequence similarity-based gene discovery (e.g., BLAST, FASTA). 3. Ab-initio gene prediction tools (e.g., GENSCAN, AUGUSTUS). 4. Pathway analysis using KEGG, Reactome. 5. Gene Set Enrichment Analysis (GSEA). 6. Construction and interpretation of molecular interaction networks.	**10**
	Computational Diagnosis of Rare Genetic Diseases	
2	1. Gene enrichment analysis for neurodegenerative disorders- Parkinson's Disease, Alzheimer's Disease, Muscular Dystrophy 2. Supervised and unsupervised learning approaches for gene selection (e.g., Random Forest, PCA, K-means) 3. Interpreting genetic variants using databases (e.g., ClinVar, dbSNP). 4. Microarray and RNA-Seq data analysis. 5. Gene clustering and biological network construction. 6. Integration of multi-layered data for disease modeling.	**10**

Computational Approaches to Mitochondrial Diseases		
3	1. Focus on Mitochondrial Encephalopathy, MIDD (Maternally Inherited Diabetes and Deafness)-mitochondrial genetics and inheritance. 2. Multi-omics data integration (genomics, transcriptomics proteomics, metabolomics). 3. Gene co-expression network analysis (e.g., WGCNA). 4. Genome-scale metabolic modeling (e.g., COBRA toolbox). 5. Applications of CRISPR-Cas in mitochondrial genome editing. 6. Case Study in Computational Diagnosis- Chronic Kidney Disease (CKD)- Disease-specific gene and biomarker selection Next-Generation Sequencing (NGS) data analysis pipelines.	**10**
4	1. Identification of Disease-Associated Genes Using DisGeNET and OMIM. 2. Gene Set Enrichment Analysis (GSEA) Using Web-Based DAVID. 3. Molecular Network Construction Using STRING and Cytoscape 4. Expression Profile Analysis Using GTEx and GEO Datasets.	**10**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. Cannataro M, Pietro Hiram Guzzi Agapito G, Zucco C, Milano M. Artificial Intelligence in Bioinformatics, Elsevier, 2022.
2. Setubal JC, Waldeyr Mendes Silva. Advances in Bioinformatics and Computational Biology, Springer Nature, 2020.
3. Glaab E. Computational systems biology approaches for Parkinson's disease. Cell and tissue research, 2018.
4. Jayaraj JM, Kuriakose BB, Alhazmi AH, Muthusamy K. Structural and functional insights on vitamin D receptor and CYP24A1 deleterious single nucleotide polymorphisms: A computational and pharmacogenomics perpetual approach. Cell Biochemistry and Function, 2021.

Suggested Readings:

1. Zvelebil, Marketa, Jeremy O Baum. Understanding Bioinformatics, published by Garland Science, 2008.
2. Pevsner, Jonathan. Bioinformatics and Functional Genomics. 3rd edition, published by Wiley-Blackwell, 2015.
3. Brown, Stuart M. Next-Generation DNA Sequencing Informatics. published by Cold Spring Harbor Laboratory Press, 2015.

4. Alberts Bruce, Johnson Alexander, Lewis Julian, Morgan David, Raff Martin, Roberts Keith, Walter Peter. Molecular Biology of the Cell, 6th Edition. Garland Science, 2015.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation		**35**
Continuous Evaluation		**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		**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 IV

KU4DSCZCB205: CELL BIOLOGY AND IMMUNOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC A5	200-299	KU4DSCZCB205	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 students with comprehensive knowledge about the cell, the fundamental unit of life. It is designed to help students understand the functions of cellular components in supporting all life processes. Through this course students will gain an in-depth understanding of the immune system and its role in animal biology. The course delves into the intriguing field of immunology, explaining the body's remarkable defense mechanisms. It aims to equip students with a foundational grasp of immunology, offering valuable insights into how the body defends itself and maintains health. The historical roots and fundamental principles of immunology are covered in this course. Participants will gain a thorough understanding of the key players in the immune system, including the organs and cells, and the mechanisms that protect the body. The course explores different types of immunity and examines how the immune system mounts primary and secondary responses to combat invaders and adapts throughout our lives.

Course Prerequisite: Knowledge gained during the previous semesters of this programme

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Understand the role of cells in supporting life and grasp the functions of cellular organelles.	U
CO2	Gain knowledge of the basic principles of inheritance.	U
CO3	Identify abnormal cellular structures and functions linked to diseases like cancer, infections, and genetic disorders.	An
CO4	Comprehend the immune system of animals and its application for human health.	An

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

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Overview of Cells and Structure & Function of Cell organelles	
1	Cell types- Prokaryotic & Eukaryotic cell, Virus & Mycoplasma.Plasma membrane: Structure (Fluid mosaic model), Functions (Transport & Cytosis), Cytoskeleton: Microtubules, microfilaments, intermediat filaments, Mitochondria: Structure, oxidative phosphorylation, electron transport chain, Endosymbiotic hypothesis, Peroxisomes-Function Nucleus-structure, nuclear envelop, nucleolus, nuclear pore complex Functions. Types of Chromosomes, Chromatin-Euchromatin & heterochromatin, Nucleosome concept.	15
	Cell Reproduction and Cancer	
2	Cellcycle, Mitosis, Meiosis Cancer- Types, Characteristics, Cancer Therapy	10
	Immunology	
3	Types of Immunity- Natural and Acquired immunity, Active and passive immunity, Cell mediated immunity, Humoral immunity. Immune response Primary immune response, Secondary immune response Cells and Organs of Immune System, Thymus. Spleen, Lymphnodes, Mucosa Associated Lymph Tissue, Tcells, BCells, Granulocytes, Mast Cells& Dendritic Cells Antibody- structure, Immune Disorders- Types of hypersensitivity I,II,III&IV, Brief accounts of allergy and anaphylaxis, AIDS, SCIDS, Autoimmunity-System specific, Organ specific,	15

	Vaccination-Definition, principles, Vaccines-types (Brief account National Immunization Programme, BCG, DPT, OPV Transplantation Immunology-Types of grafts, Graft rejection, Prevention of Graft rejection Immunotherapy. Immunological Techniques- ELIZA, RIA	
	Practicals in Zoology	
4	1. Blood Grouping (ABO & Rhfactor) 2. Histology Slides-Lymphocyte, Thymus, Tonsil, Spleen, 3. Studyof mitotic stages – Onion root tip squash preparation. 4. Staining of buccal epithelial cells. 5. Preparation of blood Smear and identification of anythree WBCs	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. De Roberties, E. D. P. et al.: Cell and Molecular Biology 7th/8th edition TMH
2. Freifelders Essentials of Molecular Biology, 4thEd (2015)
3. Gerlad Karp: Cell and Molecular Biology 6th/7th edition Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments VI edition. John Wiley and Sons.Inc.
4. Koshy Thomas& Joe Prasad Mathew (Editors)(2011)Cell Biology and Molecular Biology.
5. Rastogi S. C. (1998) Cell Biology. Tata Mc. Graw Hill Publishing Co., New Delhi.
6. Ali, S (2014) The Cell: Organization Function and Regulatory Mechanisms, Pearson
7. Rastogi V. B.(2016): Principles of Molecular Biology, 2nd edition Med Tech Science Press
8. Kindt TJ (2006) Kuby Immunology, Publisher: W H Freeman & Co
9. Chakravarty (2006) Immunology and Immunotechnology
10. Joshi KR (2007) Immunology
11. Tizard IR (2006) Immunology: An Introduction, Publisher: Cengage Learning
12. Khan (2009) Elements of Immunology, Publisher: Dorling Kindersley(India)

Suggested Readings:

1. Karp GIJ & Marshall W (2020) Karp's Cell and Molecular Biology.
2. Rastogi VB(2021) Cell Biology, 1st edition Med Tech Science Press
3. Watson JD (2014) Molecular Biology of the Gene. Pearson. 7th Edition. (ForModules 3 & 4)
4. Cooper GM. The Cell: A Molecular Approach. 2nd edition. Sunderland (MA):Sinauer Associates; 2000.

5. Alberts B, Johnson A, Lewis J et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002.
6. Brown TA. Genomes. 2nd edition. Oxford: Wiley-Liss; 2002.
7. Lodish, H, Berk A, Matsudaira P, Kaiser CA, Krieger M, Scott MP et al.(2005) Molecular cell biology. 5th Edition, W.H. Freeman and Co., New York.
8. Panicker S & Abraham G (2008) Microbiology and Immunology, Zoological Society of Kerala, Kottayam.
9. Abbas, Basic Immunology, 3rd Edition, Elsevier
10. Yada PR (2004) Immunology, Discovery Publishing House
11. Marcus DA, Goldsby RA, Osborne BA (2003) Immunology, WH Freeman & Co.

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

KU4DSCZCB206- STRUCTURAL PERSPECTIVES OF PROTEINS-PROTEIN BIOINFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC A6	200-299	KU4DSCZCB206	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 offers a comprehensive introduction to Structural Bioinformatics, focusing on the relationship between biomolecular structure and function. It covers the hierarchical organization of protein structures, including motifs, folds, and domains, and introduces key structure databases such as PDB, SCOP, and CATH. Students will explore molecular interactions, protein–DNA binding, and the principles behind experimental techniques like X-ray crystallography and NMR. Practical sessions emphasize structure prediction, evolutionary analysis, and structural data interpretation using computational tools. Hands-on computational exercises, preparing students for advanced studies or careers in structural biology, drug design, and computational life sciences.

Course Prerequisite: Basic knowledge in biology and bioinformatics.

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Understand the levels of protein structure and the correlation between amino acid properties and protein function.	U
CO2	Interpret and utilize structural bioinformatics databases such as PDB, CATH, and SCOP for protein structure classification and evolution.	A
CO3	Analyze the hierarchical organization of protein architecture including helices, sheets, motifs, folds, and domains.	An
CO4	Explain biomolecular interactions and their underlying forces, especially in protein-protein and protein-DNA binding contexts.	U
CO5	Describe the principles and methodologies of experimental techniques like X-ray crystallography and NMR used for structural determination.	U
CO6	Perform hands-on computational tasks including structure prediction, phylogenetic analysis, and quality assessment of molecular models.	A/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			✓	✓				
CO 5	✓				✓			
CO 6		✓			✓	✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Introduction to Structural Bioinformatics	
1	1. Protein Structure Levels and Their Biological Significance: Amino acids fundamental building blocks, Peptide bond, rigid plana peptide unit, cis and trans configuration, Physical properties o amino acids. Protein Function: Relationship between structure and function. 2. Data representation and Databases- PDB, mmCIF and othe formats, structure based databases for proteins and nucleic acids Comparative features-the CATH domain structure Database Protein structure evolution and the SCOP Database.	**15**
	Structural Hierarchy	
2	1. Structural Hierarchy: Helices – Classic α- Helix and π Helices, Left Handed α-Helix and Collagen Helix. β-Sheets -β-sheets - paralle and Anti-parallel, Turns and Loops. Super secondary and Tertiary structure and Quaternary Structure, Quaternary Structure Complex 3D Networks. Motifs and domains.	**10**

	2. Classes in Protein Architecture – Folds, α-Class, Bundles, Folded leaves, Hairpin arrays. β- Class folds, Anti-parallel β domain parallel and Anti-parallel Combinations. α/β and α+β- Class, α/β Barrels, Open twisted α/β folds, Leucine-rich α/β folds. α+β fold Quaternary structure. 3. Overview of the prediction of primary, secondary and tertiary structure of proteins with suitable computational biology tools.	
Biomolecular Interactions		
3	1. Intermolecular Interactions Protein-protein interactions, protein – DNA interactions, DNA binding proteins, Types of interactions o DNA with proteins and small molecules. Different forces involved in the interactions. Molecular Docking (Brief description). 2. Introduction to X-ray Crystallography: Crystal system, Bragg's law, diffraction of crystals, structure factor, atomic scattering factor, crystallization, data collection, structure solution and refinement, Structure validation. NMR Spectroscopy.	**15**
Practicals in computational biology		
4	1. Phylogenetic and evolutionary analysis of molecular sequences- Phylogenetic tree building and evaluation 2. Compare structural classification using SCOP and CATH databases. 3. Prediction of secondary structures of proteins and disordered regions 4. Prediction of secondary structures and folding of RNA. 5. Analyze structural quality and features from X-ray crystallographic data.	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. Bourne, PE, and H. Weissig. Structural Bioinformatics Wiley-Liss, 2003.
2. Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan. Molecular Modeling, Gerd Folkers, 2008.
3. Alberte Pullman. Modeling of Bimolecular Structures and Mechanisms, Joshua Jortner, 1995.
4. Jill P. Mesirov, Klaus Schulten, De Witt L. Sumners. Mathematical Approaches to Biomolecular Structure and Dynamics by, 1996.

5. 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.
5. Pesole G, Frascotti P, Gissi C, Licciulli G, Saccone C. Bioinformatics for beginners: Genes, genomes, molecular evolution, databases and analytical tools. Wiley-Blackwell, 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

KU4DSCZCB207- GENOMICS AND PROTEOMICS: MAPPING THE BLUEPRINT OF LIFE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	DSC A7	200-299	KU4DSCZCB207	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 fundamental concepts of genomics, proteomics, and genetic mapping. It covers key techniques such as gene mapping, DNA polymorphism, protein separation methods (SDS-PAGE, 2D electrophoresis), chromatography, and mass spectrometry (HPLC-MS, MALDI-TOF MS). Students will learn classical and modern DNA sequencing methods, including Sanger and Next Generation Sequencing, as well as applications of microarrays, PCR, cDNA library construction, and functional genomics tools. The course prepares students for advanced studies in molecular biology and biotechnology.

Course Prerequisite: Knowledge gained during the previous semesters of this programme.

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Understand the fundamental principles of genomics, proteomics, and metabolomics.	U
CO2	Explain genetic mapping techniques and the application of genetic markers.	U
CO3	Apply protein analysis techniques such as SDS-PAGE, 2D electrophoresis, and mass spectrometry.	A
CO4	Analyse various DNA sequencing methods including Maxam-Gilbert, Sanger, and Next Generation Sequencing.	An
CO5	Evaluate and integrate molecular biology tools such as PCR, cDNA library construction, microarrays, and ESTs in genomics research.	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		✓	✓					
CO 5		✓			✓			✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Introduction to Genomics, Proteomics and Metabolomics	
1	1. Introduction to Genomics, Proteomics and Metabolomics, - geneti mapping, linkage mapping, types of genetic mapping, 2. Application of gene mapping, genetic markers, application of genetic markers, DNA polymorphism-SNP, DNA typing. 3. Overview of genome, genome sequence acquisition and analysis comparative homologies, evolutionary changes, Microarrays sequence specific tags, sequence tagged sites, ISH, FISH. Application.	**15**
	DNA sequencing	
2	1. DNA sequencing: Maxam and Gilbert method, Sanger method Ladder, Fluorescent, Shotgun, Automation DNA sequencing Implications of DNA sequencing. Basics about Next Generation Sequencing. Southern blotting, Northern blotting. 2. Construction of cDNA and genomic DNA libraries; Polymerase Chain Reaction (PCR), Yeast two-hybrid system, SAGE Adaptation for Downsized Extract (SADE), ESTs.	**10**

	Protein digestion techniques	
3	1. SDS-PAGE, 2D-Electrophoresis, Isoelectric focusing (IEF) Chromatography, basic principles, normal phase and reverse phase chromatography, High Performance Liquid Chromatography- 2. Mass Spectroscopy (HPLC-MS). MALDI TOF MS. Tools for the analysis- use and application of these techniques.	**15**
	Practicals	
4	1. Demonstration of Plant Genomic DNA isolation. 2. In silico analysis of SNPs and DNA typing using NCBI dbSNP and BLAST tools. 3. Genome exploration and gene mapping using the Ensembl Genome Browser. 4. Virtual restriction digestion and gel electrophoresis using NEBcutter online tool. 5. Simulation of peptide mass fingerprinting using MALDI-TOF MS with Expasy tools. 6. PCR simulation and amplification of DNA using an interactive virtual lab platform.	**30**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. Leibler DC. 2002. Introduction to proteomics, tools for the new biology. Humana press.
2. Hunt SP, Livesey FJ, 2000. Functional genomics, Oxford University press.
3. Cantor CR, 1999. Genomics. John Wiley, NY.
4. Westermier R, Naven T, 2002. Proteomics in practice: A laboratory manual of proteome analysis. John Wiley- VCH.

Suggested Readings:

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education.
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley.
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi.
5. Essential Bioinformatics-Jin Xiong, Cambridge University 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.

KU4VACZCB202: ETHICS IN BIOLOGICAL RESEARCH

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC2	200-299	KU4VACZCB202	3	45

Learning Approach (Hours/Week)			Marks Distribution			Duration of ESE(Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	1	0	15L+10P	35L+15P	75	1.5

COURSEDESCRIPTION:

The course will cover the basics of ethical concerns in biological research and provide updates on research ethics guidelines. It will address ethical dilemmas that arise during research activities and the outcomes of research. Specifically, the course consists of modules on: Best practices and misconduct in science; research involving human subjects, research involving animals, and emerging biotechnologies. As an applied ethics course, the focus within these areas will involve describing typical practices in biological research, examining ethical principles, professional standards, and legal frameworks that influence responsible research conduct, and fostering ethical problem-solving abilities.

Course Prerequisite: Nil

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Gain an understanding of ethical concerns in experiments involving animals and humans.	U
CO2	Acquire knowledge regarding the regulations and ethical considerations in research and publishing.	U
CO3	Investigate alternative methods such as simulation, informatics, and organs-on-chips	An
CO4	Assess the advantages and disadvantages of animal and human experimentation, genome research, and stem cell research.	An
CO5	Develop skills in debating and creating animations, videos, and edits for biological research.	A

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

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	✓		✓		✓	✓	✓	✓
CO 2	✓		✓		✓	✓	✓	✓
CO 3	✓		✓		✓	✓	✓	✓
CO 4	✓		✓		✓	✓	✓	✓
CO 5	✓		✓		✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Introduction	
1	Importance of ethics in Biological Research, Conflicts of interest. Scientific misconduct: fabrication, falsification, plagiarism. Ethical Issues associated with Gender Bias: Forms of gender discrimination, Value of a gender approach	5
	Publication Ethics	
2	Publication Ethics: Selective reporting, misinterpretation of data. Redundant publications: Duplicate and overlapping publications, Journal finder tools-JANE, Elsevier Journal finder, Springer, Journal suggester. Plagiarism software-Turnitin, Urkund. Predatorypublications and journal Databases and Research Metrices :Indexing databases. Web of Science: Scopus, PubMed, Google scholar; Journal citation report, Impact factor. Metrices -hindex, G index, i10index.	10

	Research Involving Animals	
3	The use of animals in basic biological research, Study of human disease genetically modified animals in the study of human diseases and disorders Role of ethics committee. Safe disposal of animal wastes Pros and cons of anima experimentation-Impact of experimentations on animals. Ethics, Principles and legislation in animal experimentation- Principle of the 4R's-Reduction, Refinement, Replacement and Responsibility; Legislation regulation and policy relating to scientific procedures on animals; Choice o the animal model; Housing and environmental enrichment. Relevance o animal experimentations and possible alternatives Ethics of research involving humans.	**15**
4	1. Studyof Journal finder tools-JANE, Elsevier Journal finder, Springer, Journal, suggester 2. Plagiarism software-Turnitin, Urkund 3. Web of Science : Scopus, PubMed, Google scholar.	**10**
5	**Teacher Specific Module**	**5**

Essential Reading:

1. Muralidhar K,Ghosh A, Singhvi AK(Ed.) 2019.Ethics in Science Education, Research and Governance. Indian National Science Academy, NewDelhi. 137pp.CSIR Guidelines for Ethics in Research and in Governance 2019.
2. Resnik DB(1998) The Ethicsin Science-an introduction. Routledge, NewYork,1998.

Suggested Readings:

1. Mathaiyan J, Chandrasekaran A, Davis S (2013) Ethics of genomic research. Perspect Clin. Res. 4(1):100-4. doi: 10.4103/2229-3485.106405. PMID: 23533991; PMCID:PMC3601693.
2. Gupta JA (2013) Ethical issues and challenges in bioethics education from a gender perspective. UNESCO: International Conference on Gender and Bioethics, Kazan, Russian Federation.
3. Kiani AK, Pheby D, Henehan G, Brown R, Sieving P, 2022. Ethical Considerations regarding animal experimentation. J Prev Med Hyg;63(suppl.3): E255- E266.
4. Denzin,NK(1994) Hand Book of Qualitative Research. New Delhi: Sage Publications.
5. Mathur R, ICMR (2017) Ed. National ethical guidelines for biomedical and health research involving human participants: Eds.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation		**35**
Continuous Evaluation		**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		**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

KU4VACZCB203- INFORMATICS AND METHODS IN DRUG DESIGN

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	VAC 3	200-299	KU4VACZCB203	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	1	0	15L+10P	35L+15P	75	1.5

COURSE DESCRIPTION:

This value-added course introduces students to the foundational concepts and applications of pharmacoinformatics in modern drug design. It covers drug classification, sources, and screening filters, and explores essential informatics tools and databases used in the identification and analysis of bioactive compounds. Students will learn about various drug targets, drug-target interactions, and networks, along with key principles of pharmacokinetics and pharmacodynamics. The course is strengthened by hands-on computational biology practicals focusing on compound retrieval, drug-likeness prediction, target analysis, and molecular docking.

Course Prerequisite: Nil

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Understand the basic principles, scope, and applications of pharmacoinformatics in drug discovery.	U
CO2	Classify drugs based on their origin and properties and apply common filters used in drug design.	A
CO3	Utilize informatics approaches to explore drug targets and analyze drug-target interactions.	A/An
CO4	Interpret key pharmacokinetic and pharmacodynamic models relevant to drug action and metabolism.	An/U
CO5	Perform computational tasks including compound retrieval, drug-likeness evaluation, target identification, and molecular docking.	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	PSO8
CO 1	✓			✓				
CO 2	✓					✓		
CO 3		✓		✓		✓		
CO 4	✓		✓			✓		
CO 5		✓			✓	✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Foundations of Pharmacoinformatics and Drug Discovery	
1	1. Basics of pharmacoinformatics: Definition, branches, scope and applications. 2. Concepts of drugs: Classification, Major sources, Common filters for drugs design. 3. Data Mining Tools and Databases for Drug Design-PubChem, ChEMBL, and PhytoChem DB for data mining and compound selection.	**10**
	Informatics Approaches to Drug Targets and Drug-Target Interaction	
2	1. Classification of drug targets: intrinsically disordered proteins, ion channels, chromatin-associated proteins, noncoding RNA membranes; Drug-target interactions, Drug-target network.	**5**
	Pharmacokinetics & Pharmacodynamics	

3	1. Overview, One-compartment model, Two-compartment model Multi-compartment models, Pharmacokinetic parameters Bioavailability. 2. Drug receptor action, direct physiological action, Drug-drug interactions, drug metabolism, Drug potency and efficacy, Therapeutic index.	**15**
4	1. Retrieve and analyze bioactive compounds from chemical and phytochemical databases. 2. Evaluate the drug-likeness and pharmacokinetic properties of selected compounds. 3. Identify potential drug targets and study drug-target interactions through network analysis. 4. Molecular docking and interpret ligand-receptor binding interactions.	**10**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. Durai Ananda. Elementary Pharmacoinformatics, BSP 2014.
2. Tagelsir Mohamed Gasmelseid. Pharmacoinformatics and Drug Discovery Technologies: Theories and Applications: Idea Group,U.S.; 1 edition 2012
3. Sara E Rosenbaum. Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer SimulationsWiley; 1 edition 2011.
4. Thomas N. Tozer PharmD, Malcolm Rowland. Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy 1st Edition LWW; 1 edition, 2006.

Suggested Readings:

1. Gringauz A. Introduction to Medicinal Chemistry: How Drugs Act and Why, Wiley-VCH, 1997.
2. Katzung BG. Basic and Clinical Pharmacology (13th ed.), McGraw-Hill Education, 2015.
3. Bender A and Gul S. Chemogenomics and Chemical Genetics, Springer,2011
4. Schneider G. Chemoinformatics: Concepts, Methods, and Tools for Drug Discovery. Humana Press. 2004.
5. Azzopardi L M. Validation Instruments for Community Pharmacy: Pharmaceutical Care for the Third Millennium. CRC Press, 2000.

Assessment Rubrics:

Theory

Evaluation Type		Marks
End Semester Evaluation		**35**
Continuous Evaluation		**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		**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

KU4SECZCB201: APICULTURE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
IV	SEC1	200-299	KU4SECZCB201	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	1	0	15L+10P	35L+15P	75	1.5

COURSE DESCRIPTION:

This course aims to provide an introduction to beekeeping with a focus on honey bees. Participants will learn about honey bee biology and how to care for them throughout the year. The course will cover how to identify common honey bee diseases and pests, along with treatment methods. Additionally, it will include the history of bees and an overview of apiculture. By the end of the course, students will be equipped to manage honey bee colonies for optimal health and honey production.

Course Prerequisite: Nil

COURSE OUTCOMES:

	Expected Outcome	**Learning Domains**
CO1	Gain a comprehensive understanding of apiculture principles.	U
CO2	Study and analyze the behaviour of honey bees in their natural habitat and recognize the critical role of honey bees in preserving biodiversity	An
CO3	Learn the construction methods of artificial beehives and master the techniques for maintaining beehives to ensure bee health and productivity	U
CO4	Explore the economic value of honey, beeswax, and venom understand their uses in various industries and their market demand.	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	PSO8
CO 1	✓		✓		✓	✓	✓	
CO 2	✓		✓		✓	✓	✓	
CO 3	✓		✓		✓	✓	✓	
CO 4	✓		✓		✓	✓	✓	

COURSE CONTENTS

Contents for Classroom Transaction:

Module	Description	Teaching Hours
	Introduction to Bee Keeping	
1	History of bee keeping- Scope of Apiculture, Life cycle of Honey bee Classification of honey bee (Rock bee, Little Bee, Dammer bee), Socia organization of Honey bee, Functions of Queen, drones and worker bee in a colony, Food of the bee- Honey and pollen-royal jelly, Feeding methods Artificial feeding.	**10**
	Principles of Apiculture	
2	Bee keeping methods: Primitive bee keeping- Wall hive, Pot hive, log hive bamboo hive, Modern bee keeping-Langstroth hive, Newton hive Swarming, Types of swarming, Prevention and control, Queen rearing Principles and procedure.	**10**
	Products and Enemies of Honey Bee	
3	Honey: Collection and Extraction, Preservation and Storage, Chemical composition, Nutritive value, Medicinal values, Honey as daily food, Bee wax, Bee wax production, Extraction of Bees Wax- Characteristics and uses of Wax, Bee Venom, Collection method, Composition of bee venom. Uses of Bee venom, Enemies of bees: Mites, Greater wax moth, lesser wax moth, ants, wasps, beetles, birds and their management, Diseases of bees: adult and brood diseases- Bacterial, Fungal, Viral & Protozoan. Prevention and control of diseases of Bees.	**10**

4	Mount Honey Bee mouth parts Mount Honey Bee pollen basket Identification of Queen, Worker and Drone Demonstration of honey extraction	**10**
5	**Teacher Specific Module**	**5**
	Directions	

Essential Readings:

1. Arumugam N, Murugan T, Rajeshwar J and Prabhu R (2011) Applied Zoology. Nagercoil: Saras Publications.
2. Singh S (1962) Bee Keeping in India, KAR Delhi.

Suggested Reading:

1. Johnson J and Chandra J I (2005) Apiculture. Marthandam: Olympic Grafix.
2. Sharma P and Singh L (1987) Hand book of bee Keeping, Controller Printing and Stationery, Chandigarh.
3. Stephen R (1998) Introduction to Bee Keeping, Vikas Publishing house, NewDelhi.
4. Nagaraja N and Rajagopal D (2009) Honey bee diseases, Parasites, Pest, Predators and their Management. MJP publishers, Chennai.

Assessment Rubrics:

Theory

Evaluation Type		**Marks**
End Semester Evaluation		**35**
Continuous Evaluation		**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		**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