



Two-Year Postgraduate Programme

Master of Science

Genetics

Faculty of Applied Sciences

Parul University

Vadodara, Gujarat, India

Faculty of Applied Sciences

Master of Science in Genetics

1. Vision of the Department

Create and nurture a vibrant learning environment built on core values of science, with knowledge of advances in biological sciences is created and disseminated, with satisfaction in teaching and learning.

2. Mission of the Department

M1	To offer best quality Mentoring of Graduate, Post-graduate and doctoral studies students.
M2	To provide research facilities to lead scientific discoveries making global impact
M3	To create skilled human resource to meet the demand of biological industry
M4	To establish collaborations with industries, all other stakeholders and closely work with them to develop most sought-of curriculum, improve the skills of students

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the M.Sc. Genetics curriculum enables postgraduates to attain.

PEO 1	To develop technical skills (critical investigation, communication, analytical and computer) and human relations skills (group dynamics, team building, organization and delegation) to enable students to transform the acquired knowledge into action.
PEO 2	To inculcate critical analysis and communication skills into students to effectively present their views, both in writing and through oral presentations.
PEO 3	To provide an environment for exploring the Research & Development attitude, to help the students in Research and Development field.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Disciplinary Knowledge	Demonstrate comprehensive knowledge of the discipline that form a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PLO 2	Critical Thinking and Problem Solving	Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PLO 3	Social Competence	Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PLO 4	Research-related Skills and Scientific Temper	Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper / project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PLO 5	Trans-disciplinary Knowledge	Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PLO 6	Personal and Professional Competence	Perform independently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships,

		self-motivation and adaptability skills and commit to professional ethics.
PLO 7	Effective Citizenship and Ethics	Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PLO 8	Environment and Sustainability	Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PLO 9	Self-directed and Life-long learning	Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

5. Program Specific Learning Outcomes

PSO 1	Demand as per recent development	Design the solutions as per the recent industrial demand objective.
PSO 2	Practical skill	Employing modern tools and methods in the field of genetics for development of science and community.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester	Credit
Semester-1	24
Semester-2	24
Semester-3	24
Semester-4	26
Total Credits:	98

Category wise Credit distribution of the programme	
Category	Credit
Major Core	52
Minor Stream	26
Research Project/Dissertation	20
Total Credits:	98

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11203114	Seminar	2.00	-	-	2
2	11218101	Principles of Genetics	4.00	4	-	-
3	11218102	Cell Biology	4.00	4	-	-
4	11218103	Molecular Genetics	4.00	4	-	-
5	11218106	Lab-1 Genetics	3.00	-	6	-
6	11218107	Cell Biology-Lab-II	3.00	-	6	-
7		M.Sc.-Gen-1 (Compulsory Subjects :1)	4.00	4	-	-
Total			24.00	16	6	2

Semester 1 (Elective Subjects)						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11218180	Medical Biochemistry	4.00	4	-	-
2	11218181	Biodiversity	4.00	4	-	-

Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11203161	Seminar	2.00	-	-	2
2	11218251	Population Genetics and Biostatistics	4.00	4	-	-
3	11218252	Genomics and Proteomics	4.00	4	-	-
4	11218254	Human Cytogenetics	4.00	4	-	-
5	11218256	Lab-1 Population Genetics	3.00	-	6	-
6	11218257	Lab-2 Genetic Engineering	3.00	-	6	-

7		M.Sc-Gen-2 (Compulsory Subjects :1)	4.00	4	-	-
Total			24.00	16	6	2

Semester 2 (Elective Subjects)						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11218282	DNA Technology and Genetic Engineering	4.00	4	-	-
2	11218283	Protein purification Techniques	4.00	4	-	-

Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11203207	Seminar	2.00	-	-	2
2	11218201	Biochemical and Immunogenetics	4.00	4	-	-
3	11218202	Bioinformatics	4.00	4	-	-
4	11218203	Clinical Genetics and Genetic Toxicology	4.00	4	-	-
5	11218204	Lab-1 (Immunogenetics)	3.00	-	6	-
6	11218206	Lab-2 (Bioinformatics)	3.00	-	6	-
7		M.Sc-Gen-3 (Compulsory Subjects :1)	4.00	4	-	-
Total			24.00	16	6	2

Semester 3 (Elective Subjects)						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11218284	Somatic Cell and Cancer Genetics	4.00	4	-	-
2	11218285	Clinical Biochemistry	4.00	4	-	-

Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11203219	Dissertation Work	20.00	-	20	-
2	11218258	Developmental and Behavioural Genetics	4.00	4	-	-
3	11218259	Seminar Work	2.00	-	-	2
Total			26.00	4	20	2

8. Detailed Syllabus

Semester 1

[1]

a. Course Name: Seminar

b. Course Code: 11203114

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	2	-	2	-	20	20	-	60	100

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

For Seminar/Presentation: There will be a seminar/presentation of maximum 100 marks. It will be evaluated on the basis of the literature surveyed on assigned topics, presentation and viva.

[2]

a. Course Name: Principles of Genetics

b. Course Code: 11218101

c. Prerequisite: understanding of basic biological concepts, including cell structure, molecular biology, and organismal biology

d. Rationale: serves as a fundamental building block for advanced studies in biology, genetics, and related fields. It provides students with a profound understanding of genetic principles, laying the groundwork for more complex topics such as molecular genetics, genomics, and biotechnology.

e. Course Learning Objective:

CLOBJ 1	Understand the Fundamentals of Mendelian Genetics.
CLOBJ 2	Explore Molecular Basis of Inheritance.
CLOBJ 3	Examine Genetic Variation and Population Genetics.

f. Course Learning Outcomes:

CLO 1	Describe physical concepts behind the organic reactions.
CLO 2	Describe the foundation on the understanding of biological principles
CLO 3	Discuss the understanding of life processes - survival and maintenance.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit 1 Introduction to Genetics Mendelism, Mendel and his experiments, Law of segregation, Law of Enable Ginger Cannot connect to Ginger Check your internet connection or reload the browser Disable in this text field Edit in Ginger Edit in Ginger, independent assortment, Application of laws of probability (product rule, sum rule), Chromosomal basis of segregation and independent assortment.	22%	12
2	UNIT 2 Extensions of Mendelism, Allelic variation and gene function- Dominance relationships, basis of dominant and recessive mutations, Multiple allelism, allelic series, Testing gene	28%	18

	mutations for allelism: complementation test, intragenic complementation, Visible, sterile and lethal mutations, Genotype to phenotype: effect of the environment on phenotype development- Penetrance and expressivity, phenocopy, Gene interactions and modifying genes, Pleiotropy.		
3	UNIT 3 Sex-linked inheritance, Linkage and crossing over, Genetic recombination and construction of genetic maps in Drosophila, Interference and coincidence, Cytological demonstration of crossing over in Drosophila, Mitotic recombination, Intragenic recombination.	25%	15
4	UNIT 4 Inheritance of quantitative traits, Continuous and discontinuous variation, Polygenic inheritance, Genetic variance, heritability (narrow sense and broad sense), Cytoplasmic inheritance, maternal effects, inheritance due to parasites and symbionts.	25%	15
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice A. Fischer, and Leroy Hood
2. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons
3. "Genetics: A Conceptual Approach" by Benjamin A. Pierce
4. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick
5. "Genetics: Analysis and Principles" by Robert J. Brooker

a. Course Name: Cell Biology

b. Course Code: 11218102

c. Prerequisite: Foundation in introductory biology is essential as it familiarizes students with basic cellular structures, functions, and processes

d. Rationale: Cell Biology is integral to comprehending life at its fundamental level, exploring the structure and function of cells—the basic units of life.

e. Course Learning Objective:

CLOBJ 1	Understand the Fundamentals of Cell Structure and Function.
CLOBJ 2	Explore Cellular Processes and Signalling.
CLOBJ 3	Investigate Genetic Regulation in the Cell.

f. Course Learning Outcomes:

CLO 1	Explain the skill in the applications of the genetic principles in day-to-day life.
CLO 2	Elaborate the science of genetics.
CLO 3	Illustrate the basics of cell and its components.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
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1	UNIT 1 Plasma Membrane: Fluid mosaic model, structure of membrane, transport across membrane and mechanisms of endocytosis and exocytosis, Endomembrane system, General organization of protein transport within and outside the cell, Protein sorting and secretion, Mechanism of intracellular digestion.	28%	18
2	UNIT 2 Cytoskeleton, Microfilaments: Structural organization, cell motility and cell shape, Microtubule: Structural and functional organization, cilia, flagella, centriole, Intermediate filaments, Mitochondria, Ultrastructure, Chemiosmotic theory and respiratory chain complexes.	22%	12
3	UNIT 3 Structure and function of peroxisome, Structure and biosynthesis of ribosome, Cell cycle and its regulation, Cell-Cell Interaction, Cell adhesion molecules, Cellular junctions, Extracellular matrix.	24%	14
4	UNIT 4 Signal transduction, Intracellular receptor and cell surface receptors, signalling via G-protein linked receptors (PKA, PKC, CaM kinase), Enzyme linked receptor signalling (Growth factor receptor signalling; JACK-STAT pathway), Network and cross-talk between different signal mechanisms, Programmed cell death.	26%	16
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter
2. "Cell Biology: A Short Course" by Stephen R. Bolsover, Jeremy S. Hyams, Elizabeth A. Shephard, and Hugh A. White
3. "Essential Cell Biology" by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter

a. **Course Name:** Molecular Genetics

b. **Course Code:** 11218103

c. **Prerequisite:** Foundation in basic biology, including cell biology and genetics

d. **Rationale:** Unravelling the intricate details of genetic information flow and regulation at the molecular level.

e. **Course Learning Objective:**

CLOBJ 1	Understand the Molecular Basis of Genetic Information.
CLOBJ 2	Explore DNA Replication, Transcription, and Translation.

f. **Course Learning Outcomes:**

CLO 1	Explain the functions of the cell.
CLO 2	Discuss about genes at molecular level

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1 An overview of molecules involved in the flow of genetic information; Double helical structure of DNA, Alternate forms of DNA double helix, Denaturation and renaturation	25%	15

	of DNA, DNA binding proteins, factors affecting DNA stability. Types and structure of RNA, RNA-DNA hybrid helices.		
2	UNIT 2 Genome Replication: Experimental proof of the Watson–Crick scheme for DNA replication, The Messelson-Stahl Experiment, The topological problems, Mechanisms of replication in prokaryotes and eukaryotes, DNA polymerases and topoisomerases, Regulation of eukaryotic replication, DNA modification systems, DNA repair systems	25%	15
3	UNIT 3 Transcription Machinery: Prokaryotic RNA polymerases, Promoter, Initiation and termination, Eukaryotic RNA polymerases, transcription factors and promoters. Posttranscriptional processing of RNA, 5' capping 3' polyadenylation, splicing, RNA editing. Genetic Code: General features of the genetic code. Degeneracy and universality of genetic code. Translation Machinery: RNA, prokaryotic and eukaryotic ribosomes, Activation of amino acids, Initiation, elongation and termination of polypeptide chains, Inhibitors of protein synthesis, post-translation modifications., Structure of proteins.	28%	18
4	UNIT 4 Regulation of transcription initiation, operon and regulon, positive and negative regulation, enhancers and promoters Attenuation and antiterminations, post transcriptional regulation, alternate splicing, Gene silencing, Transport and targeting of RNA, Regulation of translation.	22%	12
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Genes XI" by Benjamin Lewin
2. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell,

Alexander Gann, Michael Levine, and Richard Losick

3. "Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice A. Fischer, and Leroy Hood
4. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons
5. "Genetics: Analysis and Principles" by Robert J. Brooker

[5]

a. Course Name: Lab-1 Genetics

b. Course Code: 11218106

c. Prerequisite: Proficiency in fundamental biology concepts

d. Rationale: Through hands-on experiments, students gain proficiency in techniques such as DNA isolation, PCR amplification, and gel electrophoresis, enhancing their ability to conduct genetic analyses and experiments in diverse scientific settings

e. Course Learning Objective:

CLOBJ 1	Develop Basic Laboratory Skills in Genetics.
CLOBJ 2	Apply Mendelian Genetics in Practical Settings.
CLOBJ 3	Explore Molecular Techniques in Genetic Analysis.
CLOBJ 4	Investigate Genetic Variation and Population Genetics.

f. Course Learning Outcomes:

CLO 1	Achievement of Lab Techniques Competency
CLO 2	Application of Mendelian Principles
CLO 3	Data Interpretation and Presentation
CLO 4	Development of Critical Thinking Skills

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme		
L	T	P	C	Internal Evaluation	ESE	Total

				Theory	CE	P	Theory	P	
-	-	6	3	-	-	40	-	60	100

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	ABO –typing
2	Rh (D) typing
3	ABH Secretor status
4	Colour Blindness
5	Phenyl Thio Carbamide (PTC)
6	Finger ball patterns
7	Palmar patterns
8	Spotters – Eukaryotic Cell Organelle-Membrane, Nucleus, Nucleolus, Mitochondria, Endoplasmic Reticulum, Golgi apparatus, Chloroplasts, Ribosomes.
9	Mitotic Chromosomes in Onion Root Tips
10	Meiotic Chromosomes in Onion Flowers

i. Text Book and Reference Book:

1. "Experiments in Molecular Genetics" by Jeffrey H. Miller, Sue Jinks-Robertson, and William Jack Bean
2. "A Guide to Methods in the Biomedical Sciences" by Ronald B. Corley
3. "Laboratory DNA Science" by Elizabeth L. Rafferty and Richard R. Rafferty
4. "Essentials of Genetics Laboratory Manual" by M. Anne Clark and Bruce A. Korf
5. "Experiments in the Genetics of Microorganisms" by James W. Wilson and John H. Hildebrand

a. Course Name: Lab-2 Cell Biology

b. Course Code: 11218107

c. Prerequisite: Proficiency in foundational biology and biochemistry concepts

d. Rationale: This hands-on experience enhances comprehension of cell biology concepts, allowing students to directly observe and analyse cellular phenomena

e. Course Learning Objective:

CLOBJ 1	Develop Proficiency in Microscopy and Imaging Techniques.
CLOBJ 2	Investigate Cellular Processes through Experimental Approaches.
CLOBJ 3	Apply Molecular Biology Techniques to Cell Biology Investigations.
CLOBJ 4	Cultivate Skills in Cell Culture and Tissue Analysis.

f. Course Learning Outcomes:

CLO 1	Mastery of Microscopy Techniques
CLO 2	Effective Experimental Design and Execution
CLO 3	Proficient Molecular Biology Skills
CLO 4	Enhanced Collaborative and Communication Skills

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	6	3	-	-	40	-	60	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	Isolation of DNA from peripheral blood
2	Isolation of DNA from Leaf
3	Isolation of DNA from Tissue
4	Isolation of RNA from Lymphocytes
5	Quantification of Genomic DNA
6	Quality check of Genomic DNA
7	Red Cell Enzyme estimations
8	Plasma Protein estimations
9	Estimation of cholesterol
10	Estimation of urea
11	Paper chromatography for separation of carbohydrates
12	Paper chromatography for separation of Amino Acids

i. Text Book and Reference Book:

1. "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
2. "Current Protocols in Cell Biology"
3. "Cell Biology Protocols" edited by Julio E. Celis
4. "Advanced Methods in Cell Biology" edited by Enrique Cadenas and Lester Packer

Elective Subjects

[7]

a. Course Name: Medical Biochemistry

b. Course Code: 11218180

c. Prerequisite: Proficiency in topics such as enzyme kinetics, metabolism, and molecular biology ensures students can delve into the complex biochemical mechanisms underlying medical processes

d. Rationale: By exploring the intricacies of biomolecules and metabolic pathways, students gain insights that are directly applicable to clinical scenarios, fostering a deep understanding of disease mechanisms

e. Course Learning Objective:

CLOBJ 1	Understand the Molecular Basis of Biomolecules.
CLOBJ 2	Explore Metabolic Pathways and Regulation.
CLOBJ 3	Investigate Enzyme Kinetics and Catalysis

f. Course Learning Outcomes:

CLO 1	Elaborate the DNA, RNA and their replication, mutations, DNA repair mechanism.
CLO 2	Explain in detail genetics and relate modern DNA technology for disease diagnostics
CLO 3	Elaborate the structural elements of proteins, the basic features of enzyme

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1 Carbohydrates: Mucopolysaccharides and related disorders, Glycolysis, Krebs cycle Gluconeogenesis, Glycogenesis and glycogenolysis, Disorders of glycogen metabolism- Galactosemia. Lipids: Fatty acids: synthesis and oxidation of fatty acids, Ketogenesis, Metabolism of cholesterol, Lipoproteins:	25%	15

	role in lipid transport and storage Prostaglandins: structure and function. Familial Hypercholesteremia.		
2	UNIT 2 Amino acids and peptides Essential and non-essential amino acids, Amino acids related disorders small peptides and their biomedical importance. Proteins: Structure-conformation-function relationship (exemplified by Myoglobin, Haemoglobin, and Collagen) Protein degradation, Enzymes: General properties, Enzyme inhibition, Mechanism of action and Regulation of enzyme activity. Phenylketonuria, Alkaptonuria.	26%	16
3	UNIT 3 Bioenergetics: Second law of thermodynamics, High energy compounds and Oxidative Phosphorylation. Hormones: Characteristics, Mechanism of action of peptide and steroid hormones, Hormone receptors and diseases. Vitamins: water and lipid soluble- their structure and function.	25%	15
4	UNIT 4 Nucleic Acids: structure and conformations, Nucleotide Metabolism, Synthesis and degradation of pyrimidine and purine nucleotides and Disorders of nucleotide metabolism	24%	14
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Harper's Illustrated Biochemistry" by Victor W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, and P. Anthony Weil
2. "Lippincott Illustrated Reviews: Biochemistry" by Denise R. Ferrier
3. "Marks' Basic Medical Biochemistry" by Michael A. Lieberman and Allan D. Marks
4. "Medical Biochemistry" by John W. Baynes and Marek H. Dominiczak
5. "Textbook of Medical Biochemistry" by Vasudevan, Sreekumari, and Kannan Vaidyanathan

a. **Course Name:** Biodiversity

b. **Course Code:** 11218181

c. **Prerequisite:** Foundational understanding of ecological principles, taxonomy, and evolutionary processes that form the basis for studying biodiversity patterns and dynamics.

d. **Rationale:** Effective conservation strategies and sustainable ecosystem management, addressing critical global challenges related to biodiversity loss.

e. **Course Learning Objective:**

CLOBJ 1	Understand the Concept and Importance of Biodiversity.
CLOBJ 2	Explore the Taxonomy and Classification of Living Organisms.
CLOBJ 3	Investigate Biotic and Abiotic Factors Influencing Biodiversity.
CLOBJ 4	Examine Conservation Strategies and Ethics.

f. **Course Learning Outcomes:**

CLO 1	Comprehensive Understanding of Biodiversity Concepts
CLO 2	Proficiency in Taxonomy and Classification
CLO 3	Application of Conservation Principles
CLO 4	Competency in Biodiversity Research Techniques

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1 Biodiversity: Concept, definition, species diversity, ecosystem diversity, genetic diversity, Magnitude of biodiversity, distribution of biodiversity, assessment of biodiversity, utilization of biodiversity, conservation of biodiversity, Biodiversity and major biomes of world Biogeography: Specific flora and fauna	25%	15
2	UNIT 2 Population dynamics: a) Population density and relative abundance b) Population age distribution c) Growth forms and carrying capacity d) Population structure: isolation and territoriality e) Interactions The species and individual in the ecosystem a) Habitat and niche b) Ecological equivalence c) Biological clock d) Basic behavioural patterns	25%	15
3	UNIT 3 Biodiversity and major biomes of world Biogeography: Specific flora and fauna Conservation of Biodiversity a) Importance b) Conservation strategies ±in situ and ex situ methods ±advantages, limitations and applications. Conservation laws, policies and organizations	23%	13
4	UNIT 4 Basic concept of Taxonomy: Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature. Taxonomy in relation to Chromosomal morphology and Evolution ± Chromosomal evolution, why location of genes matter, evolutionary oddities about chromosomes, evolutionary effect of rearrangements of chromosomes, karyotypic orthoselection, chromosomal evolution and speciation.	27%	17

	Molecular Taxonomy in relation to DNA characteristics and Protein sequences.		
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Biodiversity: An Introduction" by Kevin J. Gaston and John I. Spicer
2. "Biodiversity" by Edward O. Wilson and Frances M. Peter
3. "Biology of Biodiversity" by Maheshwari Nath
4. "Principles of Conservation Biology" by Martha J. Groom, Gary K. Meffe, and C. Ronald Carroll

Semester 2

[1]

a. Course Name: Seminar

b. Course Code: 11203161

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	2	-	2	-	20	-	-	30	50

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

For Seminar/Presentation: There will be a seminar/presentation of maximum 50 marks. It will be evaluated on the basis of the literature surveyed on assigned topics, presentation and viva.

[2]

a. Course Name: Population Genetics and Biostatistics

b. Course Code: 11218251

c. Prerequisite: Understanding of genetic principles and evolutionary processes to explore the genetic variation within populations.

d. Rationale: Gain the skills to assess genetic diversity, infer evolutionary patterns, and contribute to research in fields such as evolutionary biology, conservation genetics, and personalized medicine.

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Population Genetics
CLOBJ 2	Explore Genetic Variation in Populations.
CLOBJ 3	Investigate Evolutionary Processes.

f. Course Learning Outcomes:

CLO 1	Define the metabolic processes by which energy is produced in cells
CLO 2	Describe the roles of vitamins in metabolic processes and enzyme activity.
CLO 3	Illustrate the significance of biostatistical concepts in genetics.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1 Mendelian Population and scope of population genetics. Gene and genotype frequencies, mating patterns, Hardy-Weinberg	30%	18

	principle, heterozygotes, extension of H-W principle to multiple alleles, sex-linked alleles. Non-random mating, inbreeding and assortative mating, inbreeding coefficient. Factors that change allelic frequencies.		
2	UNIT 2 Genetic polymorphism, transient and stable and factors responsible stable polymorphism. DNA markers and populations differences. Application of population genetics. Role of population genetics in genetics counselling. Genetics origin and evolution of human races. Genetic Demography, age and gender specific death and birth rates, intrinsic rate of natural increase. Index of opportunity for natural selection.	30%	18
3	Unit 3 Importance of population studies, sampling techniques, classification of data and tabulation. Measures of central tendency- mean, median and mode. Measures of dispersion - variance and standard deviation.	25%	14
4	UNIT 4 Probability – laws of probability for independent events – permutations and combinations – conditional probability. Binomial distribution. Tests of significance – chi square test and ‘t’ test.	15%	10
	TOTAL	100%	60

i. Text Book and Reference Book:

1. The Genetics of Human Populations by LL Cavalli-Sforza and WF Bodmer Freeman and Company, 1971.
2. Population Genetics Theory by James F. Crow and W. Kimura, Harper and Row, 1970.
3. Principles of Population Genetics" by Daniel L. Hartl and Andrew G. Clark
4. Biostatistics: A Methodology for the Health Sciences" by Gerald Van Belle, Lloyd D. Fisher, Patrick J. Heagerty, and Thomas Lumley
5. Introduction to Biostatistics" by Robert R. Sokal and F. James Rohlf

a. **Course Name:** Genomics and Proteomics

b. **Course Code:** 11218252

c. **Prerequisite:** Understanding of DNA structure, gene expression, and protein synthesis to engage effectively with the genomic and proteomic principles covered in the course.

d. **Rationale:** To understand the interplay between genes and proteins, unravelling the molecular basis of cellular processes and contributing to advancements in fields such as medicine, agriculture, and biotechnology.

e. **Course Learning Objective:**

CLOBJ 1	Understand the Principles of Genomics and Proteomics.
CLOBJ 2	Explore Genome Sequencing Technologies.
CLOBJ 3	Investigate Functional Genomics and Proteomics.

f. **Course Learning Outcomes:**

CLO 1	Imparts the knowledge of basic statistical methods to solve problems
CLO 2	Explain the importance of statistics in research
CLO 3	Build a practical skill of functional genomics and proteomics

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
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1	Unit-1 Introduction to genomics, genetic mapping of human chromosomes, mapping of genetic disease locus to chromosome location, multi-locus mapping of human chromosome, physical mapping of human genome, cloning human disease genes, human genome project.	30%	18
2	Unit-2 DNA sequencing, bio chips, DNA micro arrays, gene annotation, gene structure predictions, gene ontology consortium recommendations, structural and functional genomics.	25%	14
3	Unit-3 Protein structure and its determination, structural hierarchy, domains, folds, motifs. Secondary structure prediction methods, fold recognition and abinitio structure prediction, homology comparative modelling of proteins	30%	18
4	Unit-4 Protein chip arrays, functional proteomics, docking, rational drug design.	15%	10
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Genomics: A Very Short Introduction" by John M. Archibald
2. "Genomics and Personalized Medicine: What Everyone Needs to Know" by Michael Snyder
3. "Genomics: The Science and Technology Behind the Human Genome Project" by Charles R. Cantor and Cassandra L. Smith
4. "Principles of Proteomics" by Richard Twyman
5. "Introduction to Proteomics: Principles and Applications" by Randy W. J. Purves
6. "Proteomics: From Protein Sequence to Function" by B. Daniel Hames and David W. Blackstock

a. **Course Name:** Human Cytogenetics

b. **Course Code:** 11218254

c. **Prerequisite:** Understanding of basic genetic principles, including chromosome structure, inheritance patterns, and molecular genetics, as a basis for exploring chromosomal abnormalities in human genetics.

d. **Rationale:** diagnosis of genetic disorders by examining chromosomal abnormalities. Understanding the principles and techniques involved in analysing human chromosomes equips students with the skills needed for genetic counselling, clinical diagnostics, and contributing to advancements in medical genetics.

e. **Course Learning Objective:**

CLOBJ 1	Understand the Fundamentals of Cytogenetics.
CLOBJ 2	Explore Chromosomal Aberrations and Genetic Disorders
CLOBJ 3	Investigate Molecular Techniques in Cytogenetics

f. **Course Learning Outcomes:**

CLO 1	Compare the plenty of techniques which used in functional genomics
CLO 2	Discuss radically advance our understanding of life and transform medicine
CLO 3	Explain the mechanism of determining sex of an individual

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit-1 History and development of Human Cytogenetics. Different conferences and chromosomal nomenclature. Setting up of cultures, harvesting and making chromosomes – Karyotyping. Chromosomes in mitosis and meiosis and interphase. Non-disjunction.	15%	9
2	Unit-2 Chromosomal abnormalities – Numerical and structural leading to syndromes – Monosomy, trisomy, triploidy, tetraploidy, Turner, Klinefelter, Down, Edwards, Patau, cri-du-chat, Females with multiple X chromosomes and males with XYY chromosomes. Gonadal dysgenesis, true hermaphrodites, testicular feminization, chromosomes in malignancies and spontaneous abortions. Fragile X syndrome, genetics of fragile X syndrome, molecular biology of fragile X chromosome.	30%	18
3	Unit-3 Scope of Medical Genetics. Skin- Ichthyosis, baldness, psoriasis, hereditary Hemorrhagic telangiectasia, epiloia, multiple neurofibromatosis, the porphyrias, blooms syndrome. The skeletal system – Marfan's syndrome, Nail patella syndrome, Brachydactyly, syndactyly, Polydactyly, Spina bifida and anencephaly, Ankylosing spondylitis, Rheumatoid arthritis, Osteogenesis imperfecta. Muscle – Muscular dystrophies, Myotonia.	30%	18
4	Unit-4 Eye – Glaucoma, ptosis, squint, nystagmus, cataract, retinoblastoma. Jaws – Hare lip and palate. Ears - Deafness. Alimentary system – Hypertrophic pyloric stenosis, gastric and duodenal ulcers, peptic ulcers, cirrhosis of liver. Respiratory system – Cystic fibrosis.	25%	15

	Cardio vascular system – congenital heart disease, coronary heart diseases and Hypertension Central nervous system – The ataxias and familial spastic paraplegia. Kidney and urinogenital tract – Cystinosis, polycystic kidney disease. Endocrine system – Cretinism, goiter, diabetes.		
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Human Cytogenetics: Constitutional Analysis" by Steven Gersen and Martha B. Keagle
2. "Chromosome Abnormalities and Genetic Counseling" by R.J. McKinlay Gardner, Grant R. Sutherland, and Lisa G. Shaffer
3. "Clinical Cytogenetics: Exam Review" by Lyn S. Chitty and John R. Williamson

[5]

a. Course Name: Lab-1 Population Genetics

b. Course Code: 11218256

c. Prerequisite: Understanding of genetic principles, Hardy-Weinberg equilibrium, and basic population genetic calculations

d. Rationale: Through hands-on experiments, students gain valuable experience in collecting and analysing genetic data, reinforcing theoretical knowledge and enhancing skills essential for research in evolutionary biology and genetics.

e. Course Learning Objective:

CLOBJ 1	Apply Population Genetics Principles in a Laboratory Setting
CLOBJ 2	Utilize Molecular Techniques for Population Genetic Analysis
CLOBJ 3	Investigate Genetic Diversity and Structure
CLOBJ 4	Analyse and Interpret Population Genetic Data

f. Course Learning Outcomes:

CLO 1	Application of Population Genetics Principles
CLO 2	Proficiency in Molecular Techniques
CLO 3	Effective Analysis and Interpretation of Data
CLO 4	Enhanced Collaborative and Communication Skills

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	6	3	-	-	40	-	60	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	Chromosome Nomenclature
2	Karyotyping
3	Metaphase drawing
4	Drumstick and Barr body identification
5	Demonstration of Human blood lymphocyte culture:
6	Washing and sterilization of glassware
7	Medium preparation
8	Setting up of lymphocyte culture
9	Harvesting and slide preparations
10	Identification of individual chromosomes
11	Preparation of G-banded chromosomes

i. Text Book and Reference Book:

1. "Population Genetics: A Laboratory Manual" by Jonathan L. Witz
2. "Laboratory Manual for Population Genetics" by Jeffrey K. Conner and Daniel L. Hartl
3. "Exercises in Population Genetics" by Jonathan L. Witz and Jonathan B. Losos

- a. **Course Name:** Lab-2 Genetic Engineering
- b. **Course Code:** 11218257
- c. **Prerequisite:** Understanding of DNA structure, gene expression, and recombinant DNA technologies
- d. **Rationale:** Through hands-on experiments, students gain practical experience in gene cloning, DNA editing, and genetic modification, preparing them for roles in biotechnology, pharmaceuticals, and genetic research
- e. **Course Learning Objective:**

CLOBJ 1	Apply Genetic Engineering Techniques in Laboratory Experiments
CLOBJ 2	Utilize Molecular Tools for Genetic Modification
CLOBJ 3	Investigate the Application of Genetic Engineering in Biotechnology
CLOBJ 4	Analyse and Interpret Genetic Engineering Data.

- f. **Course Learning Outcomes:**

CLO 1	Effective Application of Population Genetics and Genetic Engineering Techniques
CLO 2	Proficiency in Molecular Techniques for Genetic Analysis
CLO 3	Comprehensive Analysis and Interpretation of Genetic Data
CLO 4	Enhanced Collaborative and Communication Skills in Laboratory Settings

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	6	3	-	-	40	-	60	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	Preparation of Plasmids
2	Restriction digestion and mapping
3	Ligation of DNA fragments
4	Transformation
5	Bacterial cultures
6	Construction of cDNA libraries
7	Purification and identification of clones
8	Expression of cloned genes
9	Construction of genomic libraries
10	Purification and identification of recombinant plasmid DNA
11	Blotting Techniques: a) Southern b) Western c) Northern
12	Primer designing
13	DNA Finger printing – RFLPs
14	Amplification and purification of DNA fragments

i. Text Book and Reference Book:

1. "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
2. "Genomes" by T.A. Brown
3. "Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard Twyman
4. "Introduction to Genetic Analysis" by Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, and John Doebley

Elective Subjects

[7]

- a. Course Name:** DNA Technology and Genetic Engineering
- b. Course Code:** 11218282
- c. Prerequisite:** Understanding of DNA structure, replication, and gene expression to engage effectively with advanced techniques in genetic engineering.

d. Rationale: Gain insights into designing and manipulating genetic material for applications such as gene therapy, genetically modified organisms, and the production of therapeutic proteins, contributing to advancements in these fields.

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of DNA Technology
CLOBJ 2	Explore Recombinant DNA Technology
CLOBJ 3	Apply Molecular Tools in Genetic Engineering

f. Course Learning Outcomes:

CLO 1	Discuss the Structure of Human Chromosomes and related conditions.
CLO 2	Illustrate the chromosomal theory of inheritance
CLO 3	Compare different RDNA technology techniques and their application

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit-1 Enzymes used in DNA technology, Restriction and modification enzymes, other nucleases, Polymerases, Ligase, kinases and phosphatases Nucleic acids, Isolation and purification of DNA (genomic and plasmid) and RNA,	25%	15

	Gel electrophoresis of nucleic acids (denaturing and native), Pulse-field gel electrophoresis of DNA.		
2	Unit-2 Cloning vectors, Plasmids, Phages, Cosmids, Artificial chromosomes, Shuttle vectors, Expression vectors Cloning techniques, Construction of genomic and cDNA libraries, Positional cloning: RFLP mapping, chromosome walking and jumping, Screening and characterization of clones, Preparation of probes, Restriction mapping, Principles of hybridizations and hybridization based techniques (colony, plaque, Southern, Northern and in situ hybridizations), Expression based screening, Interaction based screening: yeast two-hybrid system	26%	16
3	Unit-3 S1 nuclease and RNase mapping, DNA sequencing, Oligonucleotide synthesis, Polymerase Chain Reaction and its applications, Microarray technology, ELISA, western and south-western blotting, Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility shift assay, DNA footprinting, DNA fingerprinting, Mutagenesis, Site directed mutagenesis, Transposon mutagenesis, Construction of knock-out mutants.	25%	15
4	Unit-4 Gene transfer techniques, Electroporation and microinjection, Transfection of cells: Principles and methods, Germ line transformation in Drosophila and transgenic mice: Strategies and methods. Applications of Recombinant DNA Technology, Crop and live-stock improvement, Molecular genetic analysis of human diseases, Gene therapy: somatic and germ line gene therapy, DNA drugs and vaccines, Biosafety and ethical considerations	24%	14
	TOTAL	100%	60

i. Text Book and Reference Book:

1. Ausubel et al Short Protocols in Molecular Biology Wiley 2002
2. Brown Essential Molecular Biology vol. I AP 2000
3. Brown Essential Molecular Biology vol. II AP 2000
4. Brown Gene Cloning - An Introduction Stanley Thomas 1995
5. Glick & Pasternak Molecular Biotechnology ASM Press 1998
6. Kracher Molecular Biology - A Practical Approach
7. Krenzer& Massey Recombinant DNA and Biotechnology ASM 2000
8. Micklos & Freyer DNA Science CSHL 1990
9. Primrose Molecular Biotechnology Panima 2001
10. Reischel Molecular Diagnosis of Infectious Diseases Humana 1998
11. Robertson et al Manipulation & Expression of Recombinant DNA AP 1997
12. Sambrook et al Molecular Cloning Vol. 1, 2, 3 CSHL 2001
13. Twyman Advanced Molecular Biology Viva 1999

[8]

- a. **Course Name:** Protein purification Techniques
- b. **Course Code:** 11218283
- c. **Prerequisite:** Understanding of protein structure, function, and basic biochemical principles
- d. **Rationale:** Applications in biomedicine, pharmaceuticals, and biotechnology, where purified proteins are utilized in drug development, diagnostics, and various industrial processes
- e. **Course Learning Objective:**

CLOBJ 1	Understand the Principles of Protein Purification
CLOBJ 2	Explore Various Protein Separation Techniques
CLOBJ 3	Apply Chromatographic Methods for Protein Purification
CLOBJ 4	Investigate Electrophoretic Techniques in Protein Purification

- f. **Course Learning Outcomes:**

CLO 1	Comprehensive Understanding of Protein Purification Principles
CLO 2	Proficiency in Chromatographic Protein Purification
CLO 3	Effective Application of Electrophoretic Techniques
CLO 4	Optimization and Troubleshooting Skills

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit 1 History of Proteins, Protein Purification and Characterization, Protein Sequencing, Proteins of Recombinant DNA Technology	25%	15
2	Unit 2 Posttranslational Modifications, tags, Immunological Probes, Chemical Modifications, Principles and Standard Conditions for Purification Techniques, Ion exchange (IEX), Hydrophobic interaction (HIC), Affinity (AC), Gel filtration (GF), Reversed phase (RPC), Expanded bed adsorption (EBA)	25%	15
3	Unit 3 Protein Structure XRay NMR EM, Evolution of Structural Motifs, Structural Motifs SCOP, Protein Interactions and Directed Evolution	23%	13
4	Unit 4	27%	17

	Overview of Computational Chemistry, Introduction to Omics, Overview of Proteins in Infectious Diseases, Overview of Drug Targets, Recent Large EM Structures		
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Protein Purification: Principles, High Resolution Methods, and Applications" by Jan-Christer Janson
2. "Protein Purification: Principles and Practice" by Robert K. Scopes
3. "Protein Purification Protocols" by Paul Cutler
4. "Protein Chromatography: Methods and Protocols" edited by Dermot
5. "Protein Purification Techniques: A Practical Approach" edited by Simon
6. "Handbook of Affinity Chromatography" edited by Toni
7. "Biochemical Methods" by S. Sadasivam and A. Manickam

Semester 3

[1]

a. Course Name: Seminar

b. Course Code: 11203207

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	2	-	2	-	20	-	-	30	50

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

For Seminar/Presentation: There will be a seminar/presentation of maximum 50 marks. It will be evaluated on the basis of the literature surveyed on assigned topics, presentation and viva.

[2]

a. Course Name: Biochemical and Immunogenetics

b. Course Code: 11218201

c. Prerequisite: Understanding of genetic principles and immune system function to explore the biochemical basis of genetic variations and immune responses.

d. Rationale: Gaining insights into the molecular mechanisms underlying genetic diseases and immune-related disorders.

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Biochemical Genetics
CLOBJ 2	Explore Immunogenetics Concepts
CLOBJ 3	Apply Molecular Techniques in Biochemical and Immunogenetics

f. Course Learning Outcomes:

CLO 1	Explain in detail about the plasmids, vectors and construction of cDNA libraries
CLO 2	Describe gene manipulation, gene expression in the area of genetic engineering
CLO 3	Build knowledge about cells and organs of immune system

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1	35%	20

	The concept of Biochemical polymorphism, enzyme and protein polymorphisms – Haemoglobin, Acid Phosphatase and Haptoglobin. Metabolic disorders, Phenylketonuria, Hypercholesteremia, Lasch Nyhan Syndrome, Orotic aciduria, muko polysaccharides, DNA studies of PKU and Hemoglobinopathies.		
2	Unit 2 Immune responses – innate immune system and adaptive immune system. Immunoglobulins. The major histocompatibility complex – HLA and Complement system. Human blood group systems. Immunodeficiency diseases – autoimmunity and acquired immunodeficiencies. DNA level studies in HLA systems.	35%	20
3	UNIT 3 Genetics in drug metabolism. Genetic Variations revealed solely by the drug – succinyl choline sensitivity. Hereditary disorders with altered drug responses – G-6-PD deficiency.	20%	15
4	UNIT 4 Eco genetics – alpha -1- antitrypsin.	10%	5
	TOTAL	100%	60

i. Text Book and Reference Book:

1. Principles of Human Biochemical Genetics by H. Harris
2. Human Genetics by A.G. Motulsky and F. Vogel
3. The metabolic basis of inherited diseases By Scriver et al.
4. Medical Genetics by Lynn B. Jorde et al

[3]

a. Course Name: Bioinformatics

b. Course Code: 11218202

c. Prerequisite: Foundation in DNA, RNA, protein structure, and genetic principles

d. Rationale: Gain skills to extract meaningful patterns and insights from genomic, proteomic, and other biological data, contributing to advancements in understanding complex biological processes and systems.

e. Course Learning Objective:

CLOBJ 1	Understand the Fundamentals of Bioinformatics
CLOBJ 2	Explore Bioinformatics Databases and Resources
CLOBJ 3	Gain Proficiency in Sequence Analysis.

f. Course Learning Outcomes:

CLO 1	Understand various immunological methods, immunogenetics.
CLO 2	Explain concept of tumour immunology and immunopathology
CLO 3	Elaborate all concepts in bioinformatics

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT 1 Basics of computers (CPU, I / O units) and operating systems. Introduction and scope of Bioinformatics. Computer networking, Internet and e-mail, concept of home pages and websites, www, uniform resource locations	25%	15

2	UNIT 2 Archiving and retrieval of information- search engines, data bases, Medline, NCBI, nucleic acid sequences, genomes, protein sequence and structures, Bibliographic	25%	15
3	UNIT 3 Access to molecular biology data bases: Entrez, Sequence Retrieval System (SRS), protein identification resources (PIR), sequence alignments and phylogenetic trees. Micro arrays and genome wide expression analysis. Pharmacogenomic, patenting, Intellectual property rights and bioinformatics patents.	30%	18
4	UNIT 4 Human Genome Project: Goals of HGP, the human genetic material, benefits from HGP, Ethical, legal and social implications of HGP. Sequence of Human Genome. Bioethics and Genetics.	20%	12
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount
2. "Bioinformatics: Sequence and Structural Analysis" by U. Ranganathan
3. "Bioinformatics For Dummies" by Jean-Michel Claverie and Cedric Notredame
4. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner
5. "Essential Bioinformatics" by Jin Xiong

[4]

a. Course Name: Clinical Genetics and Genetic Toxicology

b. Course Code: 11218203

c. Prerequisite: Understanding of genetic principles, DNA structure, and molecular processes

d. Rationale: Learn to apply genetic knowledge in clinical settings, contributing to the diagnosis, prevention, and management of genetic disorders, as well as evaluating genetic risks associated with environmental exposures

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Clinical Genetics
CLOBJ 2	Explore Molecular Basis of Genetic Diseases

f. Course Learning Outcomes:

CLO 1	Discuss basic principles of biology, computer science and mathematics
CLO 2	Illustrate the basics of sequence alignment and analysis

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit-1 Scope of clinical genetics; Monogenic diseases- Cystic fibrosis, Tay-Sachs syndrome, Marfan syndrome; Polygenic diseases- Hyperlipidaemia, Diabetes mellitus, Atherosclerosis; Inborn errors of metabolism and their genetic bases- Phenylketonuria, Maple syrup urine syndrome, Mucopolysaccharidosis, Galactosemia.	30%	18
2	Unit-2	25%	14

	Neurogenetic disorders- Major regions of human brain and nerve conduction, Charcot-Marie-Tooth syndrome, spinal muscular atrophy; Syndromes due to triplet nucleotide expansion -Alzheimer's disease; Genetic disorders of Haemopoietic systems- Sickle cell anaemia, Thalassemia, Haemophilia.		
3	Unit-3 Origin of genetic toxicology; historical prospective of genetic toxicology; fundamentals of genetic toxicity; mechanism of induction of chromosomal alterations and sister chromatid exchanges; mutagens-chemical, physical, biological, environmental and food; antimutagens.	30%	18
4	Unit-4 Mechanisms of gene mutations; germinal mutations and human genetic diseases; mutations and cancers; genetic toxicology and congenital malformations; consequences of genotoxic effects in humans.	15%	10
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "Emery's Elements of Medical Genetics" by Peter D. Turnpenny and Sian Ellard
2. "Clinical Genetics Handbook" by Maren T. Scheuner and Bettina Meiser
3. "Genetics in Medicine" by James S. Thompson and Margaret W. Thompson
4. "Clinical Genomics: Practical Applications in Adult Patient Care" by Michael Murray and Elizabeth B. Bhoj
5. "Genetic Counseling: A Guide for the Practicing Physician" by Thomas D. Nettleton
6. "Introduction to Genetic Toxicology" by Michael D. Waters and Sonia L. Maginn
7. "Genetic Toxicology Testing: A Laboratory Manual" by Michael D. Waters
8. "Genotoxicity Assessment: Methods and Protocols" edited by Bhaskar Gollapudi and P. K. Sen
9. "Genetic Toxicology and Cancer Risk Assessment" by Robert H. Heflich and Robert L. Tice

10. "Principles of Toxicology: Environmental and Industrial Applications" by Stephen M. Roberts and Robert C. James

[5]

- a. **Course Name:** Lab-1 Immunogenetics
- b. **Course Code:** 11218204
- c. **Prerequisite:** Understanding of immune system function, genetic principles, and molecular biology
- d. **Rationale:** Through hands-on experiments, students gain valuable experience in analysing immune system components at the genetic level, contributing to a deeper understanding of the molecular basis of immune responses
- e. **Course Learning Objective:**

CLOBJ 1	Apply Molecular Techniques in Immunogenetics Analysis
CLOBJ 2	Utilize Immunological Assays for Genotyping
CLOBJ 3	Investigate Immunogenetic Factors in Disease Susceptibility.
CLOBJ 4	Analyse Immunogenetic Data and Interpret Genotype-Phenotype Relationships

- f. **Course Learning Outcomes:**

CLO 1	Application of Molecular Techniques in Immunogenetics
CLO 2	Proficiency in Immunological Assays for Genotyping
CLO 3	Investigation of Immunogenetic Factors in Disease Susceptibility
CLO 4	Effective Analysis and Interpretation of Immunogenetic Data

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	

-	-	6	3	-	-	40	-	60	100
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L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	Sickling Test
2	Separation of abnormal haemoglobins
3	Estimation of Hb F
4	Estimation of Hb A2
5	Red Cell Enzymes – ACP, ESD, and GLO1
6	Plasma proteins – HP, CP, ALB and TF
7	ELISA Test
8	Radial immunodiffusion
9	Quantitative precipitin Assay
10	Immuno-electrophoresis
11	Animal Tissue culture procedure and Types

i. Text Book and Reference Book:

1. "Kuby Immunology" by Judy Owen, Jenni Punt, and Sharon Stranford
2. "Essential Immunology" by Ivan M. Roitt, Peter J. Delves, and Seamus J. Martin
3. "Immunobiology: The Immune System in Health and Disease" by Charles Janeway, Paul Travers, Mark Walport, and Mark Shlomchik
4. "Genetics of the Immune Response" by Henry O. McDevitt and Francesco Cambiaggi

[6]

- a. Course Name:** Lab-2 (Bioinformatics)
- b. Course Code:** 11218206
- c. Prerequisite:** Foundational understanding of bioinformatics algorithms, data analysis methods, and programming skills
- d. Rationale:** Through hands-on experiments, students gain practical experience in utilizing bioinformatics tools for tasks such as genomic data analysis, functional annotation, and pathway analysis, contributing to advancements in various biological research areas.

e. Course Learning Objective:

CLOBJ 1	Apply Bioinformatics Tools for Sequence Analysis
CLOBJ 2	Utilize Databases for Biological Data Retrieval
CLOBJ 3	Investigate Structural Bioinformatics Techniques
CLOBJ 4	Analyse and Interpret Genomic and Proteomic Data

f. Course Learning Outcomes:

CLO 1	Application of Bioinformatics Tools in Sequence Analysis
CLO 2	Effective Utilization of Bioinformatics Databases
CLO 3	Exploration of Structural Bioinformatics Techniques
CLO 4	Comprehensive Analysis and Interpretation of Genomic and Proteomic Data

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	-	6	3	-	-	40	-	60	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Experiment List:

Exp. No.	Name of the Experiment
1	Literature search from NCBI.
2	Working with Genome Databases
3	Working with Protein Databases
4	Similarity search using BLAST
5	Working with Bioinformatics tools
6	Rasmol
7	SwissPDB

8	Hex
9	Clustal X\W
10	Construction of Phytogenic Trees

i. Text Book and Reference Book:

1. "Bioinformatics: Sequence, Structure, and Databanks" by Des Higgins and Willie Taylor
2. "Biological Data Mining" by Jake Y. Chen and Stefano Lonardi
3. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner
4. "Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R" by R  bbe W  nschiers

Elective Subjects

[7]

a. Course Name: Somatic Cell and Cancer Genetics

b. Course Code: 11218284

c. Prerequisite: Understanding of genetic principles, cell cycle regulation, and molecular processes

d. Rationale: Gaining insights into the genetic mechanisms underlying cancer development and progression

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Somatic Cell Genetics
CLOBJ 2	Explore the Genetic Basis of Cancer.
CLOBJ 3	Apply Molecular Techniques in Cancer Genetics
CLOBJ 4	Investigate Somatic Mutation and Genomic Instability

f. Course Learning Outcomes:

CLO 1	Enlist the structure and function of genes and the organization of the human genome
CLO 2	Describe genetic toxicology, genetic damages, genotoxic agents, the biological mechanisms
CLO 3	Compare the types of cancer and their causes
CLO 4	Explain the Concept of therapeutic intervention in controlling cancer

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit-1 Somatic cell genetics: Cell cultures, somatic cell hybridization, making cell lines with different chromosomes, use of somatic cell hybrids in gene mapping. Other methods of transfer of genetic information. Complementation, mutations in cell cultures, studies of differentiated cell functions.	30%	20
2	Unit-2 Cancer Genetics: Characteristics of cancer cells, Chromosomes in neoplasia, cancer as a genetic disorder, cancer in families, loss of cell cycle control. Inherited versus sporadic cancers.	25%	13

3	Unit-3 Molecular changes in proto-oncogenes, tumour suppressor genes-Knudson's Hypothesis, Retinoblastoma, Lung cancer, Colon cancer, Brain cancer, Breast cancer, Prostrate cancer, cervical and oesophageal cancers. Cancer and environment: physical, chemical and biological carcinogens.	30%	20
4	Unit-4 Cancer prevention, Diet – cancer associations, diagnosis and treatment	15%	7
	TOTAL	100%	60

i. Text Book and Reference Book:

1. "The Biology of Cancer" by Robert A. Weinberg
2. "Genes IX" by Benjamin Lewin
3. "Cancer Genetics" by Suzanne M. McMahon and Shirley V. Hodgson
4. "Somatic Genome Variation in Human Cancers" by Nicholas E. Navin
5. "Cancer: Principles & Practice of Oncology" edited by Vincent T. DeVita Jr., Theodore S. Lawrence, and Steven A. Rosenberg

[8]

a. Course Name: Clinical Biochemistry

b. Course Code: 11218285

c. Prerequisite: Understanding of biochemical pathways, enzymology, and physiological processes

d. Rationale: Contribute to the diagnosis and monitoring of diseases. This knowledge is essential for healthcare professionals to make informed decisions regarding patient care and treatment.

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Clinical Biochemistry
CLOBJ 2	Explore Biomarkers and Diagnostic Tests
CLOBJ 3	Apply Laboratory Techniques in Clinical Biochemistry
CLOBJ 4	Investigate Metabolic Disorders

f. Course Learning Outcomes:

CLO 1	Comprehensive Understanding of Clinical Biochemistry Principles
CLO 2	Exploration of Biomarkers and Diagnostic Tests
CLO 3	Proficiency in Laboratory Techniques for Clinical Analysis
CLO 4	Analysis of Molecular Techniques in Clinical Biochemistry

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit 1: In born error metabolism: of protein, Amino acid, nucleic acid. Occurrence, pattern of inheritance, disorders of amino acids metabolism- phenyl ketonuria, Maple syrup, urine disease, cystinosis etc.	25%	15
2	Unit 2: Disorders of carbohydrates and lipid metabolism: Porphyrrias and Gout Molecular disease Sick cell	25%	15

	anaemia and thalassemia, adenosine deaminase deficiency, systemic lupus erythematosus Liver and kidney tests- their significance		
3	Unit 3: Endocrine disorders: Pancreatic, Diabetes mellitus, militaria, hypoglycaemia, glucose tolerance test, thyroid - hypo and -hyper, parathyroids, parathyroid- abnormalities of parathyroid functions	23%	13
4	Unit-4: Blood related disorders: Abnormal haemoglobin and hemoglobinopathies, anaemias, polycythaemia, erythraemia, eosinophilia, schistosomiasis, leukopenia, leukaemia, haemophilia, thrombocytopenia, thromboembolic conditions.	27%	17
	TOTAL	100%	60

i. Text Book and Reference Book:

1. Clinical Biochemistry: Metabolic and clinical aspects William J. Marshall and Stephen K. Bengert
2. Clinical Biochemistry: An illustrated text Allan Gaw et. al.
3. Clinical Biochemistry Nanda Maheshwari
4. Practical clinical Biochemistry Ranjana Chawala
5. Clinical Biochemistry R. Luxton
6. Clinical Biochemistry Nessar Ahmad

Semester 4

[1]

a. Course Name: Dissertation Work

b. Course Code: 11203219

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme		
L	T	P	C	Internal Evaluation	ESE	Total

				Theory	CE	P	Theory	P	
-	-	10	20	-	-	100	-	200	300

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

[2]

- a. Course Name:** Developmental and Behavioural Genetics
- b. Course Code:** 11218258
- c. Prerequisite:** Understanding of genetic principles, inheritance patterns, and molecular biology
- d. Rationale:** Deeper understanding of the interplay between genetic variations and environmental factors in shaping complex behaviours
- e. Course Learning Objective:**

CLOBJ 1	Understand the Principles of Developmental Genetics
CLOBJ 2	Explore the Genetic Basis of Behaviour
CLOBJ 3	Apply Genetic and Genomic Techniques in Developmental Biology
CLOBJ 4	Investigate Gene-Environment Interactions in Behaviour
CLOBJ 5	Analyse Neurogenetics and Brain Development
CLOBJ 6	Integrate Developmental and Behavioural Genetics in Research Design

- f. Course Learning Outcomes:**

CLO 1	Discuss phases of cell cycle and mechanisms involved in apoptosis.
CLO 2	Compare therapeutics of cancer as well
CLO 3	Explain the basic principles of genetics can be used in the study of behaviour.
CLO 4	Evaluate the extent to which human individual differences are influenced by genes
CLO 5	Consider the implications of genetic knowledge in expression of genotype

CLO 6	Design different study for environmental effect on genotype -phenotype interaction
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures, T- Tutorial, P- Practical, C- Credit, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Unit-1 Genetics of embryonic development; basic concepts in development, animal models in human development. Major processes in embryonic development- pattern formation, axis specification and organogenesis.	35%	20
2	Unit-2 Genomic imprinting; transgenic animals; later phases of embryonic development; phenocopies and malformations; the development of structure and birth defects in humans; sex differentiation and its errors.	35%	20
3	Unit-3 Scope and importance of behavioural genetics; animal models; behavioural genetic experiments in the mouse.	20%	15
4	Unit-4 Genetics of human behaviour; chromosomes and mental retardation; chromosomes and antisocial behaviour and	10%	5

	aggressiveness; genetics and alcoholism; genetics of psychiatric disorders- Schizophrenia; ethnic differences in IQ tests; twins in behaviour genetic research; behavioural genetics and affective disorders.		
	TOTAL	100%	60

i. Text Book and Reference Book:

1. Human Genetics: Vogel and Motulsky
2. Basic Human Genetics: Mange and Mange
3. Genetic studies in Affective Disorders: DP Papolos and HM Lachman
4. Medical Genetics: Jorde et al

[3]

a. Course Name: Seminar Work

b. Course Code: 11218259

c. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				Theory	CE	P	Theory	P	
-	2	-	2	-	20	20	-	60	100

L- Lectures, **T-** Tutorial, **P-** Practical, **C-** Credit, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

For Seminar/Presentation: There will be a seminar/presentation of maximum 100 marks. It will be evaluated on the basis of the literature surveyed on assigned topics, presentation and viva.