

M.Sc. Human Genetics and Molecular Biology

Syllabus

UNIVERSITY DEPARTMENT

Program Code: ZOOC

2023 – 2024 onwards



BHARATHIAR UNIVERSITY

(A State University, Accredited with “A++” Grade by NAAC,
Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

PROGRAMME EDUCATIONAL OBJECTIVE (PEOs)

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The M.Sc., Human Genetics and Molecular Biology program describe accomplishments that graduates are expected to attain within five to seven years after graduation.	
PEO1	The students can be employed as geneticists in hospitals and Health care sector.
PEO2	The students can go for higher education in reputed National and International Institutions.
PEO3	The candidates would be able to establish a Genetic testing laboratory
PEO4	Transform the knowledge into design the health care tools/methods for disease diagnosis.
PEO5	Delineate and evaluate the clinical data for the diagnosis of diseases of public health concern.
PEO6	The graduate can become a teacher in Human Genetics and Molecular Biology subjects in higher education institute in national and international level.



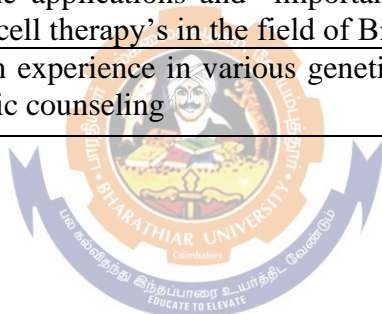
PROGRAMME SPECIFIC OUTCOMES (PSOs)

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
After the successful completion of M.Sc., Human Genetics and Molecular Biology program, the students are expected to	
PSO1	Know the inheritance patterns of human
PSO2	To explain the role of genetic changes in association with diseases and disorders
PSO3	Capacity to design a device to identify the genetic changes
PSO4	Capable of differentiate genetic and non-genetic disorders
PSO5	Capacity to manipulating the mutated diseased genes
PSO6	Capable to become a genetic counselor
PSO7	The confidence to fill their talent gaps in the emerging field in Human Genetics
PSO8	Practice the learned molecular methods in clinical center, hospitals and laboratories



PROGRAMME OUTCOMES (POs)

PROGRAMME OUTCOMES (POs)	
On successful completion of the M.Sc., Human Genetics and Molecular Biology program	
PO1	Able to know the basics in genetic concepts and organization of genome on cellular and chromosomal level
PO2	Able to explain the basic molecular genetics mechanisms in relation to the structure and function of the cells.
PO3	Candidates are able to describe the structure, function and replication of DNA as the genetic material and its manipulations
PO4	Understand the impact genetic information in society
PO5	Acquire the knowledge in the field of Medical, Cyto, Immuno, Molecular, Cancer, Developmental and Neuro genetics to diagnose diseases and disorders.
PO6	Capable to explain the various types of molecular biology methods that are used to study the regulation and function of biomolecules
PO7	Acquire the ability to use their theoretical knowledge in solving practical issues.
PO8	Know the bioethics and safety measures to be followed in handling the biological samples
PO9	Able to explain the applications and importance of biomarkers, DNA finger printing and stem cell therapy's in the field of Biomedical Genetics
PO10	Can have hands on experience in various genetics techniques and familiar with practicing of genetic counseling



BHARATHIAR UNIVERSITY: COIMBATORE - 641 046
M.Sc., HUMAN GENETICS AND MOLECULAR BIOLOGY
Curriculum (University Department)

(For the students admitted during the academic year 2023-2024 batch and onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
13A	Core I - Medical Biochemistry	4	4	-	25	75	100
13B	Core II - Cell Biology and Cell Signaling	4	4	-	25	75	100
13C	Core III - Principles of Human Genetics	4	4	-	25	75	100
13D	Core IV - Molecular Genetics	4	4	-	25	75	100
13P	Core Practical - I (Medical Biochemistry, Cell Biology and Cell Signaling, Principles of Human Genetics, Molecular Genetics)	4	-	6	25	75	100
1EA / 1EB / 1EC	Elective I - Genomics and Proteomics / r-DNA Technology / Medical Physiology	4	4	-	25	75	100
GS09	Supportive I - Genetics and Society	2	2	-	12	38	50
Total		26	22	6	162	488	650
SECOND SEMESTER							
23A	Core V - Human Cytogenetics	4	4	-	25	75	100
23B	Core VI -Medical Genetics & Genomics	4	4	-	25	75	100
23C	Core VII - Developmental and Behavioral Genetics	4	4	-	25	75	100
23D	Core VIII - Biostatistics	4	4	-	25	75	100
23P	Core Practical - II (Human Cytogenetics, Medical Genetics, Developmental and Behavioral Genetics, Biostatistics and Bioinformatics)	4	-	6	25	75	100
2EC / 2ED / 2EE	Elective II - Bio Instrumentation / Nanobiology /	4	4	-	25	75	100

	Pharmacogenomics and Cheminformatics						
GS89	Supportive II - Principles of Genetics	2	2	-	12	38	50
Total		26	22	6	162	488	650
THIRD SEMESTER							
33A	Core IX - Immunogenetics	4	4	-	25	75	100
33B	Core X - Cancer Genetics	4	4	-	25	75	100
33C	Core XI - Neurogenetics and Epigenetics	4	4	-	25	75	100
33D	Core XII - Genetic Counselling	4	4	-	25	75	100
33P	Core Practical - III (Immunogenetics, Cancer Genetics, Neurogenetics and Epigenetics, Genetic counselling)	4	-	6	25	75	100
3EC / 3ED / 3EE	Elective III - Stress and Biomarkers / Stem Cell Biology / Forensic Biology	4	4	-	25	75	100
GS106	Supportive III - Genetic toxicology	2	2	-	12	38	50
Total		26	22	6	162	488	650
FOURTH SEMESTER							
43A	Core XIII - Bioethics and Biosafety (Self Study)	4	-	-	25	75	100
46A	Project and Viva	6	-	-	60	90	150
47B	Hospital Visits / Summer Internship*					20	20
	Research papers / Oral or Poster presentation as presenting author or Training / work shop attended more than 3 days in relevant to Genetics*	2	-	-	-	20	20
	Industrial Visit*					10	10
Total		12	-	-	85	215	300
Grand Total		90	66	18	571	1679	2250
SWAYAM MOOCS#-1 or BU MOOCS#1-- 4 Weeks – 2 credits - Mandatory							
Job oriented Course#-1							
Value Added#-1							

* Report to be submitted along with project work.

Additional credits

JOB ORIENTED COURSES OFFERED*

Semester	Paper	Subject	Hrs Per week	University examination		Credit
				Hrs.	Max. Marks	
SEMESTER-I	20HGMBJOC1	Cytogenetic Techniques	2	3	50	2
SEMESTER-I	20HGMBJOC2	Molecular Diagnostics tools	2	3	50	2

*Offered in collaboration with Hospitals and Industries

VALUE ADDED COURSES OFFERED**

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER-II	20HGMBVAC1	Cell Culture Techniques	2	3	50	2
SEMESTER-II	20HGMBVAC4	Drosophila Culture and Rearing	2	3	50	2

** Offered in the department

PRACTICAL COMPONENTS:

The M.Sc., HGMB Core Practical Examination having the following Marks:

INTERNAL MARKS: 25

Major Practical	10	Marks
Minor Practical	5	Marks
Spotters (A, B, C, D and E)	5x1 =	5 Marks
Observation and Viva	5	Marks

	Total =	25 Marks

EXTERNAL MARKS: 75

Major Practical	20	Marks
Minor Practical	10	Marks
Minor Practical	10	Marks
Spotters (A, B, C, D and E)	5x4 =	20 Marks
Record and Viva	10+5	Marks

	Total =	75Marks

The M.Sc., HGMB Core and Elective theory Examination having the following Marks.

CORE AND ELECTIVE PAPERS: MAXIMUM MARKS - 100

INTERNAL MARKS: 25

Test - 15 Marks
Assignment - 5 Marks
Seminar - 5 Marks

EXTERNAL MARKS: 75

SECTION - A: 10x1=10 Marks (Question No. 1 to 10)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

SECTION - B: 5x5=25 Marks (Either or type- Question No. 11 to 15)

Answer all questions. All question carry equal marks. Each answer should not exceed 2pages.

SECTION - C: 5x8=40 Marks (Either or type- Question No. 16 to 20)

Answer all the questions.





Course code	13A	MEDICAL BIOCHEMISTRY	L	T	P	C
Core-I			4	-	-	3
Pre-requisite	Basic understanding about macromolecules		Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
1. Understand the basis of biochemical and physiological changes that are underlined in various genetic defects						
2. Familiarize with topics such as synthesis, classification, structure and properties of carbohydrates, lipids, proteins and enzymes.						
3. Introduce the learner with basics of the genes that are responsible in various biochemical pathways with the chemical nature and properties of biomolecules						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Get clear understanding about basic structure and function of biological macromolecules					K2
2	Distinguish the various advanced molecular and physiological mechanisms in human being.					K2
3	Distinguish the different processing mechanism of macromolecules in our system and how energy generation and transformations occurs.					K2
4	Apply the knowledge of the acid-bases role, electrolyte balances, and osmolality regulation in our system and its associated diseases diagnosis.					K3
5	Distinguish different enzymes types its clinical significance and advancements.					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6- Create						
Unit:1	STRUCTURE AND FUNCTION OF BIOMOLECULES				18 hours	
Carbohydrates - Structure, Classification, Function and Their clinical significance; Amino acids - Structure and properties; Proteins: Structure and classification, Role of proteins in various biological functions; Lipids - Structure and classification, Storage lipids and structural lipids in membranes, Lipids with specific biological activities.						
Unit:2	METABOLISM				12 hours	
Bioenergetics, Glycolysis, TCA cycle, Glycogen breakdown and synthesis, Gluconeogenesis, Oxidative phosphorylation. Biosynthesis of triglycerides and cholesterol. Oxidation of fatty acids.						
Unit:3	HORMONAL AND GENETIC REGULATIONS OF METABOLISM				10 hours	
Hormones: Functions and classification, Hormonal regulation of fuel metabolism. Molecular mechanism of signal transduction. Role of vitamins in metabolic pathways in association with diseases, Nucleic acid metabolism, Confirmation nucleic acid.						
Unit:4	HOMEOSTATIC MECHANISMS IN THE BODY				16 hours	
Acid base balance: Hydrogen ion homeostasis and related disorders; Blood gas parameters and						

clinical applications. Fluid and electrolyte balance; Regulation of osmolality and maintenance of fluids in the various body compartments and related disorders.		
Unit:5	CLINICAL ENZYMOLOGY	14 hours
Enzymes: Introduction, Classification and regulation. Clinical enzymology: Clinical importance of serum enzymes - Aspartate transaminase, Alanine transaminase, Alkaline phosphatase, Acid phosphatase, amylase, Lactate dehydrogenase, Creatine phosphokinase and Gamma-glutamyltransferase. Cardiac troponins and its clinical significance.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Textbook of Medical Biochemistry Chatterjea M. N. Jaypee Brothers Medical Publishers	
Reference Books		
1	Principles of Biochemistry (4th edition) by Albert L. Lehninger, 2004. CBS Publishers and Distributors, New Delhi.	
2	Biochemistry (8th edition) by Lubert Stryer, 2015. Co-written by Jeremy Berg, John L. Tymoczko and Gregory J. Gatto Jr and published by Palgrave Macmillan.	
3	Biochemistry (4th edition) by D. Voet and J.G. Voet, 2010. John Wiley and Sons, USA Biochemistry, by R.H. Garrett and C.M. Grisham, Saunders College Publishers	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_ccc20_bt12/preview	
2	https://swayam.gov.in/nd2_ccc19_bt02/preview	
3	https://nptel.ac.in/courses/102/105/102105034/	
Course Designed By: Dr. P. VINAYAGA MOORTHY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	L	S	S	M	L	S	M
CO2	S	S	S	M	S	S	M	L	S	M
CO3	M	M	S	M	S	S	M	M	S	M
CO4	L	M	L	L	S	S	S	L	S	S
CO5	L	M	M	L	S	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code	13B	CELL BIOLOGY AND CELL SIGNALLING	L	T	P	C
CORE – II				4	-	-
Pre-requisite	Basic understanding about cell and signaling mechanism		Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
1. Cell Biology gives a detailed understanding of the fundamental processes of cellular function is critical to all specialties within biology.						
2. This course detail properties of cell-cell and cell-substrate interactions and elaborates on the fundamentals of intracellular signal transduction during these interactions.						
3. Topics will include the function and regulation of signaling modules and membrane component in the context of cellular interactions with other cells and with the extracellular matrix.						
Expected Course Outcomes:						
On the successful completion of the course, students will be able to:						
1	The students will be having a clear idea of the structural arrangements of the components of the cell, a functional unit of living system.				K1 & K2	
2	Acquire knowledge basics of mechanism of membrane transport system.				K1 & K2	
3	The students will be exposed to the basics of the nucleus.				K1 & K2	
4	The cell communication is a crucial part of living systems and their functioning. Being a life science student, this must be learnt from them clearly. This course deals with the same.				K1 & K2	
5	The molecular mechanisms of the cell and cell signaling pathways are basics of the cell research, this has also been dealt in this course.				K1, K2 & K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit: 1	CELLULAR ORGANIZATION				14 hours	
Structure of cell organelles, an overview, cell wall and membrane structure. Membrane constituents: phospholipids, glycolipids, cholesterol, membrane proteins, receptors and phospholipases, phospholipid bilayer, fluid mosaic model.						
Unit: 2	MEMBRANE TRANSPORT				14 hours	
Membrane transport of small molecules and the ionic basis of membrane excitability. Principles of membrane transport, carrier proteins, passive movements of solutes and active membrane transport, ion channels and electrical properties of membranes. Cell junctions and cell adhesion molecules, basement membrane, extracellular matrix.						
Unit: 3	THE NUCLEUS				14 hours	
Structure of nuclear envelope, the nuclear pore complex. Selective transport of proteins to and from nucleus. Regulation of nuclear protein import, transport of RNA's. Internal organization of nucleus. Chromosomes.						
Unit: 4	CELLULAR COMMUNICATION				14 hours	
General principles of cell signaling, types and mechanisms. Cell surface receptors, GPCR Molecular structure and functions, enzyme linked receptors, Activated tyrosine kinase and MAP kinase pathways. Cell Division: Overview of cell cycle, mitosis and meiosis. Cell cycle control in mammalian cells. Regulation of cell cycle and its mechanisms. Checkpoint in cell cycle regulation.						

Unit: 5	AGING PROCESS								14 hours	
Cell biology of cell aging process and its significance. Molecular mechanism of cell death: Cell necrosis and apoptosis. CASPASE types and molecular mechanisms, proapoptotic regulators, inhibitors of apoptosis. Molecular biology of Survivin and Bcl2 family members, Anti-aging process. Computational tools for modeling in cell biology. Computer aided tools for studying cell signaling.										
Unit:6	CONTEMPORARY ISSUES								2 hours	
Expert lectures, online seminars - webinars on the cell biology and cell signaling										
								Total Lecture hours		72 hours
Book(s) for study										
1	Cell Biology Orgnelle Structure and Function by Davide E. Sadava. Published by Panima India Edition.									
2	Molecular Biology by Lodish, Berk, Kaiser, Krieper, Scot, Bretscher, Ploegh, Matsundania. Published by NH Freeman and Company.									
Book (s) for reference										
1	The Cell (7 th edition) by Gerald Karp. Published by Wiley.									
2	Molecular Cell Biology (6 th edition) by Alberts. Published by Garland Science.									
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]										
1	https://swayam.gov.in/nd2_cec19_bt12/preview									
2	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/152									
3	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/41									
Course Designed By: Dr. A. VIJAYA ANAND										
Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	L	M	M	L	L	L
CO2	S	S	M	M	L	M	M	L	L	L
CO3	S	S	S	S	S	S	M	M	L	S
CO4	S	S	S	S	S	M	M	M	L	M
CO5	S	S	S	S	S	M	M	M	L	M

*S-Strong; M-Medium; L-Low

Course code	13C	PRINCIPLES OF HUMAN GENETICS	L	T	P	C
CORE-III			4	-	-	4
Pre-requisite	Basic understanding about principles of human genetics and genetic disorder	Syllabus Version	2023-24			
Course Objectives						
The main objectives of this course are to:						
1. To provide the knowledge about the genetic influence and history of human genetics and Mendelian laws to the students for their curriculum development and knowledge enrichment.						
2. To understand the principles and mechanisms of the inheritance from one generation to the next.						
3. To understand the mechanism of inheritance by scientific experimentation.						
4. To get updated with the knowledge on genetic diseases and its research approach.						
5. To understand the genetic disorders and its complications						
Expected Course Outcomes						
On the successful completion of the course, student will be able to:						
1	Gain knowledge on fundamentals of genetics and its impact.					K1 &K2
2	Identify the genetic disease and the pattern of inheritance.					K2 &K3
3	The course would be helpful for the students to obtain job opportunities in public and private sectors related to biology and medicine.					K3, K5& K6
4	This aims to gain knowledge on futuristic aspects of genetics diseases and treatment and preventive options.					K4, K5, &K6
5	Helps the students to avail opportunities in research in different areas of genetics both Nationally and internationally.					K2, K4 & K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	THE CELLULAR AND MOLECULAR BASIS OF INHERITANCE				14 hours	
Nucleus, Human Chromosome structure, Cell division, Types of DNA Sequence, Cell divisions: chromosomal segregation during mitosis and meiosis. Inheritance: Mendelian Laws (law of segregation, law of independent assortment, law of segregation and independent assortment), Non mendelian Inheritance, multiple allele, Codominance, Linkage, Crossing over.						
Unit:2	GENETICS OF HUMAN TRAITS				14 hours	
Monogenic traits, autosomal inheritance (Dominant and Recessive), Sex-linked inheritance, Sex limited and influenced traits, Mosaicism, Chimerism, Uniparental disomy, Genome imprinting, X-inactivation, mitochondrial inheritance. Complex traits.						
Unit:3	CHROMOSOMAL NOMENCLATURE				14 Hours	
International system of Human Chromosome Nomenclature, Nomenclature of aberrant karyotypes, Chromosomal abnormalities: Common syndromes due to numerical chromosomal changes, Structural alterations (translocations, duplications, deletions, microdeletions, fragile sites and mutations).						
Unit:4	PEDIGREE AND ITS COMPLICATIONS				14 hours	
Pedigree analysis: Family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees, Complications to the basic pedigree patterns.						

Unit:5	DISORDERS	14 hours
Disorders of Amino Acid and Peptide Metabolism, Disorders of Carbohydrate Metabolism, Disorders of Lipid and Lipoprotein Metabolism, Lysosomal Storage Disorders, Disorders in the Metabolism of Purines, Pyrimidines, and Nucleotides Peroxisomal Disorders.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Concepts Of Genetics 10th Edition by Michael A Palladino and Michael K Cummings and William S Klug, Pearson	
2	Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th edition. McGraw Hill.	
3	Cummings, M. R. 2014. Human Heredity: Principles and Issues. West Publishing Company.	
4	Principles Of Genetics 8th Edition by Gardner	
Reference Books		
1	Alberts <i>et al.</i> , Molecular Biology of the Cell 2 nd Edition, Garland2007.	
2	Snustad and Simmons, Principles of Genetics, 4th Edition, Wiley'2005.	
3	Lewin, Genes IX, 9th Edition Jons and Bartlett2007.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://dmhuk8np1ucwy.cloudfront.net/wp-content/uploads/2015/08/CH25-lm.pdf	
2	https://nptel.ac.in/courses/102/104/102104052/	
3	https://www.coursera.org/learn/geneticsevolution?ranMID=40328&ranEAID=7bhGe75fAQ8&ranSiteID=7bhGe75fAQ8-GHJVooGTS0D2rg9M08o2uA&siteID=7bhGe75fAQ8 GHJVooGTS0D2rg9M08o2uA&utm_content=15&utm_medium=partners&utm_source=linkshare&utm_campaign=7bhGe75fAQ8	
Course Designed By: Dr. P.VINAYAGA MOORTHI		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	S	M	M	S
CO3	S	S	M	S	S	S	M	S	S	M
CO3	M	M	M	S	M	M	S	M	M	M
CO4	S	S	S	M	M	S	M	M	M	S
CO5	M	S	M	M	M	M	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13D	MOLECULAR GENETICS	L	T	P	C
CORE – IV			4	-	-	4
Pre-requisite	Fundamentals in genetics	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
1. To understand the fundamentals of genetic material in living system						
2. To enable them with better understanding about the defects in genetic material and to modify them for the proper functioning						
3. To have an overview of all kinds of diagnostic techniques for such molecular mechanisms.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understanding the fundamentals of hereditary materials and their role in functioning of human system.					K1&K2
2	Able to identify the damage in hereditary material and malfunctioning of genes to help in eradicating the disease.					K3&K4
3	Capable of understanding the Gene editing techniques					K3
4	Able to understand the human Genome and features					K2&K4
5	With the wide technical knowledge, the students able to modify the genes and restore the functions of the hereditary material.					K5&K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	CENTRAL DOGMA AND ADVANCEMENTS					14 hours
General concept of a gene, gene families, C-value paradox non- coding genes, repetitive DNA, replication, transcription (“rho” dependent and “rho” independent termination), splicing, translation and post translational changes in Prokaryotes and Eukaryotes. Regulation of Gene Expression at different levels Inducible operons - Galactose Repressible operon - Tryptophan.						
UNIT:2	FUNDAMENTALS OF DNA CLONING AND MOLECULAR HYBRIDIZATION					14 hours
Cell based DNA cloning, vector based cloning; nucleic acid hybridizations, PCR based DNA cloning and DNA analyses. Types of mutations and nomenclature, mutagenesis. DNA damage and DNA repair: Types of DNA damage, Endogenous and Exogenous origins of DNA damage. DNA repair pathways: Error- prone, Mismatch, photo activation, excision and SOS.						
Unit:3	RECOMBINATION					14 hours
Models and molecular mechanisms, Site Specific recombination: Molecular mechanism. Transposons and transposition mechanisms. Gene editing techniques: using CRISPR-Cas9, ZFNs and TALENs.						
Unit:4	FEATURES OF THE HUMAN GENOME					14 hours
Organization of the human genome, human multigene families, Mapping of the human genome: Physical mapping and Genetic mapping. Footprints of evolution, human DNA instability. Chromosome walking. Introduction to human genome project- telomere to telomere, Ancestry by variations						

Unit:5	APPLICATIONS OF MOLECULAR GENETICS	14 hours
Disease diagnosis, Epigenetic testing, Prognostic and diagnostic markers, Development of molecules in Biopharma, Therapeutic advancements, Disease diagnosis and Disease inheritability, Improving existing biological outcomes, Vaccine development and Gene therapy and other molecular genetics based therapeutic approaches.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Principles of Genetics Gardner, Simmons, Snustad 8th Edition 2006.	
Reference Books		
1	Tom Strachan and Andrew. P. Read, Human Molecular Genetics, Bios Scientific Pub UK. (1996).	
2	Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J. and Weinter, A.M., Molecular Biology of Genes (4th edition) 1987. The Benjamin/Cummings publishing Company Inc., Joky.	
3	Lewin, B. Genes VI (1997). Oxford University Press, Oxford, New York, Tokyo.	
4	Darvell, J.et.al., Molecular Cell Biology (7th edition) 2002. Garland Publishing Iwc., New York	
5	Molecular Biology by Glick and Pasternack, 2003.	
6	Lewin, Genes IX, 9th Edition Jones and Bartlett 2007	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc20_bt06/preview	
2	https://brighterion.com/artificial-intelligence-101-genetic-algorithms/	
3	https://www.ncbi.nlm.nih.gov/books/NBK21571/	
4	https://www.cell.com/trends/biotechnology/pdf/0167-7799(92)90173-S.pdf	
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2628815/	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	L	L	L	M	S
CO2	M	M	S	S	S	M	M	M	S	M
CO3	L	M	S	S	S	M	L	M	S	S
CO4	S	S	S	M	M	S	L	L	S	M
CO5	S	S	S	M	M	S	L	M	S	S

*S-Strong; M-Medium; L-Low

Course code	13P	MEDICAL BIOCHEMISTRY, CELL BIOLOGY AND CELL SIGNALING, PRINCIPLES OF HUMAN GENETICS, MOLECULAR GENETICS)	L	T	P	C
CORE PRACTICAL-I			-	-	6	4
Pre-requisite	Basic knowledge in macromolecules and genetic materials		Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Develop the knowledge in the area of disease diagnosis through various biochemical markers and its disease association. 2. Inculcate the cell culturing and visualization techniques for the distinguishing the normal and disease conditions. 3. Apply the principles of inheritance pattern and to study the structural alterations of chromosomes and DNA in diseased individuals. Practical and experimental knowledge will be gained from the hands-on experiments. 4. To understand the structural and functional aspect of Human Genomic DNA for studying the molecular mechanism behind genetic diseases and To perform various molecular techniques for understanding the genetic and epigenetic mechanism behind various human disease progression 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Measure and interpret the biochemical markers and its association in diseases					K3
2	Visualize and culture the cells of cytology importance and interpret the diseases association with it.					K3
3	Students can able to learn and understand the genetic pattern of a disease and the significance of chromosomal change in evolution and illness. They can understand how mutations can affect gene dosage and function.					K5
4	Understand the properties and functions of every component present in the DNA and perform basic molecular genetic tests to identify structural alterations in DNA					K3,K, K5 & K6
5	Employ the techniques for their services in disease diagnosis in hospitals and research institutes					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
MEDICAL BIOCHEMISTRY						
<ol style="list-style-type: none"> 1. Determination of blood glucose 2. Estimation of total cholesterol 3. Estimation of DNA by using Diphenylamine method 4. Estimation of RNA by Orcinol method 5. Determine the melting temperature and GC content by using melting curve. 						
CELL BIOLOGY AND CELL SIGNALING						
<ol style="list-style-type: none"> 1. Uses of Microscope and Micrometry 2. Preparation of blood smear 3. Counting of RBC and WBC using Haemocytometer 4. Slides for Mitosis and Meiosis 5. Preparation of medium and cultivation of Human cell lines 						

<ol style="list-style-type: none"> 6. DNA Fragmentation Assay 7. PBMC isolation and differentiation 8. Buffy coat 	
PRINCIPLES OF HUMAN GENETICS	
<ol style="list-style-type: none"> 1. Pedigree analysis 2. Karyotyping 3. Buccal micronucleus 4. Banding techniques 	
MOLECULAR GENETICS	
<ol style="list-style-type: none"> 1. Nucleic acid extraction 2. Estimation of DNA and RNA 3. Restriction Digestion and Ligation 4. Primer designing 5. Polymerase chain reaction 6. Retrieval of sequences from nucleic acid databases 7. Chromatogram analysis 	
Total Lecture hours	
108 hours	
Book(s) for study	
1	Concepts Of Genetics 10th Edition by Michael A Palladino and Michael K Cummings and William S Klug, Pearson
2	Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th edition. McGraw Hill.
3	Cummings, M. R. 2014. Human Heredity: Principles and Issues. West Publishing Company.
4	Principles Of Genetics 8th Edition by Gardner
5	Analytical Biochemistry, 3 rd Edition. Holme, D.J and Peck, H. 1998. Pearson Education Limited.1-501.
6	Tom Strachan and Andrew. P. Read, Human Molecular Genetics, Bios ^{sc} Scientific Pub UK. (1996).
Books for references	
1	Alberts et al., Molecular Biology of the Cell 2 nd Edition, Garland2007.
2	Snustad and Simmons, Principles of Genetics, 4 th Edition, Wiley 2005.
3	Lewin, Genes IX, 9 th Edition Jons and Bartlett 2007.
4	Modern experimental Biochemistry, 3 rd Edition, Rodney Boyer. 2000. Benjamin Cummins. 1-480.
5	Amaldi, F., 1982. Practical Methods in Molecular Biology.: RF Schleif and PC Wensink. Springer-Verlag, New York, Heidelberg, Berlin, 1981, xiii+ 220 pp. DM69. 00, US \$32.20.
6	Schleif, R.F. and Wensink, P.C., 2012. <i>Practical methods in molecular biology</i> . Springer Science & Business Media.
7	Davis, L., 2012. <i>Basic methods in molecular biology</i> . Elsevier.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://onlinecourses.swayam2.ac.in/cec20_bt17/preview
2	https://nptel.ac.in/courses/102/104/102104052/

3	https://www.futurelearn.com/courses/biochemistry
4	https://bio.libretexts.org/Bookshelves/Genetics/Book%3A_Online_Open_Genetics_(Nickle_and_Barrette-Ng)/08%3A_Techniques_of_Molecular_Genetics
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2592051/
6	https://www.ncbi.nlm.nih.gov/books/NBK21248/?term=molecular%20Genetics
Course Designed By: Dr. A. VIJAYA ANAND, Dr. P. VINAYAGA MOORTH, AND Dr. R. SIVASAMY	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	S	S	S	S
CO2	M	S	M	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	M	M	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	IEB	r-DNA TECHNOLOGY	L	T	P	C
ELECTIVE-I				4	-	-
Pre-requisite		Basic understanding about DNA and other prokaryotic and eukaryotic organisms	Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To understand the concepts of gene cloning and vectors used. To study the techniques available to reveal the structural architecture of the genetic materials. To study the methods used for extracting and eluting the genetic material from biological samples. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Describe the basics of genes, how it is being controlled by different biomolecules					K1
2	Gain knowledge to classify the restriction and modification enzymes and apply it for genetic analysis and functioning.					K2
3	Understand the construction of gene library, role of different vectors and its biomedical application in larger scale.					K2
4	Learn profound understanding about techniques that dissect the DNA, RNA and Protein and use it for analyzing disease.					K4
5	Apply the recombinant techniques for production of health care materials.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6- Create						
Unit:1	GENES AND ITS MODIFICATION ENZYMES				14 hours	
Genes within the cells, genetic elements that control gene expression, restriction and modification enzymes (Restriction enzymes, DNA ligases, Klenow fragment, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase). All different types of polymerases.						
Unit:2	GENE LIBRARY AND VECTORS				16 hours	
Construction of genomic DNA Library, Design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors, Insect, Yeast and Mammalian vectors. Gene isolation, gene cloning, screening and expression of cloned gene.						
Unit:3	MOLECULAR BIOLOGY TECHNIQUES				18 hours	
Isolation of DNA, mRNA and total RNA, polymerase chain reactions (PCR) and types of PCR. Southern and Northern and Western blotting. <i>In situ</i> hybridization, Site-directed mutagenesis, Transposons. Short read and long read next gen sequencing						
Unit:4	SEQUENCING TECHNIQUES				12 hours	
DNA sequencing (Maxam and Gilbert, Sangers, Pyrosequencing, Shotgun sequencing method), Protein sequencing, RNA sequencing, Metagenomics.						
Unit:5	APPLICATIONS OF r-DNA TECHNIQUES				10 hours	
Production of insulin, Human growth factor, Gene therapy (antisense and ribozyme technology), Safety guidelines of recombinant DNA research, Molecular Kit						
Unit:6	CONTEMPORARY ISSUES				2 hours	

Expert lectures, online seminars – webinars	
Total Lecture hours	72 hours
Text Book(s)	
1	H.K. Das, Text Book of Biotechnology, 1st Ed, 2004, Wiley Publishers
2	Winter P.C., Hicker G.I., H.L. Fletcher. Instant notes: Genetics. 2 nd Edition 2003. Viva's Book (Pvt) Ltd.
Reference Books	
1	Old and Primrose, Principles of Gene Manipulation, 3rd Ed, Blackwell Scientific Publishers
2	Brown TA, Genomes, 3rd ed. Garland Science 2006
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc19_bt15/preview
2	https://nptel.ac.in/courses/102/103/102103013/
3	https://nptel.ac.in/courses/102/103/102103074/
Course Designed By: Dr. P. VINAYAGA MOORTHY	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	M	S	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	M	S	M	S	S	S	M	S	M
CO4	S	S	S	M	S	S	S	M	S	S
CO5	M	M	M	M	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code	1EA	GENOMICS AND PROTEOMICS	L	T	P	C
ELECTIVE-I				4	-	-
Pre-requisite		Understanding about the Genomics and Proteomics	Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
1 To understand the genome organization of various organisms						
2 To understand the corresponding protein and their functional role in various systems						
3 To know the principles and working mechanism of all the genomic and proteomic techniques						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Able to understand the Genome organization					K1&K2
2	Understanding the Genome of prokaryotic and Eukaryotic system					K2
3	Capable of understanding the mechanism of protein product in every genes					K2&K3
4	Techniques used in genomics and proteomics study will be helpful in future research by exploring many aspects of defective genes and their products.					K4&K5
5	Abe to understand the Biological Databases and their applications					K3&K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	BASICS IN GENOMICS					14 hours
Structure and organization of prokaryotic and eukaryotic genome, genetic and physical mapping. Assembly of a contiguous, DNA sequence, clone contig approach, whole genome shot gun sequencing.						
UNIT:2	GENOME OF PROKARYOTIC AND EUKARYOTIC ORGANISM					14 hours
<i>E. coli</i> , <i>Arabidopsis thaliana</i> and <i>Musmusculus</i> . Evolution and structure of mitochondrial genomes, mtDNA and mitochondrial diseases, High throughput screening for discovery and identification of drugs. Drug targets and development SNP analysis.						
UNIT:3	TRANSCRIPTOMICS					14 hours
Transcriptome, yeast transcriptome and the human transcriptome, link between the transcriptome and proteome. Transcripts analysis, Serial analysis of gene expression (SAGE), non- array based whole transcriptome analysis, differential display, Yeast two hybrid systems.						
UNIT:4	PROTEOMICS					14 hours
Tools for proteome analysis,2D-PAGE, Mass spectrometry, MALDI,TOF, TANDOM,MS, LC-MS, protein microarray Affinity purification of proteins and TAP TAG. . Protein-Protein interactions and uses of their databases. Peptide finger printing: Techniques for protein purification, sequencing of proteins. Sample preparation for proteomic analysis						
UNIT:5	BIOLOGICAL DATABASES					14 hours
Overview, applications, gene and protein sequence databases, GenBank, EMBL, DDBJ, and PDB. Online databases InterPro, UniProt, Pride and Pfam Sequence alignment and sequence analysis: Concept of local and global sequence alignment, Pair- wise sequence alignment, BLAST, Multiple sequence alignment, homology, analogy. RNA Seq Data analysis, Metagenome analysis, Proteome data analysis (Mascot and Peaks)						

UNIT:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Brown, T.A., 2006, Genomes, John Wiley and Sons, Pvt. Ltd., Singapore.	
Reference Books		
1	Campbell A, Heyer. 2004, Discovering Genomics, Proteomics and Bioinformatics, Pearson Education, New Jersey.	
2	Liebler, Daniel,C.,2002, Introduction to proteomics tool for the new biology, Humana Press, New Jersey.	
3	Lesk, A.M. 2007. Introduction to Bioinformatics, Oxford University Press, Oxford.	
4	Old, R.W. and Primrose, S.B. 2006. Principles of Gene Manipulation, Blackwell Science Publication, Berlin.	
5	Pennington, S.R , Dunn, M,J., 2002, Proteomics from Protein sequence to function, Viva Books Pvt., Ltd, New Delhi.	
6	Introduction to Bioinformatics, Tramontano A, Chapman and Hall.	
7	Understanding Bioinformatics, Zvelebil M and Baum JO, Taylor and Francis.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.frontiersin.org/articles/10.3389/fgene.2020.00309/full	
2	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6325641/	
3	https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1005457	
4	https://www.ncbi.nlm.nih.gov/books/NBK21121/	
5	https://www.denbi.de/online-training-media-library/proteomics	
6	https://www.sciencedirect.com/science/article/pii/S1874391912001479	
7	http://www.bio.iitb.ac.in/~sanjeeva/e-learning-activities/	
8	https://swayam.gov.in/nd1_noc19_bt26/preview	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	M	S	S
CO2	S	S	S	S	M	S	M	M	S	S
CO3	M	M	S	M	L	S	M	M	L	S
CO4	S	M	S	L	M	S	S	M	S	S
CO5	M	M	M	L	L	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	13C	MEDICAL PHYSIOLOGY		L	T	P	C
ELECTIVE I				4	-	-	4
Pre-requisite	Basic understanding human physiology		Syllabus Version	2023-24			
Course Objectives:							
The main objectives of this course are to:							
1. Medical Physiology is a subject that mainly helps the learners to understand the morphology, function and so on.							
2. To acquire a core scientific knowledge about humans as a physiological entity.							
3. To apply basic physiology principles in the appropriate clinical context.							
Expected Course Outcomes:							
On the successful completion of the course, students will be able to:							
1	Students will understand the organs and its specific parts and functions.					K1 & K2	
2	It depicts them to understand the parameters of healthy and unhealthy nature of the organs.					K1 & K2	
3	It helps the students to know the disease condition through various structures and physiological nature.					K1 & K2	
4	It also helps the students to design the novel therapeutic approaches.					K1 & K2	
5	It gives aware of physiological research to improve diagnoses and treatments of diseases.					K1 & K2	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create							
Unit: 1	BLOOD					14 hours	
Blood: Composition and functions of blood, Blood plasma, Formed elements, Hemostasis: Vascular spasms, Platelet plug, Coagulation, Clot retraction and repair. Fibrinolysis, Transfusion and Blood replacement, Diagnostic blood tests, Developmental aspects of blood.							
Unit: 2	CARDIOVASCULAR SYSTEM					14 hours	
Cardiovascular system: Heart anatomy, Blood supply to the heart, Properties of muscle fibers, Heart physiology: Electrical events, Mechanical events - cardiac cycle, Heart sounds. ECG - its principle and significance.							
Blood vessel: Arterial system, Capillaries, Venous system. Blood pressure, Measurement of blood pressure.							
Unit: 3	RESPIRATORY AND EXCRETORY SYSTEM					14 hours	
Functional anatomy of the respiratory system, Mechanism of breathing, Gas exchanges in the body, Transport of Respiratory gases by blood, Control of respiration.							
Kidney anatomy, Kidney physiology: Mechanism of urine formation - Glomerular filtration, Tubular reabsorption, Tubular secretion. Renal clearance, Characteristics and Composition of urine.							
Unit: 4	DIGESTIVE AND NERVOUS SYSTEM					14 hours	
Functional anatomy of digestive system. Physiology of chemical digestion and absorption. Malabsorption of nutrients.							
Organization of the nervous system: The central nervous system, Peripheral nervous system,							

Neurons. Neurophysiology: Resting membrane potential, Synapse, Neurotransmitters and their receptors.		
Unit: 5	ENDOCRINE AND REPRODUCTIVE SYSTEM	14 hours
Endocrinology and Reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation. The adrenal medulla and adrenal cortex, hormonal control of calcium metabolism and the physiology of bone, The Pituitary gland, the gonads: development and functions of the reproductive system, Other endocrine organs. Quantitative techniques for hormones.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Human Physiology: An integrated Approach by Dee Unglaub Silverthorn. Published by Pearson.	
2	Gray's Anatomy by Roger Warwick and Peter Williams. Published by Longman Group Ltd.,	
Reference Books		
1	Textbook of Medical Physiology by A.C. Guyton and J.E. Hall. Published by W.B. Saunders Company.	
2	Physiology (3rd edition) by L.S. Costanzo. W.B. Saunders Company.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_cec20_bt19/preview	
2	https://www.classcentral.com/course/independent-anatomy-and-physiology-mooc-3757	
3	https://swayam.gov.in/nd2_cec20_bt21/preview	
Course Designed By: Dr. A. VIJAYA ANAND		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	L	M	S	S	M	M	L	M
CO2	M	S	L	M	S	S	M	M	L	M
CO3	M	S	L	M	S	S	M	M	L	M
CO4	M	S	L	M	S	S	M	M	L	M
CO5	M	S	L	M	S	S	M	M	L	M

*S-Strong; M-Medium; L-Low

Course code	GS09	GENETICS AND SOCIETY		L	T	P	C
SUPPORTIVE – I				2	-	-	2
Pre-requisite	Basics in genetics		Syllabus Version		2023-24		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1 To know the impact of genetic diseases on the society 2 To make students aware about the ethical and legal issues behind genetic research 3 To have a better understanding about the social impact on various kinds of research associated with genetics 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Able to understanding about the impact of genetics in medicine and society					K2	
2	Inculcate the knowledge to understanding about the genetic makeup of Human					K2&K3	
3	Capable of understanding the human Genome project and applications					K2	
4.	Able to understand the ethical and legal issues involved in genetics					K3&&K4	
5.	Able to understand the modern genetics tools and their uses					K2&K3	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
UNIT:1	HUMAN GENOME					6 hours	
The history and impact of Genetics in Medicine and Society, Medical Genetics, Early beginnings, Centre for Genetics and Society around the world, an overview							
UNIT:2	GENETIC ASSOCIATION OF DISEASES					6 hours	
Genes and Pedigrees in a Population. Creation of Awareness about Genetic diseases and disorders. Genetic Testing (Prenatal & Postnatal)							
UNIT:3	HUMAN GENOME PROJECT					5 hours	
Human Genome Project, Beginning and Organization of the HGP, Sequencing of the Human Genome, Promises and Achievements., Diversity Project							
UNIT:4	ETHICAL AND LEGAL ISSUES					5 hours	
Ethical, Legal and Social issues of the HGP, Other Genome Projects initiated as a direct consequence of HGP completion, Human Genome							
UNIT:5	ADVANCES IN MODERN GENETICS					10 hours	
Advances in Modern Genetics: Some of the areas of concern in Modern Genetics, GM crops, personal DNA data, Gene Therapy, Pharming, Ethical and Legal issues in Medical Genetics. Molecular Cytogenetics							
UNIT:6	CONTEMPORARY ISSUES					2 hours	
Expert lectures, online seminars - webinars							
Total Lecture hours						36 hours	
Text Book(s)							
1	Genetics, A Conceptual Approach, 4 th ed., B.A. Pierce, Palgrave Macmillan, 2012.						
2	Emery's Elements of Medical Genetics, 14 th ed., P.D. Turnpenny and S. Ellard, Churchill Livingstone, 2012.						

Reference Books	
1	Introduction to Genetics, A Molecular Approach, T. Brown, Garland Science, 2012
2	Genome Duplication, Concepts, Mechanism, Evolution and Disease, M.L. De Pamphilis and S.D. Bell, Garland Science, 2011.
3	Human Molecular Genetics, 4 th ed., T. Strachan and A. Read, Garland Science, Taylor and Francis Group, 2011.
4	A Guide to Genetic Counseling, 2 nd ed., W.R. Uhlmann, J.L. Schuette and B.M. Yashar, Wiley, Blackwell, 2009.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://portal.e-lfh.org.uk/Component/Details/465515
2	https://www.e-lfh.org.uk/programmes/genomics-education-programme/
3	http://www.bionet.nsc.ru/ICIG/CHM/books/Hartl_Jones_Genetics.pdf
Course Designed By: Dr. R. SIVASAMY	



CYTOGENETIC TECHNIQUES		
The objectives of the Course are:		
The main objectives of this course are to:		
1	To provide a working knowledge of cytogenetics, the preparation of materials for study, and the importance of chromosomal variations in structure and number in human diseases.	
2	Diagnose and interpret pathology of human chromosomes	
3	Demonstrate a professional knowledge of the cytogenetic disorders and clinical diagnosis.	
4	To understand the human karyotype in normal and diseased patients.	
5	To study the mechanism of disease progression and its genetic influence	
Course Content	Lecture / Practical / Project / Internship	
Module 1	<p>Classical Cytogenetics Pedigree analysis, Peripheral blood leukocyte culture for chromosomal studies, G-banding, C-banding, R-banding, Karyotyping, Microscopy - operation and maintenance of bright-field microscopy, inverted and fluorescence microscopy. Each fellow is expected to conduct cytogenetic analysis for at least 2 cases per week and review/interpret the abnormal cases vs. control samples during this training module. The fellow should document his/her roles in every case that he/she is involved.</p>	6 hours
Module 2	<p>Molecular Cytogenetics FISH (Fluorescent In-situ Hybridization), CGH (Comparative genomic hybridization), aCGH (Array comparative genomic hybridization). Each fellow is expected to process and analyze at least 2 cases per week and review/interpret the results for abnormal vs. control samples using FISH, CGH and aCGH during this training module. The fellow should document his/her roles in every case that he/she is involved.</p>	6 hours
Module 3	<p>Sex chromatin analysis (buccal mucosa, hair bud), Buccal micronucleus, Blood Micronucleus test and COMET assay. Each fellow is expected to process and analyze at least 2 cases per week and review/interpret the results and should document his/her roles in every case that he/she is involved.</p>	6 hours
Module 4	<p>Case study analysis: Interacting with patients, learning family history and preparation of pedigree chart. The participating fellows will be involved in patient's direct contact to obtain information regarding family history and expected to prepare pedigree chart for the participants involved and preparation of case reports.</p>	6 hours
Module 5	<p>Prenatal diagnosis: Chorionic villi sampling, foetoscopy, ultrascopy, amniocentesis. Postnatal: sister chromatid exchange, fragile site, Mitotic index and Genetic Counselling. Each fellow is expected to process and analyze at least 2 cases per week and review/interpret at least 20 cases (normal vs. abnormal) during this training module. The fellow should document his/her roles in every case</p>	6 hours

	that he/she is involved. The fellow will be trained to conduct genetic counselling for the needed patients.	
		30 Hours
Book(s) for Study		
1	DP Snustad and MJ Simmons (2012) Principles of Genetics, John Willey & Sons Publication, 6th Edition	
2	Human Genetics 5th Edition 2017 By Gangane	
Book(s) for reference		
1	Alberts et al., Molecular Biology of the Cell 2 nd Edition, Garland 2007.	
2	Snustad and Simmons, Principles of Genetics, 4th Edition, Wiley' 2005.	
Related Online Contents		
1	https://www.coursera.org/learn/genes	
2	https://www.gfmer.ch/SRH-Course-2011/community-genetics/pdf/Cytogenetics-Dahoun-2011.pdf	
3	https://arup.utah.edu/media/andersen-introCyto-2018/lecture-slides.pdf	





Course code	23A	HUMAN CYTOGENETICS		L	T	P	C
CORE-V				4	-	-	4
Pre-requisite	Basic understanding about human classical and molecular cytogenetics		Syllabus Version	2023-24			
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Demonstrate an advanced knowledge on human cytogenetics and human diseases 2. Diagnose and interpret pathology of human chromosomes 3. Demonstrate a professional knowledge of the cytogenetic disorders and clinical diagnosis. 4. To understand the human karyotype in normal and diseased patients. 5. To study the mechanism of cancer progression and its genetic influence 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	The course would help in acquainting with case studies and the practice of genetic counseling individually.					K1,K2 &K3	
2	Basically cytogenetic studies are widely used for genetic testing of various diseases; hence the students will get trained in identifying different hereditary diseases and could analyze any chromosomal anomalies which will be helpful in medical practice.					K2,K3, K4 &K5	
3	This course could help students to get placement in various hospitals and R&D laboratories as technicians or genetic counsellors.					K4, K5 &K6	
4	The course outcome helps the students in availing opportunities in both technical as well in computational biology (Artificial Intelligence).					K1, K4 & K6	
5	The course helps to understand the application of genetics in Medical Practice					K4, K5 &K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	HISTORY OF HUMAN CYTOGENETICS					14 hours	
History of Human Cytogenetics, Denver conference (1940), Denver Conference (1960), Chicago conference (1966), Paris conference (1971). Marker chromosome, Derivative chromosome, Ring chromosome, isochromosome, Pseudodicentric chromosome.							
Unit:2	CHROMOSOMAL ANALYSIS					14 hours	
Peripheral blood cultures; banding techniques: G, Q, C and R band identification of 23 pairs of human chromosomes by band position. Molecular Cytogenetics: Fluorescent In-situ Hybridization –Types of FISH probes. Spectral Karyotyping, Multicolor FISH, Applications of FISH: Structural Abnormalities, Microdeletion Syndromes, Interphase FISH for Prenatal Diagnosis of Common Aneuploidies. Preimplantation FISH Diagnosis of Aneuploidies. Molecular Approaches for Delineating Marker Chromosomes							
Unit:3	PRENATAL DIAGNOSIS					14 hours	
Prenatal diagnosis: Chorionic villi sampling, foetoscopy, ultrascopy, amniocentesis. Postnatal diagnosis: Peripheral blood leucocyte culture, Sister chromatid exchange, fragile site, Mitotic index, Genetic Counseling. Mosaicism, PGD, Neonatal diagnostics							

Unit:4	CYTOGENETIC REPORTING AND DISORDERS	14 hours
Standard cytogenetic reports: Components of standard cytogenetic report, Prenatal normal results, Neonatal normal results. ISCN rule and reporting of chromosome. Autosomal trisomies: 21, 13, 18; Trisomy Mosaic: 21, 8, 9, 20, 22. Translocations: Robertsonian translocation.		
Unit:5	CANCER CYTOGENETICS	14 hours
Oncogenes and cancer. Cytogenetic abnormalities in myeloid and lymphoid disorder. Cytogenetic abnormalities in solid tumors. Chromosomal microarray for tumors. Molecular Tests and gene panel sequencing		
Unit:6	MEDICAL GENETICS AND GENOMICS	8 hours
Expert lectures, video lectures, online seminars – webinars		
Total Lecture hours		60 hours
Text Book(s)		
1	DP Snustad and MJ Simmons (2012) Principles of Genetics, John Willey & Sons Publication, 6th Edition	
2	Human Genetics 5th Edition 2017 By Gangane	
3	Principles Of Genetics 8th Edition by Gardner	
Reference Books		
1	Albertset <i>al.</i> , Molecular Biology of the Cell 2 nd Edition, Garland2007.	
2	Snustad and Simmons, Principles of Genetics, 4th Edition, Wiley'2005.	
3	Lewin, Genes IX, 9th Edition Jons and Bartlett2007.	
4	Textbook of Human Genetics: The Yale journal of biology and medicine 45(5) · Sep1972	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.coursera.org/learn/genes	
2	https://www.gfmer.ch/SRH-Course-2011/community-genetics/pdf/Cytogenetics-Dahoun-2011.pdf	
3	https://arup.utah.edu/media/andersen-introCyto-2018/lecture-slides.pdf	
Course Designed By: Dr. P VINAYAGA MOORTHI		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	M	M	M	M
CO3	S	S	S	S	S	S	M	S	M	S
CO3	M	M	S	S	M	S	S	M	S	S
CO4	S	S	S	M	M	S	M	M	M	M
CO5	S	M	M	M	M	M	M	M	M	S

*S-Strong; M-Medium; L-Low

Course code	23B	MEDICAL GENETICS & GENOMICS	L	T	P	C
CORE-VI			4	-	-	4
Pre-requisite	Basic Understanding in genetics	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
1. To have a thorough understanding about human genetic diseases, disorders and syndromes						
2. To know the risks associated with genetic diseases, disorders and syndromes						
3. To initiate the genetic counselling for the family members about the chances of inheriting the genetic disease to the following generations						
4. To prevent common people from genetically inherited diseases						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Able to understand uniqueness of disorders and syndromes at the molecular level.					K1&K2
2	Capable of classifying genetic basis of Inborn errors of metabolism					K2&K3
3	Improve the knowledge the field of Neurogenetic disorders.					K3&K4
4	Capable of understanding the hematopoietic and eye disorder					K5&K6
5	Able to differentiate various polygenic syndromes					K3&K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	GENETIC BASIS OF SYNDROMES AND DISORDERS					14 hours
An overview of the genetic basis of syndromes and disorders. Monogenic diseases with well-known molecular pathology: Cystic fibrosis, Tay Sach's syndrome, Marfan syndrome. Congenital and non-congenital diseases, Family associated diseases, Pseudogenes, Founder effect						
UNIT:2	INBORN ERRORS OF METABOLISM					14 hours
Genetic bases and Classification, Phenylketonuria, Maple syrup urine syndrome, Mucopolysaccharidosis, Galactosemia. Genome imprinting Syndromes: Prader Willi and Angelman syndromes, Beckwith- Wiedemann Syndrome.						
UNIT:3	NEUROGENETIC DISORDERS					14 hours
Charcot Marie Tooth syndrome, Spinal muscular atrophy. Syndromes due to triplet nucleotide expansion: Alzheimer's disease, Autism spectrum disorder and Epilepsy and Seizures. Movement disorders Dystrophies (Becker Muscular Dystrophy) myotonias, myopathies.						
UNIT:4	HEMATOPOIETIC & EYE DISORDERS					14 hours
Overview of Blood cell types and haemoglobin, Sickle cell anemia, Thalassemia, Hemophilia. Genetic disorders of Eye: Colour Blindness, albinism Retinitis pigmentosa, Glaucoma, Cataracts, aniridia, Retinoblastoma, Diabetic Retinopathy						
UNIT:5	COMPLEX POLYGENIC DISEASE AND DISORDERS					14 hours
Polygenic syndromes: Hyperlipidemia, Atherosclerosis, Diabetes mellitus, mitochondrial syndrome, Management of genetic disorder. Counseling for multifactorial disorders. Whole						

genome sequencing (WGS), whole exome sequencing(WES), clinical genome sequencing		
UNIT:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Clinical Genetics, A short course by Wilson, 2000	
2	Principle and Practice of Medical Genetics, Rimoin et al., 2002.	
Reference Books		
1	Genes in Medicine, Rasko and Doumes, 1995.	
2	An introduction human molecular genetics, Pasternack, 2000.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.sciencedaily.com/releases/2019/06/190606133805.htm	
2	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6947640/	
3	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2845894/	
4	https://www.sciencedirect.com/topics/medicine-and-dentistry/inborn-error-of-metabolism	
5	https://swayam.gov.in/nd2_cec20_bt03/preview	
6	https://swayam.gov.in/nd2_cec20_bt17/preview	
7	https://swayam.gov.in/nd1_noc20_bt06/preview	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	M	M	S	S
CO2	M	S	S	S	S	M	M	S	S	S
CO3	M	S	M	S	S	M	M	L	S	S
CO4	M	M	S	S	S	L	L	L	S	S
CO5	M	M	M	S	S	M	M	M	S	M

*S-Strong; M-Medium; L-Low

Course code	23C	DEVELOPMENTAL AND BEHAVIORAL GENETICS	L	T	P	C
CORE-VII			4	-	-	4
Pre-requisite	Basic understanding about organisms		Syllabus Version		2023-24	
Course Objective						
The main objectives of this course are to:						
1. Study the basic developmental stages of the animal development and its associated internal cellular changes.						
2. Understand the developmental morphogenetic and gene expression pattern in Drosophila models.						
3. Reveal the information on behavioral changes and its associated disorders in human being.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basics developmental processes					K2
2	Distinguish developmental events in Drosophila and humans					K4
3	Identify how genes behave with respect to different developmental stages in different organisms and significance in maintenance of genetic architect.					K4
4	Describe the basic and advanced information's about behavioral changes and its associated disorders.					K2
5	Discuss the basic and essential knowledge about disorders of behaviors and its genetic basis.					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6- Create						
Unit:1	EARLY DEVELOPMENT				18 hours	
Early development: Structure of Sperm and egg, Fertilization in sea urchin and mammals, Types of cleavage, Gastrulation: Cell movement and formation of germ layers in Frog, Chick and Mammals. <i>Drosophila</i> : Maternal genes and formation of body axes and signaling pathways in development, Segmentation genes, Homeotic genes function, Imaginal disc development and Sex determinations.						
Unit:2	DEVELOPMENT IN VERTEBRATES				16 hours	
Differentiation of germ cells and Gametogenesis, Fertilization and implantation, Development of vertebrate nervous system, formation of neural tube, Formation of brain regions, Axes formation, and HOX genes, Genetic determination of sex in mammals, Stages of human embryonic development. Genetic basis of male and female infertility and Assisted Reproductive technology.						
Unit:3	GENETIC MANIPULATION DURING DEVELOPMENT				12 hours	
Programmed rearrangements in genes: Chromatin diminution, Endoreplication cycles, Gene amplification, Congenital malformations and Teratogenesis, Epigenetic regulation. Regeneration, Senescence, Embryonic stem cells and their applications.						
Unit:4	BASICS OF BEHAVIOR AND DISORDERS				10 hours	
Nature and behavior, Identifying genes for behavior, Investigating the genetics of human behavior: Twin and adoption study design. Dementia, Schizophrenia, Mood disorders, Anxiety disorders.						
Unit:5	BEHAVIORAL DISEASE AND DISORDERS				14 hours	
Cognitive study designs: Disorders of childhood personality disorders, Antisocial personality disorder. Cognitive disabilities: Mental retardation. Learning disorders: Communication disorders. Artificial						

Intelligence - Introduction - Neural networks - Application of Artificial Intelligence in Psychiatric disorder diagnosis		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, Online seminars – Webinars		
	Total Lecture hours	72 hours
Text Book(s)		
1	A Textbook of Developmental Genetics. Sharma & Chakraborty. 2012. Wisdom Press	
2	Principles of Developmental Biology. Sally A. Moody. (Editor). 2007. Academic Press	
Reference Books		
1	Scott F. Gilbert, Developmental Biology, VIII edition, Sinauer Associates Inc., Publishers, Sunderland, Massachusetts USA (2006).	
2	Bruce Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter (2008). Molecular Biology of the cell, V edition, John Wiley and sons Inc., 2008.	
3	Benjamin Lewin (2010), Genes X, Jones and Bartlett Publishers, England	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc20_bt35/preview	
2	https://nptel.ac.in/courses/102/106/102106084/	
3	https://swayam.gov.in/nd2_cec20_ed13/preview	
Course Designed By: Dr. P. VINAYAGA MOORTHY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	S	M	S	M	S	M
CO2	M	S	M	M	S	S	M	M	S	S
CO3	S	S	M	M	S	M	S	M	M	S
CO4	M	M	M	M	S	S	M	M	M	M
CO5	S	S	M	M	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23D	BIostatISTICS		L	T	P	C
CORE VIII				4	-	-	4
Pre-requisite	Basic understanding research design, presentation and interpretation of the results		Syllabus Version	2023-24			
Course Objectives:							
The main objectives of this course are to:							
1. The role of Biostatistics is tremendous in all branches of life sciences.							
2. It serves as the base to analyze and understand the sample outcomes with comparative and probability based studies.							
3. This course will provide the basic knowledge on essential research works to learners.							
Expected Course Outcomes:							
On the successful completion of the course, students will be able to:							
1	Biostatistics is the tool to analyze and interpret the results of the biological research. This course helps the students to understand the role of biostatistics.			K1, K2 & K3			
2	The various methods of analysis have also been dealt in this course, which helps the students to get clear information's regarding the biostatistical analysis.			K1, K2, K3, K4 & K5			
3	This course also deals with the computational tools of analysis for biological research.			K1, K2, K3, K4 & K5			
4	Better way to present the research data.			K1, K2, K3, K4 & K5			
5	To derive positive interpretation and better outcomes of the results.			K1, K2, K3, K4 & K5			
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit: 1	STATISTICAL INVESTIGATION			14 hours			
Statistical population and sample in biological studies, variables, qualitative and quantitative measures, discrete and continuous series. Sampling methods: probability and non-probability methods, classification of data, representation of data, frequency distribution, tables, diagram and graph.							
Unit: 2	MEASURES OF CENTRAL TENDENCY AND DISPERSION			14 hours			
Measures of central tendency: mean, median and mode. Measures of dispersion: range, mean deviation, quartile deviation, standard deviation, variance, standard error.							
Unit: 3	CORRELATION, REGRESSION AND CHI-SQUARE			14 hours			
Correlation: types, methods of correlation, graphic method, Karl Pearson's correlation, Spearman Rank correlation. Regression analysis, equation, estimation of unknown value from known value. Chi-square test, test of independence, test for goodness of fit and homogeneity.							
Unit: 4	TESTING SIGNIFICANCE			14 hours			
Testing of hypothesis: Null and alternate hypothesis, test for significance for large samples - based on mean, standard deviation, correlation coefficient and test for significance for small samples.							
Unit: 5	ANOVA			14 hours			

ANOVA: One way and two way classification. Statistical analysis of Duncan's multiple range test. Basic statistical tools in research and data analysis. Software used in statistical analysis. Excel use for statistics and SPSS. Statistical techniques for genetic analysis - development and application of analytical methods to derive inferences from genetic data. Artificial intelligence and data science. Vital statistics.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Biostatistics: A foundation for analysis in the Health Sciences by Wayne W. Daniel. Published by Wiley India.	
2	Statistics in Human Genetics by Pak Sham. Published by Aronald Publishers.	
Reference Books		
1	Statistical Methods (44 th edition) by S.P. Gupta. Published by Sul-ton Chand and Sons Publishers.	
2	Introductory Statistics (7 th Edition) by Prem S. Mann. Published by John Wiley and Sons (ASIA) Pvt Ltd.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc20_ma22/preview	
2	https://swayam.gov.in/nd2_cec20_mg04/preview	
3	https://www.classcentral.com/course/swayam-probability-and-statistics-5228	
Course Designed By: Dr. A. VIJAYA ANAND		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	M	M	L	S	S	M	M
CO2	L	L	L	M	M	L	S	S	M	M
CO3	L	L	L	M	M	L	S	S	M	M
CO4	L	L	L	M	M	L	S	S	M	M
CO5	L	L	L	M	M	L	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	23P	HUMAN CYTOGENETICS, MEDICAL GENETICS, DEVELOPMENTAL AND BEHAVIORAL GENETICS AND BIOSTATISTICS	L	T	P	C
CORE PRACTICAL - II			-	-	6	4
Pre-requisite	Basic knowledge in chromosome, genetic materials and developmental biology		Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. The students will gain the ability to analyze and assess the genetic defects through performing cytogenetic techniques in fundamental molecular genetic 2. To motivate students in developing techniques and methods to identify mutations in genetic diseases. 3. Make awareness in use of model organism (Drosophila) for various developmental and behavioral analysis 4. Import the significance of statistics in research through practical exposure in SPSS software 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Student can gain the practical knowledge on chromosomes and its related aberrations. They can be able to expand their knowledge on the chromosomal basis of inheritance and would be able to identify the type of chromosomal alterations using various cytogenetic techniques.					K5
2	Capable of performing tests that can identify the exact genetic modifications present in different diseases that are rare and complicated					K4,K5, K6
3	Observe the change in the behavior by applying the various developmental study techniques					K6
4	Validate the quality of any data from the research for the precise identification of the research outcomes					K3
5	Apply the cytogenetic, medical genetic and behavioral assays for diagnosis of diseases and disorders					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
HUMAN CYTOGENETICS						
<ol style="list-style-type: none"> 1. Peripheral blood leukocyte culture for chromosomal studies 2. Sister chromatid exchange 3. Blood Micronucleus test 4. Chromosomal disorders: Numerical and Structural 5. COMET assay 6. Lymphoblastic stem cells 7. Fish (Video Demonstration) 						
MEDICAL GENETICS						
<ol style="list-style-type: none"> 1. Mutation identification by RFLP 2. DNA fragmentation Assay 3. Western blotting analysis 4. Identification of the sickle cell anemia 5. Case study on eye disorders 6. NGS data analysis 						

DEVELOPMENTAL AND BEHAVIORAL GENETICS	
<ol style="list-style-type: none"> 1. Live Observation of <i>Drosophilla melanogaster</i> embryo 2. Dissection and mounting of Imaginal disc of <i>Drosophilla melanogaster</i> 3. Study of behavior in <i>Drosophilla</i> model: 1. Climbing assay and 2. Flight assay 4. Dissection of brain of <i>Drosophilla melanogaster</i> 5. Case studies, learning disorders, Mental retardation 6. Study the life stages of <i>Drosophilla melanogaster</i> 	
BIOSTATISTICS	
<ol style="list-style-type: none"> 1. Learning of SPSS software <ol style="list-style-type: none"> a) Mean b) Standard Deviation c) Student t test d) chisquare test e) ANOVA 2. Graphad Prism software 3. Microsoft Excel 	
Total Lecture hours	
108 hours	
Book(s) for study	
1	DP Snustad and MJ Simmons (2012) Principles of Genetics, John Willey & Sons Publication, 6th Edition
2	Human Genetics 5th Edition 2017 By Gangane
3	Principles Of Genetics 8th Edition by Gardner
4	Key experiments in Practical developmental Biology. Maria-Beffa, M. and Knight, J. 2005. Cambridge University Press
5	Molecular Cloning - A laboratory manual. 3 rd Edition. Sambrook and Russel. Cold Spring harbor laboratory Press. 2001.1-2331.
6	Principle and Practice of Medical Genetics, Rimoin et al., 2002.
Books for Reference	
1	Alberts et al., Molecular Biology of the Cell 2 nd Edition, Garland2007.
2	Snustad and Simmons, Principles of Genetics, 4th Edition, Wiley 2005.
3	Lewin, Genes IX, 9th Edition Jons and Bartlett 2007.
4	Methods in Molecular Biology-Genomics Protocol - Starkey, M.P. and Elaswarapu, R. 2001. Humana Press.1-538
5	Maria-Beffa, M. and Knight, J. Key experiments in Practical developmental Biology. 2005. Cambridge University Press.
6	Sharga, B.M., Pylypiv, D.B. and Feketa, V.P., MEDICAL BIOLOGY PRACTICALS. GENETICS.
7	Gelehrter, T.D., Collins, F.S. and Ginsburg, D., 1998. <i>Principles of medical genetics</i> . Lippincott Williams & Wilkins.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1684083/
2	https://fypuxumoboz.hottelwin.com/human-cytogenetics-book-14960yw.php
3	https://www.sheffield.ac.uk/bms/undergrad/modules/bms6083
4	https://www.jove.com/v/5325/an-introduction-to-developmental-genetics
5	https://www.ncbi.nlm.nih.gov/books/NBK61999/?term=MEDICAL%20Genetics
6	https://www.ncbi.nlm.nih.gov/books/NBK21766/?term=RFLP
7	https://www.ncbi.nlm.nih.gov/books/NBK21248/?term=RFLP
Course Designed By:Dr. R. SIVASAMY, Dr. P. VINAYAGA MOORTHY AND Dr. A. VIJAYA ANAND	

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	M	M	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	L	S	L	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	2EC	BIO INSTRUMENTATION	L	T	P	C
ELECTIVE-II				4	-	-
Pre-requisite	Basic understanding about Instrumentation		Syllabus Version	2023-24		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To teach the principal, working mechanism and applications of instruments in biology,. To learn to operate the instruments in different fields of biology. To understand the imaging techniques useful for field of sciences. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Learning of various types of centrifugation techniques				K1&K2	
2	Able to understand the electrophoresis techniques and its applications				K3&K4	
3	Inculcate the students with the knowledge of handling radioactive materials and use				K4,K5&K6	
4	Able to Understand the principles of spectrophotometry and importance				K4	
5	It's mainly used for students to learn basic principles, working mechanism and applications of all microscopic techniques.				K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	CENTRIFUGATION AND GEL FILTRATION TECHNIQUES				14 hours	
Principles of centrifugation, different types of instruments, rotors and its applications. Chromatography: Principles and application of adsorption, partition and ion, exchange chromatography, gel filtration, affinity, high performance liquid chromatography and gas liquid chromatography. Pipette multichannel, micro volume test, magnetic beads, genetic analysis, DNA RNA purification						
UNIT:2	ELECTROPHORESIS				14 hours	
: Moving boundary and zonal electrophoresis, gel electrophoresis (Native PAGE, SDS PAGE, agarose gel electrophoresis, Real Time PCR), isoelectric focusing technique. Immunoelectrophoresis, ELISA and RIA. Sequencing: NGS and Sanger sequencing.						
UNIT:3	RADIOACTIVITY AND IT'S APPLICATION				14 hours	
Disintegration of radionuclides, half-life of radioactive compounds, determination of radioactivity by Geiger Muller counter and scintillation counting, isotopic tracer techniques and autoradiography. Applications of radio isotopes in biological and medical sciences.						
UNIT:4	SPECTROPHOTOMETRY				14 hours	
Beer, Lamberts law, extinction coefficient and its importance, design of colorimeter and spectrophotometer. Flow Cytometry, Principles of atomic absorption spectrophotometry, circular dichroism spectroscopy and its application in Biology. Principles and applications of x-ray diffraction and NMR in structure determination.						

UNIT:5	MICROSCOPE								14 hours	
Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy, Confocal Microscopy, Cytophotometry and Flow Cytometry, advances of microscopy.										
UNIT:6	CONTEMPORARY ISSUES								2 hours	
Expert lectures, online seminars - webinars										
								Total Lecture hours		72 hours
Text Book(s)										
1	Instrumental methods of chemical analysis, P.K. Sharma									
2	Handbook of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw Hill									
Reference Books										
1	Skoog, D.A. et al., "Principles of Instrumental Analysis", 5th Edition, Thomson / Brooks, Cole, 1998.									
2	Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.									
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]										
1	https://nptel.ac.in/courses/102/103/102103044/									
2	https://www.google.com/search?q=Electrophoresis+(Part+1)%3ABasic+Concept+of+Electrophoresis%2C+performance+of+electrophoresis+and+its+applications&oq=									
3	https://nptel.ac.in/courses/108/105/108105064/									
Course Designed By: Dr. R. SIVASAMY										
Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	M	M	S	M	S	S
CO2	M	L	L	M	M	S	S	L	L	S
CO3	L	L	M	M	S	S	S	L	S	S
CO4	L	L	L	L	M	S	S	L	L	S
CO5	L	L	L	M	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

Course code	2ED	NANOBIOLOGY		L	T	P	C
ELECTIVE-II				4	-	-	4
Pre-requisite	Basic understanding about nanoparticles and nanotechnology		Syllabus Version	2023-24			
Course Objectives:							
The main objectives of this course are to:							
1. Understand the origin, development and application of Nanotechnology.							
2. Measure the level of development of Nanotechnology in healthcare sectors.							
3. Estimate the dispersal and cause of nanoparticle in the environment and associated health hazards.							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the foundation and advancement of nanotechnology					K2	
2	Apply the methods and instruments used for nanoparticle synthesis and characterization.					K3	
3	Distinguish the nanoparticles and its application in healthcare industry such as treatment and therapies.					K4	
4	Create the awareness about the route of entry of nanoparticle into our body					K5	
5	Distinguish merit and demerits of nanoparticles of clinical significance					K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	INTRODUCTION TO NANOTECHNOLOGY					12 hours	
Introduction and History of Nanotechnology, Emergence of Nanotechnology, carbon age, new form of carbon, Challenges in Nanotechnology, Occurrence of cells and systems in Nanoscale.							
Unit:2	SYNTHESIS AND ANALYSIS OF NANOPARTICLES					14 hours	
Synthesis of metals (Au, Ag) and Metal oxides (TiO ₂ , CeO ₂ , ZnO) Nanoparticles. Characterization Techniques: Infra red spectroscopy (IR), UV-visible, Absorption and Diffraction analyses X-ray diffraction. Scanning Electron Microscope (SEM) with Energy Dispersive Spectroscopy, Transmission Electron Microscopy (TEM), Atomic Adsorption Spectroscopy.							
Unit:3	NANODIAGNOSTICS AND BIOSENSORS					14 hours	
Nanomolecular diagnostics and Biosensor. Nanodiagnosics: Optamers, nanochips, Nanoparticles for molecular diagnostics, DNA nanomachines, CNT biosensor, application of nanodiagnosics, Nanodevices for health care industries.							
Unit:4	NANOPHARMACEUTICALS					16 hours	
Nanobiotechnology for drug discovery, peptide drugs for cancer and diabetes, nanoparticle based drug delivery, Sustainable release, micelles, lipid nanoparticles, vaccination, nanocell therapy, and Gene therapy.							
Unit:5	HEALTH IMPACT OF NANOMATERIALS					14 hours	
Bionanoparticles, Toxicity of nanomaterials in health care industries. Handling of Nanomaterials, entry routes into the human body: Lungs, inhalation, deposition and translocation, intestinal tract, skin and eye. Nanoparticle interaction with biological membrane, Neurotoxicology.							

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Textbook of Nanoscience and Nanotechnology. T. Pradeep. 2012. McGraw Hill Education (India) Private Limited	
Reference Books		
1	Kewal K. Jain, The Hand book of Nanomedicine, Humana Press, Springer 2008.	
2	Dr. ParagDiwan and Ashish Bharadwaj (Eds), Nano Medicines, Pentagon Press, 2006	
3	C.N.R. Rao, A. Muller, A.K. Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH VerlagGmbh and Co, Weinheim, 2004.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc19_bt23/preview	
2	https://nptel.ac.in/courses/102/107/102107058/	
4	https://nptel.ac.in/courses/118/107/118107015/	
Course Designed By: Dr. P. VINAYAGA MOORTHY		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	S	S	M	M	S
CO2	L	L	M	L	L	S	S	M	M	S
CO3	L	L	M	M	S	M	S	M	M	S
CO4	L	L	L	M	S	M	M	M	S	M
CO5	L	L	M	M	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code	2EE	PHARMACOGENOMICS AND CHEMINFORMATICS	L	T	P	C
ELECTIVE II			4	-	-	4
Pre-requisite	Basic understanding about bioinformatics		Syllabus Version	2023-24		
Course Objectives:						
The main objectives of this course are to:						
1. This course gives an introduction to the application of genetic and genomic methods to explain about the drug response and the genetic basis for variation in that response.						
2. It will give the students a wide viewpoint on the emergence Pharmacogenomics as a new field and also provides the approaches into the growing importance in the clinical therapeutics and future drug design.						
3. It has been described as the application of informatics methods to solve chemical problems. It focuses primarily on chemical information related to derive from structural information.						
Expected Course Outcomes:						
On the successful completion of the course, students will be able to:						
1	Understanding the basics of Pharmacogenomics will facilitate the students to better understand and manage the new genomics based tools for the best treatment					K1, K2 &
2	The genetic basis of variability in the drug response can contribute to the drug efficacy and toxicity, adverse drug reactions as well as the drug-drug interactions.					K1, K2 & K3
3	To impart knowledge on chemical databases, various advanced techniques and tools, which employed in computational drug discovery.					K1 & K2
4	To impart knowledge about computation tools available in research.					K1 & K2
5	Make understanding about the database available and retrieving data.					K1 & K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit: 1	PHARMACOGENOMICS				14 hours	
Pharmacogenomics: Introduction, basic concepts about genetics diseases. Personalized medicine: Introduction and importance. The genetics of therapeutic targets and gene based targets. Pharmacogenomics - necessity in drug designing. Pharmacogenomics databases.						
Unit: 2	DRUG ANALYSIS				14 hours	
Drug response to patients, structural influence in the Drug response. Efficacy and metabolism of drugs. Pharmacogenomics vs. Structural Pharmacogenomics. Drug metabolism pathways and adverse drug reactions.						
Unit: 3	TOOLS FOR PHARMACOGENOMIC ANALYSIS				14 hours	
Tools for pharmacogenomic analysis. Pharmacokinetics, Pharmacodynamics. Process in Structural Pharmacogenomics - Target Structure optimization, Validation, lead identification, ADME prediction, synthesis, assays and Clinical trials.						
Unit: 4	CHEMINFORMATICS				14 hours	

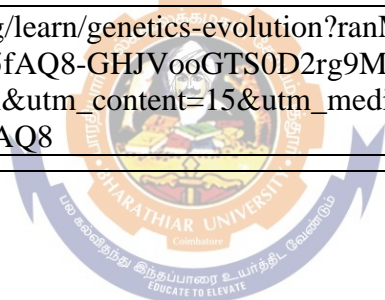
Cheminformatics: Introduction, origin and scope, applications in drug discovery and development, the old bottlenecks and HTS Technologies, Combinatorial chemistry. Recent Development and Challenges in Cheminformatics.		
Unit: 5	IN SILICO APPROACH	14 hours
<i>In silico</i> chemistry: Data processing and data output problems. Molecular modeling, structure and substructure searches, Pubchem, compound databases, structural file conversion, smiles. Molecular drawer chemsketch, editor, drug like liners, molecular properties and bioactivity prediction. Computer-assisted structure elucidation. Database mining for computer-assisted knowledge discovery.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Genetics, Genomics, Proteomics & Bioinformatics, by Rajeev Tyagi and Yougesh Kumar. Published by Mangalam Publishers and Distributors.	
2	Pharmacogenetics by Ian P. Hall and Munir Pir Mohamed. Taylor and Francis.	
Reference Books		
1	Pharmacogenomics An Introduction and Clinical Perspective. BY Joseph S. Bertino, Angela Kashuba, Joseph D. Ma, Uwe Fuhr, C. Lindsay De Vane. Published by Mc-Grow Hill Publications.	
2	Chemoinformatics: Basic Concepts and Methods by Thomas Engel, Johann Gasteiger. Published by John Willey and Sons.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc20_bt10/preview	
2	https://swayam.gov.in/nd2_cec20_bt03/preview	
3	https://www.classcentral.com/course/swayam-bioinformatics-algorithms-and-applications-10031	
Course Designed By: Dr. A. VIJAYA ANAND		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	M	L	M
CO2	S	S	S	S	S	M	S	M	L	M
CO3	S	S	S	S	S	M	S	M	L	M
CO4	S	S	S	S	S	M	S	M	L	M
CO5	S	S	S	S	S	M	S	M	L	M

*S-Strong; M-Medium; L-Low

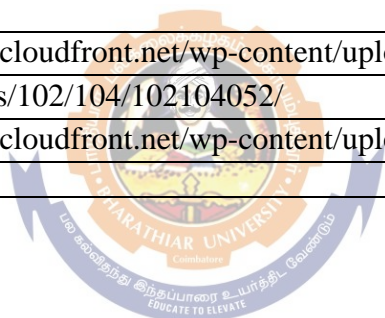
Course code	GS89	PRINCIPLES OF GENETICS			L	T	P	C
SUPPORTIVE-II					2	-	-	2
Pre-requisite		Basic understanding about Mendelian genetics and inheritance pattern of chromosomes.			Syllabus Version		2023-24	
Course Objectives:								
The main objectives of this course are to:								
1. To provide the knowledge about the genetic influence and history of human genetics and Mendelian laws to the students for their curriculum development and knowledge enrichment.								
2. To understand the principles and mechanisms of the inheritance from one generation to the next.								
3. To understand the inheritance mechanism by scientific experimentation.								
4. To get updated with the knowledge on genetic diseases and the research approaches.								
5. To understand and apply the knowledge on human inherited disorders.								
Expected Course Outcomes:								
On the successful completion of the course, student will be able to:								
1	Gain knowledge on fundamentals of genetics and its impact.						K1, K2	
2	Identify the genetic diseases and its inheritance pattern.						K3, K5	
3	The course would be helpful for the students to get placed in government hospitals and private medical laboratories.						K3, K4 & K5	
4	This course helps to obtain knowledge on the genetic diseases and its research approach towards treatment options.						K3, K4 & K6	
5	The students can gain knowledge on the pattern of inheritance from learning the pedigree analysis						K3, K5& K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create								
Unit:1	MENDELIAN LAWS						6 hours	
Mendelian Laws (law of segregation, law of independent assortment, law of segregation and independent assortment; test-cross; back cross.								
Unit: 2	INHERITANCE						6 hours	
Monogenic traits, autosomal inheritance, Sex-linked inheritance, mitochondrial inheritance.								
Unit:3	INTERNATIONAL SYSTEM OF HUMAN CHROMOSOME NOMENCLATURE						8 hours	
International system of Human Chromosome Nomenclature; Structural and Numerical alterations. Chromosomal basis and non-chromosomal basis of sex determination.								
Unit:4	INHERITANCE PATTERN AND PEDIGREE ANALYSIS						6 hours	
Pedigree analysis: family history, pedigree, construction of pedigrees; Complications to the basic pedigree patterns.								
Unit: 5	AUTOSOMAL AND SEX-LINKED INHERITANCE						8 hours	
Autosomal and Sex-linked inheritance; consanguinity and its effects; Mosaicism and chimerism,								

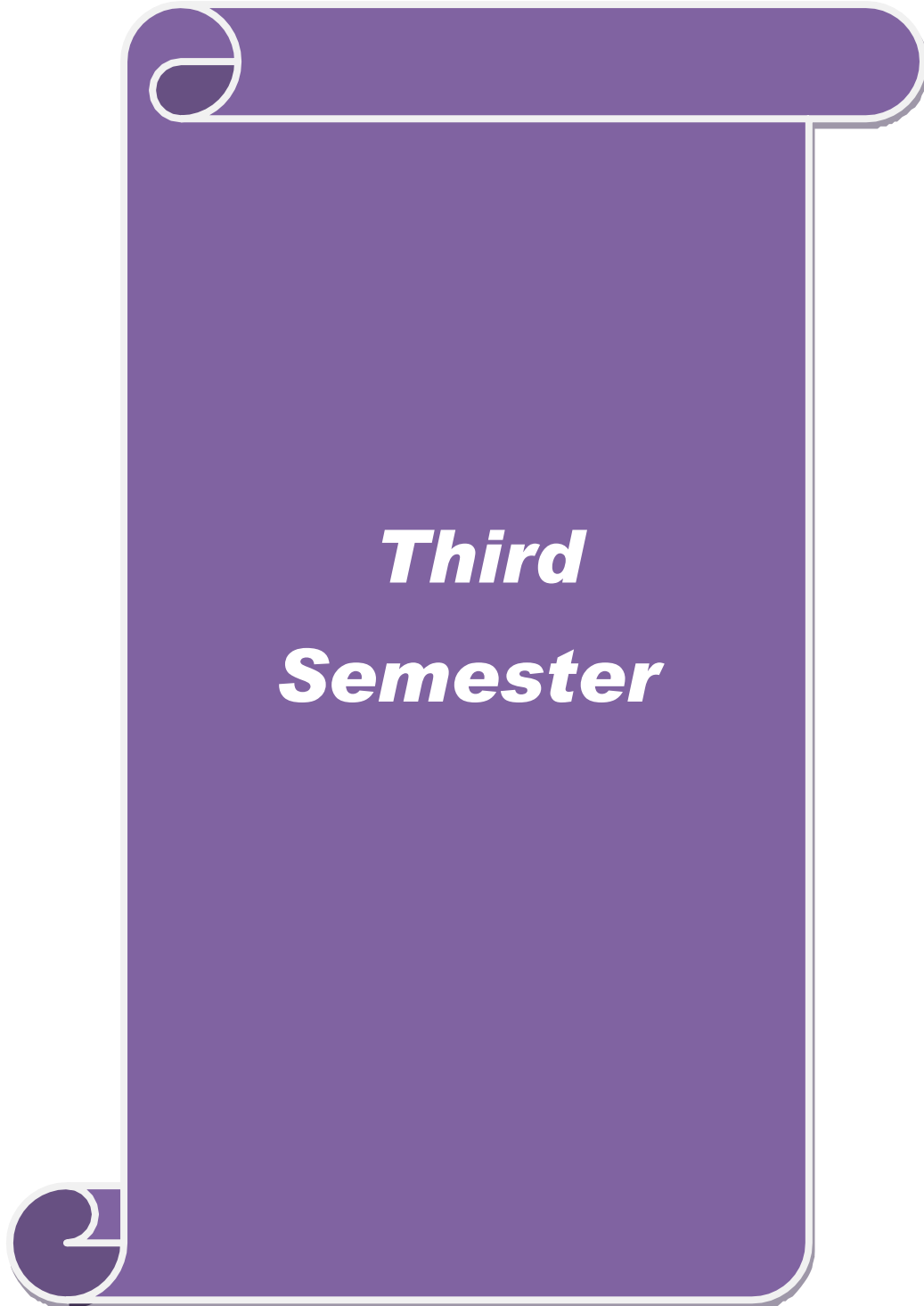
male lethality, X-inactivation, Gene cards database		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		36 hours
Text Book(s)		
1	Principles of Genetics, 6th ed. (Course Smart), D.P. Snustad and M.J. Simmons, John Wiley and Sons,2012.	
2	Principles Of Genetics 8th Edition by Gardner	
3	Human Molecular Genetics 4e (PB) by Strachan, Routledge Taylor and Francis group	
Reference Books		
1	Human Genetics 5th Edition 2017 By Gangane	
2	Genetics: A molecular perspective,1st edition W.S. Klug and M.R. Cummings, Benjamin Cummings,2002	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://dmhuk8np1ucwy.cloudfront.net/wp-content/uploads/2015/08/CH25-lm.pdf	
2	https://nptel.ac.in/courses/102/104/102104052/	
3	https://www.coursera.org/learn/genetics-evolution?ranMID=40328&ranEAID=7bhGe75fAQ8&ranSiteID=7bhGe75fAQ8-GHJVooGTS0D2rg9M08o2uA&siteID=7bhGe75fAQ8-GHJVooGTS0D2rg9M08o2uA&utm_content=15&utm_medium=partners&utm_source=linkshare&utm_campaign=7bhGe75fAQ8	



MOLECULAR DIAGNOSTICS TOOLS		
Name of the Department	Human Genetics and Molecular Biology	
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr. R. SIVASAMY Assistant Professor Dept. of Human Genetics and Molecular Biology Bharathiar University, Coimbatore - 641 046 Email: rsivasamy@gmail.com Phone: (M): +91-94873-60779	
Inter / Intra Department Course	Intra Department	
Duration of the Course	30 Hours	
Eligibility	Any life Science Degree	
Number of Candidates to be Admitted	15	
Registration Procedure	Enroll through BU admission process	
Job Opportunities:		
1. Students will become independently carry out their research projects for Ph.D., 2. Students will be eligible to work in research companies and university laboratories.		
The objectives of the Course are:		
The main objectives of this course are to:		
1	Selection of an appropriate diagnostic method/tool for a particular disease condition and sample type	
2	Adequate knowledge about recent advances and technological developments in the field of diagnostics	
3	Practical knowledge of various diagnostic tools used in healthcare, industry and research	
4	Expertise to perform any diagnostic test with an ability to in troubleshoot	
Course Content	Lecture / Practical / Project / Internship	
Module 1	Introduction to Molecular Diagnostics History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.	6 hours
Module 2	Biomarkers in disease diagnostics FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.	6 hours
Module 3	Molecular Oncology Mitochondrial disorders Cancer - Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing.	6 hours
Module 4	Immunodiagnostic techniques Introduction, Radioactive isotopes, DNA reporters, fluorogenic reporters, electro-chemiluminescent tags & label free immunoassays. Immunoassays - precipitation, agglutination	6 hours

	hemagglutination, RIA, ELISA, RIA, MELISA and specific applications. Quantum dots. Immunohistochemistry - principle and techniques.	
Module 5	Advance Molecular Diagnostics Chromosomal techniques, DNA and RNA sequencing, In situ hybridization, Microarray analysis, Western blot analysis, Protein mass spectroscopy, Imaging based diagnosis, Biochemical testing, Histopathology, Flow cytometry and Blood cell screening	6 hours
		30 Hours
Book(s) for Study		
1	DP Snustad and MJ Simmons (2012) Principles of Genetics, John Willey & Sons Publication, 6th Edition	
2	Human Genetics 5th Edition 2017 By Gangane	
3	Principles Of Genetics 8th Edition by Gardner	
Book(s) for reference		
1	An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons	
2	Human Chromosomes by Miller & Tharman, Springer Publishing Company,	
3	Molecular Cell Biology: Darnell J, Lodish H and Baltimore D	
Related Online Contents		
1	https://dmhuk8np1ucwy.cloudfront.net/wp-content/uploads/2015/08/CH25-lm.pdf	
2	https://nptel.ac.in/courses/102/104/102104052/	
3	https://dmhuk8np1ucwy.cloudfront.net/wp-content/uploads/2015/08/CH25-lm.pdf	





Course code	33A	IMMUNOGENETICS	L	T	P	C
CORE-IX			4	-	-	4
Pre-requisite	Basic understanding about blood cells and antigen	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
1. Understand the basics of immune cells, development and maturation.						
2. Create ability to distinguish different types of Immunoglobulin and role of HLA in transplantation.						
3. Teach the background information of vaccines, its development, uses and the techniques to measure the quantity in clinical diagnosis						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basic architect of immunology such as Immunity, immune cells and organs.					K2
2	Write the role of immune response stimulating proteins					K3
3	Differentiate the pathways involved in defending the antigen and other immune modulating members					K4
4	Understand the background informations about the vaccine preparation					K3
5	Analyse the antigen and antibody interacts and how their interaction will be visualized in ELISA and immunoelectrophoresis					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	BASICS OF IMMUNOLOGY				18 hours	
Historical perspective, lymphoid organs, lymphocytes. Cells of immune system, T and B cell activation and maturation, Haematopoiesis, Haematopoitic stem cells, apoptosis and necrosis. Immunoglobulins, Class switching, Antigens. The molecular basis of antigen and antibody interactions. Types of immunity and immune responses. HLA, genetic oriented rejections						
Unit:2	PATHWAYS AND IMMUNOREGULATORS				10 hours	
Cytokines, interleukins, complement system, the classical pathway, alternate pathway and the membrane attack pathway. Immunostimulation, Immunosuppression and its clinical significance, Immunopotential, adjuvants						
Unit:3	MHC AND DISEASE IMMUNOLOGY				16 hours	
Immunogenetics in anthropology, MHC gene in man and mouse, Genomic map, gene expression, antigen presentation and processing by MHC class I and class II molecules. Tissue typing and organ transplantation, HLA assays, Immunoinformatics. Hypersensitivity. Autoimmune diseases and application of Artificial Intelligence in autoimmune disease, Transplantation Immunology, Tumour Immunology, Immunobiology of HIV infection. Immunobiology of SARS CoVID						
Unit:4	VACCINES				14 hours	
Immunization, active and passive. Vaccines: whole organism vaccine, synthetic peptide vaccine, multivalent subunit-vaccine, anti idio type vaccine, designer vaccine, edible vaccine, Nucleic acid vaccines, recombinant vector vaccine. Production and applications of monoclonal antibodies,						

genetically engineered monoclonal antibodies, Abzymes, Vaccinomics and Adversomics.		
Unit:5	IMMUNOTECHNIQUES	12 hours
Immunoprecipitation, Immunoelectrophoresis Radioimmuno Assay, ELISA, Immunofluorescence technique, Immune-histochemistry, Karyotyping.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Essential Immunogenetics. A. R. Williamson and M.W. Turner. 1987. Blackwell Scientific Publication	
Reference Books		
1	Kuby, J., 2008, Immunology, W.H. Freeman and Co., New York.	
2	Roit, I.N., Brostaff, J.J. and Male, D.K., 2007, Immunology, C. Mosby, St. Louis.	
3	Murphy, K., Travers, P., and M. Walport. 2008. 7 th - Jane way's- Immunobiology-Garland Science (Taylor and Francis)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_cec20_bt05/preview	
2	https://swayam.gov.in/nd1_noc20_bt43/preview	
4	https://nptel.ac.in/courses/102/105/102105083/	
Course Designed By: Dr. P. VINAYAGA MOORTHY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	S	S	L	M	S
CO2	M	M	L	L	S	S	S	M	M	S
CO3	S	S	M	L	S	S	S	M	S	M
CO4	M	M	M	L	S	S	S	M	S	S
CO5	M	S	M	L	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	33B	CANCER GENETICS	L	T	P	C
CORE-X			4	-	-	4
Pre-requisite	Basic Understanding in cell biology and cancer genetics	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
1 To understand the various types of cancers and their prevalence						
2 To understand the molecular basis and functional aspect of various genes involved in progression of cancer						
3 To make them find out various pathways involved in various cancers and to equip the students with the existing and novel therapeutic approaches for controlling cancer growth						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Able to understand the status of Cancer worldwide and types.					K1&K2
2	Capable of Understanding the transformation and progression cancer					K2&K4
3	Able to understand the role of genes in cancer developments					K2
4	Inculcating the knowledge in the field of chromosome abnormalities in cancer progression					K4&K5
5	Able to understand familial association of cancer					K5&K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	CANCER HISTORY AND TYPES					14 hours
Scope and current scenario of cancer research. Cancer: Types and their prevalence, Carcinoma, Lymphoma and Malignancy. Classification based on tissue types. Molecular biology of tumor invasion and metastasis. Somatic and germline mutation database						
UNIT:2	CELL TRANSFORMATION AND TUMOURIGENESIS					14 hours
Oncogenes, tumour suppressor genes, DNA repair genes and genetic instability, epigenetic & Post translational modifications, telomerase activity, centrosome malfunction. Tumour progression: angiogenesis and metastasis.						
UNIT:3	ONCOGENES AND HUMAN CANCERS:					14 hours
Role of proto- oncogenes in regulating cell growth and survival, mechanisms of activation of oncogenes, retro viral activation , point mutations, fusion genes, gene amplification, chromosome rearrangements, promoter insertion, tumour suppressor genes. Cell cycle and Cancer, Knudson's two hit hypothesis.						
UNIT:4	CHROMOSOME ABNORMALITIES					14 hours
Chronic myeloid leukemia, Chronic lymphocytic leukemia, Acute myeloid leukemia, Acute lymphoblastic leukemia, Myelodysplastic syndromes, Myeloproliferative disorders, Hodgkin's disease, non Hodgkin's lymphoma, Burkitt's lymphoma.						
UNIT:5	FAMILIAL CANCERS, BIOMARKERS AND THERAPY					14 hours
Familial cancers, Biomarkers and Therapy : Retinoblastoma, Wilm's tumour, Li- Fraumeni syndrome, Colorectal cancer and Breast cancer. Cancer therapy: At cellular, gene and protein						

level. Stages of cancer - TNM classification. Principles of cancer biomarker and their applications, chemotherapeutics for cancer, Phytotherapy for cancer. Advance therapies in cancer- Monoclonal Antibody therapies for cancer		
UNIT:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	The Biology of Cancer, R.A. Weinberg, Garland Science, Taylor and Francis Group, 2007.	
Reference Books		
1	Cancer Biology,3rd ed., R.J.B. King and M.W. Robbins, Pearson Education Ltd., 2006.	
2	Cancer cytogenetics, chromosomal and molecular genetic aberrations of tumor cells,3rd ed., S. Heim and F. Mitelman, Wiley, Blackwell Inc., 2009.	
3	Human cytogenetics: malignancy and acquired abnormalities, a practical approach,3rd ed., D.E. Rooney, Oxford University Press, 2001.	
4	ISCN 2013 An International System for Human Cytogenetic Nomenclature (2013),Recommendations of the International Standing Committee on Human Cytogenetic Nomenclature, L.G. Shaffer, J. Mc Gowan, Jordan and M. Schmid, S. Karger, 2013.	
5	Introduction to the Cellular and Molecular Biology of Cancer,4th ed., M.A. Knowles and P.J. Selby, Oxford University Press, 2005.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd2_cec20_ma14/preview	
2	https://www.sciencedirect.com/science/article/pii/S0753332220304479	
4	https://pubmed.ncbi.nlm.nih.gov/30671672/	
5	https://www.ncbi.nlm.nih.gov/books/NBK9963/	
6	https://oncologypro.esmo.org/education-library/esmo-e-learning-and-v-learning	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S	S	S	M	L	S	M
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	M	S	S	S	L	M	S	S
CO4	S	M	S	S	S	S	M	L	M	S
CO5	M	S	M	S	S	M	L	L	S	M

*S-Strong; M-Medium; L-Low

Course code	33C	NEUROGENETICS AND EPIGENETICS	L	T	P	C
CORE-XI			4	-	-	4
Pre-requisite	Basic understanding about Neurological functions		Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
1. Neuroscience is study of nervous system, whose ultimate goal is to understand higher brain function at a variety of levels.						
2. This course provides the learners with current knowledge about common neuro diseases and disorders from both a basic research and a clinical perspective						
3. Epigenetics explain the key concepts of what epigenetics is, types of epigenetic modifications, the importance of epigenetics and how it can be related to disease. It also discusses how diet can have an impact on health and disease through epigenetics.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Being a human genetics student, able learn about nervous systems and their functions				K2&K1	
2	Understand the diseases associated with nervous systems				K2&K5	
3	Inculcate the knowledge on degenerative brain diseases				K3&K4	
4	The epigenetic basis of the nervous disorders is discussed along with the associated risks that help the students to attain knowledge regarding the same.				K4	
5	Capable of understanding the epigenetics disease and therapy				K3&K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	ORGANIZATION OF THE NERVOUS SYSTEM				14 hours	
Organization of the nervous system. Histology of the nervous tissue: supporting cells and neurons. Neurophysiology: Resting membrane potential, Membrane potentials and signals. Synapse, postsynaptic potentials and synaptic integration. Neurotransmitters and receptors. Neuroendocrine system. Mimicking Nervous System Advance Artificial Intelligence.						
Unit:2	NEUROLOGICAL DISEASES				14 hours	
Autosomal (recessive and dominant) and X-linked neurological diseases. Neurodegenerative diseases, Unstable mutation (repeat expansion) causing spinocerebellar ataxias, Huntington's disease, Myotonic dystrophy, Fragile-X syndrome. Metabolic defects causing neurological diseases (Tay-Sach's and Gaucher's diseases).Diagnostic procedures for assessing neurogenetic diseases and Mitochondrial Diseases						
Unit:3	DEGENERATIVE BRAIN DISEASES				14 hours	
Degenerative brain diseases: Cerebrovascular accidents, stroke, Parkinson disease and Alzheimer's disease: history, causes, signs, symptoms, pathophysiology, diagnosis, preventions and management. Therapeutics and novel therapeutics						
Unit:4	MECHANISMS OF EPIGENETIC MODIFICATION				14 hours	
Epigenetics: Mechanisms of DNA methylation, histone modifications, chromosomal position effect and gene variegation, epigenetic control of gene activity, analysis of gene-specific DNA methylation, methods of assessing genome-wide DNA methylation. Model organism of epigenetics:						

Drosophila		
Unit:5	EPIGENETICS DISEASE AND THERAPY	14 hours
Effects of diet and environmental agents on epigenetic processes. Role of epigenetic in immune diseases and disorders. Imprinting disorders in humans. Epigenetic therapy. epigenetic assays, DNA and Chromatin modifications		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Human Anatomy and Physiology by Elaine N. Marieb and Katja Hoehn, 2012. Published by Pearson Publisher.	
2	Textbook of Medical Physiology (11 th edition) by Arthur C Guyton and John E Hall, 2006. Published by Elsevier Publications.	
Reference Books		
1	Handbook of Epigenetics by Tollefsbol T, 2011. Published by Elsevier Publications	
2	Epigenetics by David C. Allis, Marie-Laure Caparros et al., 2015. Published by Cold Spring Harbor Laboratory Press.	
3	Practical Guide to Neurogenetics by Thomas T. Warner and Simon R. Hammans, 2009. Published by Elsevier Ltd.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc19_bt24/preview	
2	https://www.nextbigfuture.com/2018/12/will-mimicking-the-nervous-system-advanceartificial-intelligence.html	
3	https://link.springer.com/chapter/10.1007/978-3-642-22887-2_27	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	L	M	M	M
CO2	M	M	M	S	S	S	L	M	M	M
CO3	M	M	M	S	S	S	L	L	L	L
CO4	L	L	L	S	S	M	L	L	M	M
CO5	S	S	M	S	S	M	L	L	S	S

*S-Strong; M-Medium; L-Low

Course code	33D	GENETIC COUNSELING	L	T	P	C
CORE-XII			4	-	-	4
Pre-requisite	Basic understanding about Genetic Counseling	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
1. Provides learners with the appropriate knowledge, experience and Skills to become motivated genetic counselors.						
2. Provide exposure to coursework, including: clinical training, hospital visits, case studies and seminars, to develop their personalized skills towards understanding and handling of genetically inherited disorder subjects.						
3. Promote graduates prepared to work in a variety of interdisciplinary clinics as well as in areas of research or commercial genetics laboratories relevant to genetic counseling and human genetics.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the Pedigree for Genetic counseling					K2
2	Analyze the basic pedigree patterns of humans for diagnosis					K4
3	Differentiate inheritance patterns of human					K3
4	Use genetic counseling public awareness					K2&K5
5	Able to understand the components of genetic counseling					K4&K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	HISTORY OF HUMAN GENETICS				14 hours	
Pedigrees, gathering family history, Pedigree symbols, Construction of pedigrees, Presentation of molecular genetic data in pedigrees, Pedigree charts for different inheritance patterns..						
UNIT:2	COMPLICATIONS TO THE BASIC PEDIGREE PATTERNS				14 hours	
Genomic imprinting and uniparentaldisomy, Spontaneous mutations, Mosaicism and chimerism, Male lethality, X-inactivation, Consanguinity and its effects in the pedigree pattern.						
UNIT:3	INHERITANCE				14 hours	
Monozygotic and dizygotic twins and adoption studies, Polygenic inheritance of continuous (quantitative) traits, normal growth charts, Dysmorphology, Polygenic inheritance of discontinuous (dichotomous) traits, Genetic susceptibility in complex traits						
UNIT:4	GENETIC COUNSELING				14 hours	
Historical overview and components of genetic counseling. Indication for and purpose, Information gathering and construction of pedigree Medical genetic evaluation (Basic components of medical history, past medical history, social and family history).						
UNIT:5	COMPONENTS OF GENETIC COUNSELING				14 hours	
Physical examination, Patterns of inheritance, risk assessment and counseling in common Mendelian and multifactor syndromes. Prenatal and postnatal screening: noninvasive methods and invasive methods. Indications for chromosomal testing.						
UNIT:6	CONTEMPORARY ISSUES				2 hours	
Expert lectures, online seminars - webinars						

		Total Lecture hours	72 Hours
Text Book(s)			
1	1. Genetics, A Conceptual Approach, 4thed., B.A. Pierce, Palgrave Macmillan, 2012.		
Reference Books			
1	Emery's Elements of Medical Genetics, 14thed., P.D. Turnpenney and S. Ellard, 2012.		
2	6. Practical Genetic Counseling - 7 ed., P. S. Harper, CRC Press., 2010.		
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
1	https://kidshealth.org/en/parents/genetic-counseling.html		
2	https://www.ncbi.nlm.nih.gov/books/NBK115552/		
Course Designed by: Dr. P. VINAYAGA MOORTHY			

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	M	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M	M	L
CO4	L	S	M	S	S	M	M	M	M	M
CO5	L	S	M	S	S	L	L	M	L	L

*S-Strong; M-Medium; L-Low



Course code	33P	IMMUNOGENETICS, CANCER GENETICS, EPIGENETICS, BIOETHICS AND BIOSAFETY	L	T	P	C
CORE PRACTICAL - III			-	-	6	4
Pre-requisite		Basic knowledge in immunology, cancer, genetics and bioethics	Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Equip the learners with immunotechniques for understanding the antigen antibody interaction and its use in disease diagnosis 2. Understand the functional and genetic aspect of various types of cancers and their prevalence among various races and perform various techniques for understanding the cancer stages and genetics behind its progression 3. Highlight and give hands on exposure in the epigenetic techniques for understanding mechanisms behind certain genetic changes 4. To introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Distinguish the various immunological reactions for the diagnosis of diseases and disorders					K4
2	Analyze the genetic defect behind the different cancer types and their corresponding molecular mechanism and apply and evaluate various assays and tests to develop testing kits for early diagnosis					K3,K4, K5 & K6
3	Decipher the mode of epigenetic mechanisms creates the genetic changes					K4
4	Follow the ethics and safety measures in all areas of research and realize the importance of IPR.					K3
5	Develop the self-sufficiency to be eligible for any medical or diagnostic works					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
IMMUNOGENETICS						
<ol style="list-style-type: none"> 1. Blood grouping test 2. Electrophoretic separation of serum proteins 3. Complement mediated haemolysis 4. Isolation and enumeration of lymphocytes from human blood 5. Determination of lymphocyte viability by Trypan blue dye exclusion test 6. Estimation of serum lysozyme and total peroxidase secretion 7. Detection of Antibody using ELISA 8. Immunoelectrophoresis 						
CANCER GENETICS						
<ol style="list-style-type: none"> 1. Preparation of Culture room and Media preparation. 2. Human Blood Lymphocyte Culture 3. Cell Proliferation Assay (MTT) 4. Isolation of DNA from Tissues 5. cDNA Synthesis for MMP2 gene 6. MAP Kinase activity (Demonstration) 7. Sequence similarity analysis for protein and nucleic acid using online bioinformatics tools 						

NEUROGENETICS AND EPIGENETICS	
<ol style="list-style-type: none"> 1. DNA methylation analysis <ol style="list-style-type: none"> a. Bisulfide conversion b. High resolution melt analysis c. Examination of different DNA methylation conditions using Restriction assay 	
GENETIC COUNSELING	
<ol style="list-style-type: none"> 1. Role of genetic counselor in hospitals 2. Hospital visit and report preparation 	
Total Lecture hours	
108 hours	
Text Book(s)	
1	Analytical Biochemistry, 3 rd Edition. Holme, D.J and Peck, H. 1998. Pearson Education Limited.1-501.
2	Analytical Biochemistry, 3 rd Edition. Holme, D.J and Peck, H. 1998. Pearson Education Limited.1-501.
3	Molecular Cloning - A laboratory manual. 3 rd Edition. Sambrook and Russel. Cold Spring harbor laboratory Press. 2001.1-2331.
4	Cancer Biology, 3rd ed., R.J.B. King and M.W. Robbins, Pearson Education Ltd., 2006.
5	Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational
Reference Books	
1	Modern experimental Biochemistry, 3 rd Edition, Rodney Boyer. 2000. Benjamin Cummins. 1-480.
2	Methods in Molecular Biology-Genomics Protocol - Starkey, M.P. and Elasarapu, R. 2001. Humana Press.1-538
3	Current Protocols in Immunology. John Donovan and Patricia Brown. 1995. John Wiley & Sons, Inc.
4	Bunz, F., 2008. Principles of cancer genetics (Vol. 1). New York, NY, USA:: Springer.
5	Haber, D.A. ed., 2010. Principles of clinical cancer genetics: a handbook from the Massachusetts General Hospital. Springer.
6	Matloff, E., 2013. Cancer principles and practice of oncology: handbook of clinical cancer genetics. Lippincott Williams & Wilkins.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://link.springer.com/chapter/10.1007/978-981-10-0875-7_24
2	https://books.google.co.in/books/about/Biosafety_and_Bioethics.html?id=IiqPrFYzRMMC&redir_esc=y
3	https://books.google.co.in/books/about/Bioethics_and_Biosafety.html?id=xP9dzbSBTZQC
4	https://www.nature.com/articles/35077207
5	https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(11)70092-4/fulltext
6	https://www.cancergeneticsjournal.org/
Course Designed By: Dr. P. VINAYAGA MOORTHY, Dr. R. SIVASAMY, AND Dr. A. VIJAYA ANAND	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	S	S
CO2	M	M	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	L	L	L	S	M	M	L	S	M	M
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low



Course code	3EC	STRESS AND BIOMARKERS	L	T	P	C
ELECTIVE III				4	-	-
Pre-requisite		Basic understanding about stress physiology and toxicology	Syllabus Version		2023-24	
Course Objectives:						
The main objectives of this course are to:						
1. The topics are introductory in nature and build the ability to learn how human system works in stressed conditions under the influence of various internal and external stimuli.						
2. The curriculum of pathology aims at preparing the learners in basic understanding of diseases and their pathogenesis with reference to stress by using biomarkers.						
3. Toxicology is a vast, multidisciplinary subject encompassing various other basic fields of science. Not all toxicity effects are well understood, many of them unpin themselves into stress. Hence, it allows the learners to gain basic knowledge on toxicology effects.						
Expected Course Outcomes:						
On the successful completion of the course, students will be able to:						
1	Next to neurology, it is necessary for the human genetics student to learn about the substances produced by the nervous system; this has been discussed in this course.				K1 & K2	
2	The functions of the substances produced by the nervous system have also been discussed in this course which helps the students to obtain clear knowledge on the same.				K1 & K2	
3	The biomarkers that indicates the malfunctioning of the body parts has to be known by the life science students, which has also been discussed by this course.				K1 & K2	
4	Understanding about the neurological effects associated with stress.				K1 & K2	
5	Learn basic research and toxicity test.				K1, K2, K3 & K5	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit: 1	STRESS PHYSIOLOGY				14 hours	
Factors contributing to stress, physiological systems respond to stress. Principle pathways linked to steroidal hormones. Biomarkers: Introduction and types of biomarkers acting based on organ and tissue specific and non-specific. Biomarkers discovery and its applications.						
Unit: 2	BIOMARKERS				14 hours	
Methods for identifying biomarkers: Biomarker selection development and assay. Significance of biomarkers in oxidative stress, metabolic biomarkers, immunological biomarkers and physiological biomarkers. Blood chemistry and histopathology. Heat shock proteins.						
Unit: 3	NEUROENDOCRINE BIOMARKERS				14 hours	
Neuroendocrine biomarkers: The primary physiological factor that determine the neuroendocrine stress response, Stress relaxation and receptors, arterial pressure and regulation, functions of cortisol in stress and inflammation.						
Unit: 4	STRESS AND NEUROLOGICAL EFFECTS				14 hours	
Promising new vistas for chronic stress characterization, metabolomics, ultrastructure modifications in mitochondria. Neuroanatomy changes seen under stressed conditions. Neuropsychic disorders characteristic features, disease progression, treatment and control. Stress management using Artificial intelligence.						
Unit: 5	TOXICOLOGY				14 hours	

Chemical stress and Toxins: Introduction, definition, sub disciplines, environmental toxicants, routes of entry of xenobiotics. Toxicity tests: basic requirements, test organisms. Types of acute toxicity tests and chronic toxicity tests, terminologies used in toxicity tests and need for conducting toxicity tests.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
	Total Lecture hours	72 hours
Text Book(s)		
1	The Nervous System: The basic of neurosciences by Donald B. Tower and Roscoe O. Brady. Published by Raven Press Publishers.	
2	Human Anatomy and Physiology by Elaine N. Marieb. Published by The Benjamin/Cummings Publishing Company, Inc.	
Reference Books		
1	Text book of Medical Physiology (11 th edition) by Arthur C Guyton and John E Hall. Published by Elsevier Publications.	
2	Principles of Biochemical Toxicology (4 th edition) by J.A. Timbrell. Taylor and Francis. Published by CRC Press.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/nd1_noc19_ge26/preview	
2	https://ciet.nic.in/swayam_psychology03_module08.php	
3	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/697	
Course Designed By: Dr. A. VIJAYA ANAND		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	S	S	S	S	S	L
CO2	S	S	M	M	S	S	S	S	S	L
CO3	S	S	M	M	S	S	S	S	S	L
CO4	M	S	M	S	S	M	S	S	S	L
CO5	M	M	L	M	S	S	S	S	S	L

*S-Strong; M-Medium; L-Low

Course code	3ED	STEM CELL BIOLOGY		L	T	P	C
ELECTIVE-III				4	-	-	4
Pre-requisite	Basic understanding about Stem Cells, characterization and its applications		Syllabus Version	2023-24			
Course Objectives							
The main objectives of this course are to:							
1. Understanding key implications of stem cell research.							
2. Relate the importance of stem cells to the development and maintenance of multicellular organisms.							
3. To describe how stem cells can be used for medical purposes.							
4. To understand how defects in stem cell behavior can lead to medical problems.							
5. To understand complex molecular, cellular, and genetic techniques used to investigate stem cell biology.							
Expected Course Outcomes							
On the successful completion of the course, student will be able to:							
1	Describe the characteristics of stem cells and the different types of stem cells			K2			
2	Understand the isolation process and culturing of stem cells.			K3			
3	Understand basic biology/mechanisms and applications of stem cells			K3			
4	To obtain knowledge and understanding the behavior of stem cells in laboratory.			K2, K3 & K4			
5	To gain knowledge and understand the mechanism of techniques involved in stem cell research			K2, K3 & K6			
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	INTRODUCTION TO STEM CELLS			14 hours			
Introduction to stem cells and basis of stemness; Embryonic stem cells, adult stem cells, hematopoietic stem cells, mesenchymal stem cells, cancer stem cells, induced pluripotent stem cells.							
Unit:2	EMBRYONIC STEM CELLS			14 hours			
Isolation, characterization and maintenance of embryonic stem cells. Serum and feeder free culture of human embryonic stem cells							
Unit:3	MESENCHYMAL STEM CELLS			14 hours			
Introduction to mesenchymal stem cells; isolation and characterization; Differentiation of mesenchymal stem cells into various lineages							
Unit:4	INDUCED PLURIPOTENT STEM CELLS (iPSCs)			14 hours			
Introduction to iPSC technology; Reprogramming iPSCs: integration and non-integration methods; Advantages and disadvantages of iPSCs							
Unit:5	APPLICATIONS OF STEM CELLS			14 hours			
Neurodegenerative diseases, spinal cord injury, eye diseases; Ethical and regulatory issues in the use of stem cells							
Unit:6	CONTEMPORARY ISSUES			2 hours			
Expert lectures, online seminars - webinars							
			Total Lecture hours	72 hours			
Text Book(s)							

1	Handbook of Stem Cells, 2nd Edition, Atala A & Lanza R, Academic Press, 2012
2	Essential of Stem Cell Biology, 3rd Edition, Lanza R, et al, Elsevier Academic Press, 2013
3	Translational Approaches in Tissue Engineering & Regenerative Medicine, Mao JJ, et al, Artech House, 2007
4	Stem Cell Repair and Regeneration, Volume-2, Habib NA, Levièar NY, Gordon M, Jiao L & Fisk N, Imperial College Press, 2007.

Reference Books

1	Stem Cells Handbook, Edited by Stewart Sell, Human Press, 2010
2	Human embryonic stem cells, Edited by Arlene Y. Chiu, Mahendra Rao, Human 5. Press, 2011.
3	Stem cell basics and application Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
4	Stem cell Biology: Daniel R. Marshak, Richard Lavenham Gardner, David I. Gottlieb - 2001
5	Essentials of Stem cell Biology: Robert Lanza, John Gearhart, Brigid Hogan - 2009

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/learn/stem-cells
2	https://online.stanford.edu/courses/xgen204-stem-cell-therapeutics
3	https://www.classcentral.com/course/advances-stem-cells-13105



Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	S	M	M
CO3	S	S	M	S	M	S	M	M	S	S
CO3	S	M	M	M	S	M	S	M	M	M
CO4	M	M	S	M	M	L	M	S	M	L
CO5	M	M	M	M	M	M	M	M	M	M

*S-Strong; M-Medium; L-Low

Course code	-	FORENSIC BIOLOGY	L	T	P	C
ELECTIVE - III			4	-	-	4
Pre-requisite	Knowledge in genetics	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. To understand the forensic ethics, rules and regulations for investigation of crime 2. To understand the techniques of investigation 3. To analyse the biological evidences through DNA processing 4. To know the legal standards of forensics 5. To study the tools and applications of forensics 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Able to understand the forensic science disciplines and their functions					K1
2	Understand about the crime and investigation techniques					K3&K4
3	Capable of knowing the different types of genetic markers that are used for forensic genetic analysis and interpretation					K4&K5
4	Able to understand the forensic profiling and their importance					K5&K6
5	Inculcate the knowledge on various tools and applications in Forensic Biology					K6&K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
UNIT:1	INTRODUCTION TO FORENSICS					14 hours
Forensic science principles, forensic science disciplines and their functions. Basics, Rules, Ethics, Laws, Procedures, Cross Examinations, Investigating the Crime Scene- Crime scene and evidence collection and processing.						
UNIT:2	INVESTIGATION TECHNIQUES					14 hours
Crime Detection Devices, LA-ICP-MS, Alternative Light Photography, Forensic Carbon-14, Dating, High-Speed Ballistics Photography, 3D Forensic Facial Reconstruction, DNA, Sequencer, Magnetic Fingerprinting and Automated Fingerprint Identification (AFIS).						
UNIT:3	DNA DETECTION TECHNIQUES					14 hours
DNA Isolation, quantification and quality assessment from hard and soft tissues. RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Evaluation of results, frequency estimate calculations and interpretation, Determining the allelic frequency.						
UNIT:4	FORENSIC PROFILING					14 hours
History of DNA profiling applications in disputed paternity cases, missing person's identity, child swapping, civil immigration, legal perspectives - legal standards for admissibility of DNA profiling - procedural & ethical concerns, status of development of DNA profiling in India & abroad. Overlapping genes and multiple gene families, VNTRs, STRs, Mini STRs, SNPs.						
UNIT:5	TOOLS AND APPLICATIONS					14 hours
Introduction Basics of gene prediction, pattern recognition, gene prediction tools, Tools for microarray analysis and application, Algorithm for identifications of homology. Combined DNA Index System (CODIS). Scope of analysis in forensic science laboratories/institutions. Legendries and their contributions in the field of forensic science.						

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars - webinars		
Total Lecture hours		72 hours
Text Book(s)		
1	Barnett P.D. (2001), Ethics in Forensic Science: Professional Standards for the Practice of Criminalistics, CRC press.	
Reference Books		
1	B. A. J. Fisher, D. R. Fisher;“Techniques of Crime Scene Investigation, 8th Edition”, CRC Press London, 2012.	
2	Alan Gunn. Essential Forensic Biology, 2nd Edition, 2nd edition, Wiley-Blackwell 2009.	
3	Henry C. Lee and R.E. Gaensslen; (1990), DNA and other Polymorphism in Forensic Science, Year book Medical Publishers, Inc.	
4	F. Toroni, S. Bozza, A. Biedermann, P. Garbolino; “Data analysis in Forensic Science”, Wiley, 2010.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.semanticscholar.org/paper/Artificial-Intelligence-in-Forensic-Sciencehinnikatti/	
2	https://ieeexplore.ieee.org/document/8701416	
4	https://www.sciencedirect.com/science/article/pii/S1877050920302672	
5	https://swayam.gov.in/nd2_cec20_ge10/preview	
Course Designed By: Dr. R. SIVASAMY		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S	M	L	M	M	S	S
CO2	L	M	M	S	S	L	M	M	S	S
CO3	M	M	M	S	S	L	M	L	S	S
CO4	M	M	M	S	S	L	M	M	S	S
CO5	M	M	M	S	S	L	M	M	S	S

*S-Strong; M-Medium; L-Low

Course code	GS106	GENETIC TOXICOLOGY	L	T	P	C
SUPPORTIVE-III			2	-	-	2
Pre-requisite	Basic understanding about mutagens and mutations	Syllabus Version	2023-24			
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Inculcate principles and guidelines in mutagenicity and genotoxic agents. 2. Cater various assays and procedures involved in mutagens evaluation. 3. Create the awareness about the effect of genotoxic agents and mutagens on health and nature. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the basic principles and guidelines in mutagen monitoring and testing					K2
2	Classify the genotoxic agents and relate the genetic defects with mutagens					K4
3	Apply the assays and methods for measuring the toxic agents for its genetic effects					K3
4	Gain the understanding on health effects of genotoxic agents/mutagens					K2
5	Collect the genotoxic agents that can affect the developing embryo					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	PRINCIPLES AND GUIDELINES					8 hours
General Principles of Mutagenicity, Testing and Regulatory Control of Environmental Chemicals. Monitoring of Chemical Mutagens in the environment						
Unit:2	GENOTOXIC AGENTS					6 hours
Classification of Genotoxic agents. Genetic effects of environmental agents and Genotoxic agents in various occupations.						
Unit:3	ASSAYS AND METHODS					7 hours
Various assay procedures to determine genotoxicity, Methods of evaluation of mutagens, Microbial to mammals.						
Unit:4	HEALTH EFFECTS OF MUTAGENS					7 hours
Epidemiological approach to evaluate genetic hazards: Occupational Epidemiology and Reproduction						
Unit:5	HEALTH EFFECTS IN NEW BORN					6 hours
Monitoring for genetic disease in the new born: Transplacental genotoxic agents						
Unit:6	CONTEMPORARY ISSUES					2 hours
Expert lectures, online seminars - webinars						
Total Lecture hours					36 hours	
Text Book(s)						
1	Handbook of Mutagenicity Test Procedures. Kilbey, B.J., Lehgator, M., Nichols, W and Ramel, C (1984) Elsevier.					

Reference Books	
1	Hsu, T.C (1982). Cytogenetic Assays of Environmental Agents., Oxford and IBH, New Delhi.
2	Hollaender. A, and Serres F.J., Chemical Mutagens, Principles and Methods for their Detection. Volume 1- 10, Plenum Press
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.criver.com/products-services/safety-assessment/toxicology-services/genetic-toxicology?region=3701
2	https://www.atsdr.cdc.gov/training/toxmanual/modules/1/lecturenotes.html
3	https://ec.europa.eu/health/ph_projects/2003/action3/docs/2003_3_09_a21_en.pdf
Course Designed By: Dr. P. VINAYAGA MOORTHY	



CELL CULTURE TECHNIQUES		
Name of the Department		HUMAN GENETICS AND MOLECULAR BIOLOGY
Name of the Faculty Member i/c With Complete Address with Phone and e-mail		Dr. R. SIVASAMY Assistant Professor Dept. of Human Genetics and Molecular Biology Bharathiar University, Coimbatore - 641 046 Email: rsivasamy@gmail.com Phone: (M): +91-94873-60779
Inter / Intra Department Course		Intra Department Course
Duration of the Course		30 Hours
Eligibility		Any life science Degree
Number of Candidates to be Admitted		15
Registration Procedure		Enroll through BU admission portal
Job Opportunities:		
The students who enroll in this value added course will learn how to culture the cell lines of different type's tissues which is essential for the any kind of morpho and molecular studies. It helps the students to get wide knowledge and it enhances cell interaction, cytotoxicity and cell signaling studies. It increases the opportunity to get to work in state and central institutions and various research projects.		
The objectives of the Course are:		
The main objectives of this course are to:		
1	Understand the basic principles of Cell Culture techniques	
2	Provide theoretical and practical knowledge in relation to animal cell culture techniques.	
3	Gain practical skills to subculture animal cells and quantify cell growth	
Course Content		Lecture / Practical / Project / Internship
Module 1	Cell culture III (cell differentiation, cell quantification, cytotoxicity and viability).	6 hours
Module 2	Cell culture techniques (types of tissue culture, primary cultures vs. finite vs. immortalized cell lines, finite cell lines, immortal cell lines, primary cultures).	6 hours
Module 3	Culture vessels & media development, Serum-free medium development & sterilization	6 hours
Module 4	Cell separation, characterization, differentiation & transformation Contamination, cryo-preservation & cyto-toxicity	6 hours
Module 5	Introduction to tissue engineering, Biomaterials: natural materials, polymers, Biomaterials: hydrogels, ceramics, scaffold fabrication	6 hours
		30 Hours
Book(s) for Study		
1	Molecular Cloning - A laboratory manual. 3 rd Edition. Sambrook and Russel. Cold Spring harbor laboratory Press. 2001.1-2331.	
Book(s) for reference		
1	Modern experimental Biochemistry, 3 rd Edition, Rodney Boyer. 2000. Benjamin Cummins. 1-480.	
2	Methods in Molecular Biology-Genomics Protocol - Starkey, M.P. and Elaswarapu, R. 2001. Humana Press.1-538	
Related Online Contents		
1	https://onlinecourses.nptel.ac.in/noc20_me04/preview	
2	https://nptel.ac.in/courses/102/104/102104059/	



***Fourth
Semester***

Course code	43A	BIOETHICS AND BIOSAFETY	L	T	P	C
CORE-XIII		(Self study)	4	-	-	4
Pre-requisite		Basic understanding about Intellectual Property Rights, Biosafety regulation and bioethics	Syllabus Version	2023-24		
Course Objectives:						
The main objectives of this course are:						
1. To study the details about the equipment to acquire the basic knowledge of handling instruments.						
2. To acquire the knowledge on biosafety levels.						
3. To know the procedure of obtaining ethical clearance.						
4. To obtain knowledge on Good Laboratory Practice.						
5. To gain knowledge on IPR and patents in biological research.						
Expected Course Outcomes:						
On the successful completion of the course, students will be able to:						
1	Understand the ethical guidelines and biosafety procedures when handling human samples and animal models.	K1, K2& K5				
2	The importance of bioethics will be acknowledged during the course.	K2, K3 & K4				
3	Students will be well-trained in operating instruments and handling samples.	K3,K4, K5				
4	The course aims in good practice for students to work in the laboratory.	K2, K3 & K5				
5	Helps to obtain knowledge on Intellectual Property Right in research and development.	K2, K3 & K6				
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	INTRODUCTION TO BIOETHICS					14 hours
Introduction to bioethics in biotechnology, Positive effects, Negative effects, Toxic soils, Biological Pest Controls. Fast Growing Trees, Fast Growing fish, food safety, Economic and Social Concerns, Human Ethical Clearance, Consent forms, Helsinki regulations						
Unit:2	BIOSAFETY REGULATIONS					14 hours
National and International Guidelines. Introduction, Regulation of framework in various countries, USA, European Union, Canada, Australia, South Africa, Asian Region including India.						
Unit:3	CPCSEA GUIDELINES FOR LABORATORY ANIMAL FACILITY					14 hours
Goal, Animal procurement, Quarantine, Sterilization, Surveillance, Animal care and technical personnel, Multiple surgical procedures on single animal, Duration of experiments, Physical facilities, Environment, Animal husbandry, Activity, Food, Bedding, Water, Sanitation and cleanliness, Assessing the effectiveness of sanitation, Waste disposal, Pest control, Emergency measures.						
Unit:4	GLP AND BIOETHICS					14 hours
Introduction, National Good Laboratory Practice (GLP) Programme, The GLP authority functions, quality standards for Clinical Trials, Clinical Trials worldwide.						

Unit:5	INTELLECTUAL PROPERTY RIGHTS	14 hours
An Introduction, Origin of the Patent Regime, Early patterns Act and History of Indian Patent System. The Present Scenario, Basis of Patentability, Patent Application Procedure in India, Patent Granted Under Convention Agreement, Patent Procedure. Artificial Intelligence - Introduction - Intellectual Property Rights - Application of Artificial Intelligence in Intellectual Property Rights		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	72 hours
Text Book(s)		
1	Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational	
Reference Books		
1	IPR, Bioethics and Biosafety by Deepa Goel, Shomini Parashar. Pearson Education India	
2	Bioethics and Biosafety by M.K. Satheesh (2008). I. K. International Pvt Ltd	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://link.springer.com/chapter/10.1007/978-981-10-0875-7_24	
2	https://books.google.co.in/books/about/Biosafety_and_Bioethics.html?id=IiqPrFYzRMMC&redir_esc=y	
3	https://books.google.co.in/books/about/Bioethics_and_Biosafety.html?id=xP9dzbSBTZQC	

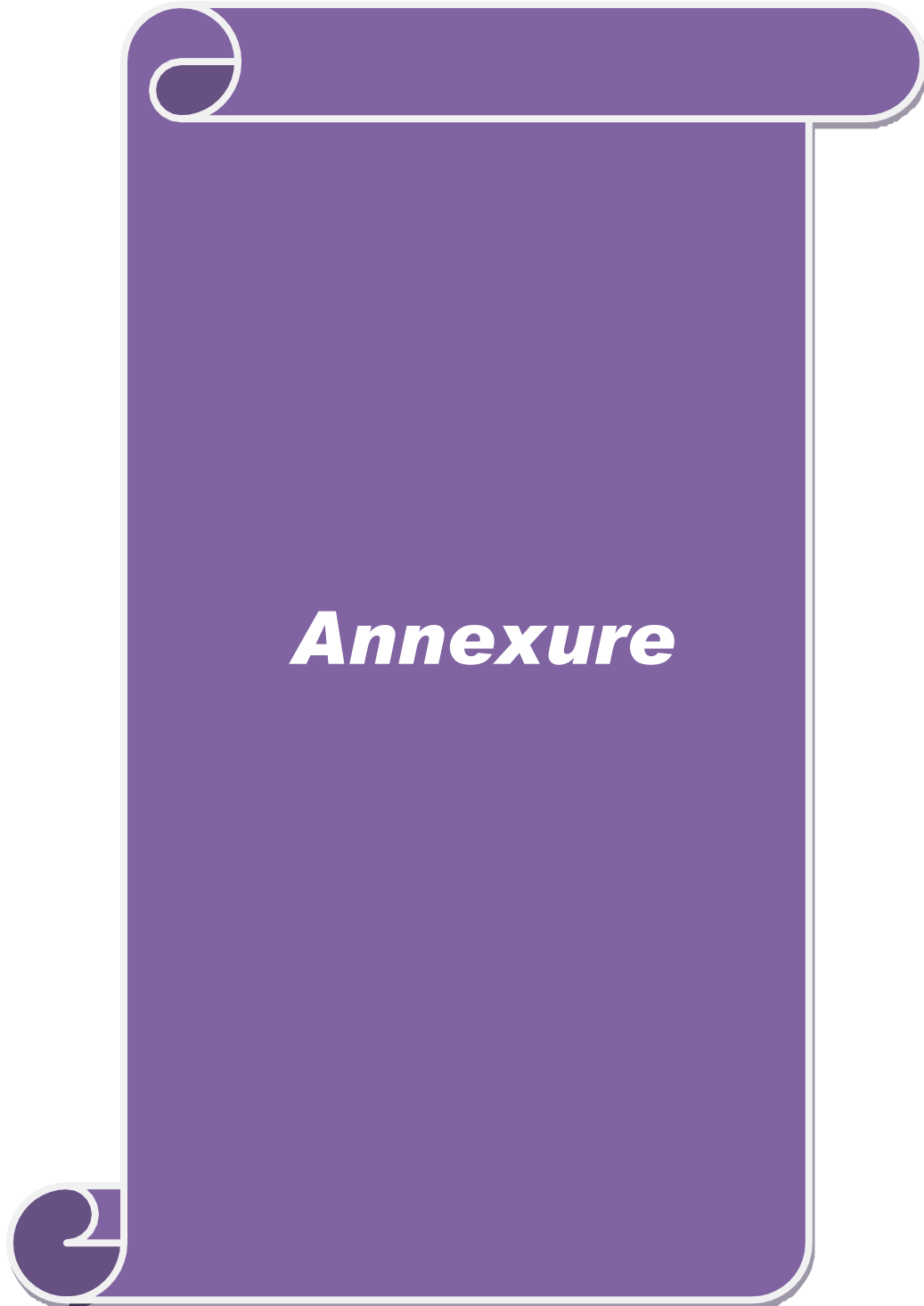
Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	M	M	M	M	S	M	S
CO3	M	S	S	M	S	M	S	M	M	M
CO3	S	M	M	M	M	M	M	M	S	S
CO4	S	M	S	S	M	M	M	M	M	M
CO5	M	M	M	M	M	S	S	M	M	M

*S-Strong; M-Medium; L-Low

DROSOPHILA CULTURE AND REARING		
Name of the Department	HUMAN GENETICS AND MOLECULAR BIOLOGY	
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	Dr. P. VINAYAGA MOORTHY Assistant Professor Department of Human Genetics and Molecular Biology Bharathiar University Coimbatore - 641 046 Tamil Nadu, INDIA MOBILE: 9994809189 EMAIL: vinayputhu@gmail.com; pvmhgmb@buc.edu.in	
Inter / Intra Department Course	Intra Department Course	
Duration of the Course	30 Hours	
Eligibility	Any life science Degree	
Number of Candidates to be Admitted	15	
Registration Procedure	Enroll through BU admission portal	
Job Opportunities:		
<p>The students who enroll in this value added course will learn how to rear the <i>Drosophila</i> and culture it for different generations. <i>Drosophila</i> is a model organism used by many researchers for studying the genetic disease through various behavioral assays due to sequence similarity with human genes. So learning the rearing skill and practical handling of behavioral assays give them self-sufficiency and give them courage to independently work for their doctoral thesis. It also give the learners a eligibility work in various disease model projects as JRF, SRF and get opportunity work in central government institutions. Besides, if they start doing it with different types of species for different disease model flies, they can supply the flies for research works and they become entrepreneur in the field.</p>		
The objectives of the Course are:		
The main objectives of this course are to:		
1	learn the basic developmental stages of the <i>Drosophila melanogaster</i>	
2	Understand the requirement for raising the colonies of <i>Drosophila melanogaster</i>	
3	Use the <i>Drosophila melanogaster</i> for the behavioral assays	
Course Content	Lecture / Practical / Project / Internship	
Module 1	Identification of Male and Female - Egg - Embryo - Larval stages and Pupa - Life Cycle	5 hours
Module 2	<i>Drosophila</i> : Media preparation - Culture Conditions - Basic requirements - Safety Conditions	5 hours
Module 3	<i>Drosophila</i> : Maternal Genes, Segmentation Genes and its role in Development	6 hours
Module 4	<i>Drosophila</i> : Live observation of Embryo	2 hours
Module 5	<i>Drosophila</i> : Dissection of larval Brain	2 hours
Module 6	<i>Drosophila</i> : Dissection of adult brain	2 hours
Module 7	<i>Drosophila</i> : Behavioral assays - Flight assay	2 hours
Module 8	<i>Drosophila</i> : Behavioral assays - Climbing assay	2 hours

Module 9	Drosophila: Dissection of thorax for mitochondria - Theory	2 hours
Module 10	Drosophila: Dissection of thorax for mitochondria - Practical	2 hours
		30 Hours
Book(s) for Study		
1	Principles of Developmental Biology. Sally A. Moody. (Editor). 2007. Academic Press	
Book(s) for reference		
1	Scott F. Gilbert, Developmental Biology, VIII edition, Sinauer Associates Inc., Publishers, Sunderland, Massachusetts USA (2006).	
2	Bruce Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter (2008). Molecular Biology of the cell, V edition, John Wiley and sons Inc., 2008.	
Related Online Contents		
1	https://swayam.gov.in/nd1_noc20_bt35/preview	
2	https://nptel.ac.in/courses/102/106/102106084/	
4	https://swayam.gov.in/nd2_cec20_ed13/preview	





SYLLABUS

M. Sc., HUMAN GENETICS AND MOLECULAR BIOLOGY **(With effect from 2023-2024 - ONWARDS)**



DEPARTMENT OF HUMAN GENETICS AND MOLECULAR BIOLOGY

Bharathiar University

(A State University, Accredited with “A++” Grade by NAAC

Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY: COIMBATORE - 641 046
DEPARTMENT OF HUMAN GENETICS AND MOLECULAR BIOLOGY

MISSION

The mission is to empower the young talents to equip with knowledge and to solve practical problems in the field of Human genetics. The programs aims to train students to be productive, knowledgeable scientists and molecular geneticist to pursue focused in genetics to work in national, international laboratories, academic, government and private sectors. Our process of education is to create the manpower with professional ethics and moral values.

