UNIVERSITY OF KALYANI

Credit Based Postgraduate Course

in

GENOME SCIENCE

Syllabus

(2024 Onwards)

Semester I:

Course Code	Course Name	Credits	Weekly hours	Marks (Exam + Internal assessment)
Theoretical				
GS COR101	Biomolecules and Enzymology	4	3+1+0	50 (40+10)
GS COR102	Cell Biology and Bioenergetics	4	3+1+0	50 (40+10)
GS COR103	Genetics	4	3+1+0	50 (40+10)
GS COR104	Methods in Biology	4	3+1+0	50 (40+10)
GS COR105	Programming and Bioinformatics	4	3+1+0	50 (40+10)
GS AECC106	Biostatistics	2	2+1+0	25 (20+5)
Practical				
GS COR 111	Instrumentation Lab	2	0+0+2	25 (20+5)
GS COR112	Molecular Biology Lab	4	0+0+3	50 (40+10)
GS COR113	Programming and Bioinformatics Lab	2	0+0+2	25 (20+5)
Total Credits				**30**

Semester II:

Course Code	Course Name	Credits	Weekly hours	Marks (Exam + Internal assessment)
Theoretical				
GS GEC 201*	Fundamentals of Genome Science (Open Choice - CBCS Course)	4	3+1+0	50 (40+10)
GS COR 202	Molecular Biology and Genetic Engineering	4	3+1+0	50 (40+10)
GS COR 203	Ecology and Evolution	4	3+1+0	50 (40+10)
GS COR 204	Computational Biology	4	3+1+0	50 (40+10)
GS DSE 205	**<u>One elective offered by the Department</u>** I. Molecular Phylogeny II. Comparative Genomics III. Biomedical Genomics	4	3+1+0	50 (40+10)
Practical				
GS COR 211	Advanced Molecular Biology Lab	4	0+0+4	50 (40+10)
GS COR 212	Biochemistry Lab	4	0+0+3	50 (40+10)
GS COR 213	Computational Biology Lab	2	0+0+3	25 (20+5)
Total Credits				**30**

***Selection of course type and corresponding credits should be transferred from any other Department during 2nd semester examination.**

Semester III:

Course Code	Course Name	Credits	Weekly hours	Marks (Exam + Internal assessment)
Theoretical				
GS COR 301	Animal Genomics	4	3+1+0	50 (40+10)
GS COR 302	Plant Genomics	4	3+1+0	50 (40+10)
GS COR 303	Research Methodology	4	3+1+0	50 (40+10)
GS COR 304	Bio-entrepreneurship, IPR and Bioethics	4	3+1+0	50 (40+10)
GS SEC 305	Immunological techniques	2	2+1+0	25 (20+5)
GS SEC 306	**<u>One elective offered by the Department</u>** I. Personalized Medicine in Genomics II. Nanotechnology in Genomics III. Radiation Biology in Genomics	2	2+1+0	25 (20+5)
Practical				
GS COR 311	Review Writing	6	0+0+4	75 (50+25)
GS COR 312	Teaching Methodology	4	0+0+4	50
Total Credits				**30**

Semester IV:

Course Code	Course Name	Credits	Weekly hours	Marks (Exam + Internal assessment)
Practical				
GS DSE 411	Dissertation (Final)	12	NA	150
GS DSE 412	Seminar	10	NA	125
GS DSE 413	Grand viva	8	NA	100
Total Credits				**30**

Semester wise Credit Distribution:

Semester I + Semester II + Semester III + Semester IV = 30+30+30+30 = **120**

Semester wise Marks Distribution:

Semester I + Semester II + Semester III + Semester IV = 375 + 375 + 375 + 375 = **1500**

COR: Core Courses
AECC: Ability Enhancement Compulsory Courses
GEC: Generic Elective Courses
SEC: Skill Enhancement Courses
DSE: Discipline Specific Elective

SEMESTER - I

Course Code: GS COR101

Course Name: Biomolecules and Enzymology

Total Credits: 4 **Marks: 50**

MODULE I

Nucleic acid: Chemistry of nucleic acid (DNA, RNA), chemistry of nucleosides and nucleotides, A, B, and Z forms of DNA, super coiling of DNA, denaturation and renaturation kinetics, nucleotide sequence composition: unique, middle and highly repetitive DNA.

Protein: Amino acid, categorization, primary, secondary and tertiary structure of protein, protein folding.

Carbohydrates: Structures and biological functions of mono and polysaccharides.

Lipids: Fatty acids, fats and oils, phospholipids, sphingolipids, glycolipids, cholesterol, gangliosides, lipoproteins, rancidity, acid value, saponification value, Iodine number, acetyl number, R.M. number.

MODULE II

Enzymology basics: Classification, properties, Enzyme units, turnover of enzymes, different models, metallo-enzymes and metal activated enzymes, coenzymes, factors affecting catalytic efficiency of enzymes.

Enzyme functionality: Michaelis-Menten equation, activators, inhibitors, allosteric and feedback inhibition, competitive, non-competitive, un-competitive and mixed type inhibition.

SEMESTER - I

Course Code: GS COR102

Course Name: Cell Biology and Bioenergetics

Total Credits: 4 **Marks: 50**

MODULE I

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, electrical properties of membranes.

Cell cycle: Steps in cell cycle, regulation and control of cell cycle.

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two- component systems, bacterial chemotaxis and quorum sensing.

Cellular communication Regulation of hematopoiesis: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, metastasis, apoptosis.

MODULE II

Bioenergetics: Thermodynamic principles; free energy; energy rich bonds- phosphoryl group transfer and ATP; redox potentials and Biological redox reactions.

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways.

Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

SEMESTER - I

Course Code: GS COR103

Course Name: Genetics and Molecular Biology

Total Credits: 4 **Marks: 50**

MODULE I

Mendelian Inheritance: Meiosis; Chromosome theory of inheritance; Mendelian laws; Gene interactions.

Non-Mendelian Inheritance: Organelle heredity; Infectious heredity; Maternal effects.

Population Genetics: Hardy-Weinberg principle; gene frequency in a population, genetic equilibrium, factors affecting gene frequency.

Microbial Genetics: Transformation, conjugation and transduction and their significance in gene mapping.

Chromosome: Structure and nomenclature, centromere and telomere, chromosomal aberrations.

Special Chromosomes: Lampbrush, Polytene and B-chromosome.

MODULE II

Sex Determination: Sex determination; dosage compensation; sex linked inheritance.

Linkage and Crossing Over: Chiasma frequency and genetic map distance; Tetrad analysis; Centromere mapping with ordered tetrad.

Transposable Elements: In bacteria (IS elements, composite transposons), maize (Ac and Ds elements), *Drosophila* (P-elements) and their genetic significance.

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Recombination: Homologous and non-homologous recombination.

SEMESTER - I

Course Code: GS COR104

Course Name: Methods in Biology

Total Credits: 4 **Marks: 50**

MODULE I

X-ray crystallography: Basic concepts and principles of X-ray diffraction, Bragg's law; **Spectroscopy:** UV-Visible, fluorescence; Nuclear Magnetic Resonance (NMR), AAS, CD spectroscopy.

Microscopy: Bright field, phase contrast, fluorescence and confocal microscopy, SEM, TEM, AFM.

Sequencing techniques: Sanger sequencing, Maxam-Gilbert sequencing, NGS.

MODULE II

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, EEG, stimulation of brain.

Biomedical imaging: CAT, PET, MRI.

SEMESTER - I

Course Code: GS COR105

Course Name: Programming and Bioinformatics

Total Credits: 4 **Marks: 50**

MODULE I

Biological databases: NCBI-GenBank, UniProt, DDBJ, EMBL, PDB; NCBI different modules: ORF-finder, Taxonomy browser, BOLD, PubMed.

Sequence analysis: Introduction to sequence analysis, local and global alignment, pairwise and multiple alignment, Substitution Matrix (introduction: PAM, BLOSUM), BLAST, FASTA.

MODULE II

Structure-Prediction of Biomolecules with applications in Bioinformatics: Structure classification of proteins (SCOP, CATH).

Patterns, motifs and Profiles in sequences: Derived Databases of patterns, motifs and profiles e.g. Prosite, Blocks, Prints-S, Pfam.

Overview of tertiary structure prediction methods: Protein structure prediction by comparative modeling approaches (homology modeling and fold recognition); ab-initio structure prediction methods, etc.

SEMESTER - I

Course Code: GS AECC106

Course Name: Biostatistics

Total Credits: 2 **Marks: 25**

Basic terminologies and definition: Variability, range, mean, mode, mean deviation, standard deviation, variance, central moments, coefficient of quartile deviation, coefficient of variation, coefficient of dispersion.

Hypothesis: Definition, importance, types.

Tests: Parametric and non-parametric statistics.

SEMESTER - I

Course Code: GS COR111

Course Name: Instrumentation Lab

Total Credits: 2 **Marks: 25**

1. UV-Visible Spectrophotometer
2. Fluorometer
3. NMR
4. Powder XRD
5. Gel electrophoresis
6. Gel documentation system
7. SEM
8. Bright Field microscope
9. Fluorescence microscope
10. Confocal microscope

SEMESTER - I

Course Code: GS COR112

Course Name: Molecular Biology Lab

Total Credits: 4 **Marks: 50**

1. Isolation of DNA from plant tissue
2. Isolation of DNA from bacteria
3. Isolation of DNA from animal cell
4. Agarose gel electrophoresis
5. Quantitative & qualitative analysis of nucleic acid
6. Introduction to microbial culture
7. Introduction to fungal culture
8. Introduction to animal cell culture
9. Introduction to plant tissue culture
10. Primer designing

SEMESTER - I

Course Code: GS COR113

Course Name: Programming and Bioinformatics Lab

Total Credits: 2 **Marks: 25**

1. Introduction to C and MS Excel.
2. Primer designing: Primer3, Oligocalc.
3. Sequence alignment using BLAST
4. Handling of Databases: NCBI, BOLD etc.
5. Raw Sequence: Reading & Editing
6. Sequence submission in NCBI-GenBank/BOLD
7. Basic phylogenetic analysis: Distance Based methods and Character Based methods
8. Advanced phylogenetic analysis, Molecular Clock
9. Structure-Prediction of Biomolecules with applications in Bioinformatics
10. Structural validation

SEMESTER - II

Course Code: GS GEC 201

Course Name: Fundamentals of Genome Science

(Open Choice - CBCS Course)

Total Credits: 4 **Marks: 50**

MODULE I

Biomolecules: Chemistry of carbohydrates, Lipids, Amino Acids and Nucleic acids.

Detection Techniques: Electrophoresis, X-ray crystallography, UV-Visible spectroscopy, fluorescence spectroscopy, light, fluorescence, confocal microscopy, SEM, TEM.

MODULE II

Basic concept of genetics: Mendelian and Non-Mendelian inheritance, pedigree, chromosomal aberrations.

Biostatistics: Statistics of dispersion, hypothesis, non-parametric statistics.

Applications of genome science: Identification of human biomarkers using genomics, principles of inheritance and working with family-based genetic disorders genomics in child development, concept of pharmacogenomics, genetic counseling.

SEMESTER - II

Course Code: GS COR 202

Course Name: Molecular Biology and Genetic Engineering

Total Credits: 4 **Marks: 50**

MODULE I

Central Dogma in molecular Biology: DNA Replication; Transcription; Translation in prokaryotes and eukaryotes, Concept of genetic code

Genetic Regulation: Regulation of gene expression in prokaryotes and their viruses – lac, trp and ara operons of *E. coil*, Lambda lytic-lysogenic regulatory cascade; regulation of eukaryotic gene expression – brief account.

MODULE II

Gene Cloning: Restriction endonuclease, DNA modifying enzymes, Different types of vectors for Cloning (plasmid, phasmid, cosmid, bacterial artificial chromosome, yeast artificial chromosome, mammalian artificial chromosome); PCR; Different modified PCR; quantitative PCR.

Different types of cloning and expression techniques in prokaryotic and Eukaryotic model cell system: Restriction cloning, TOPO TA cloning, PCR product cloning, and GATEWAY cloning technology; Construction and screening of genomic and cDNA library.

***In vitro* mutagenesis and deletion techniques:** Gene knock out in bacterial and eukaryotic organisms.

Markers for mapping: RFLP, RAPD, AFLP, SNP, SSR

SEMESTER - II

Course Code: GS COR 203

Course Name: Ecology and Evolution

Total Credits: 4 **Marks: 50**

MODULE I

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, age structured populations.

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

MODULE II

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism**.**

Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale

Speciation: Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

SEMESTER - II

Course Code: GS COR 204

Course Name: Computational Biology

Total Credits: 4 **Marks: 50**

MODULE I

Introduction to various databases: genome browsers & associated tools: ENSEMBL, GeneCards, UCSC Genome Browser and their application.

Overview of various genome scale projects: Human genome project, HapMap project, 1000 genome projects, Expressed sequence Tag (EST) project; ethical, legal, and social implications addressed by the Human Genome Project.

Handling of NGS data: Overview of different NGS data formats, Sequencing machine to raw sequence, Initial QC (e.g. Phred Score), Alignment, Post alignment processing, Depth and Coverage, Variant Calling, Annotation, data visualization (in IGV).

MODULE II

Molecular Dynamics Simulation: molecular dynamics simulations (e.g. GROMACS); Energy minimization techniques.

Structure comparison using database formalisms (DALI, VAST).

Drug designing: Classification of drug targets, characterization of drugs, Target discovery and validation methodologies, Structure based drug design methods including computer-aided drug design (pharmacophore development) and recent technology developments; Target selection, Ligand (lead compound) design,optimization and analysis.

Molecular Docking: protein-protein, protein-ligand docking, scoring methods.

SEMESTER - II

Course Code: GS DSE 205

Course Name: Elective - Molecular Phylogeny

Total Credits: 4 **Marks: 50**

MODULE I

Distance Based methods: clustering based methods, optimality-based methods: Fitch-Margoliash and Minimum evolution methods, Neighbor joining and related neighbor methods.

Character Based methods: Maximum parsimony methods, Maximum likelihood method

Phylogenetic trees and other models; optimality criteria for selecting phylogenetic hypothesis

Phylogenetic tree evaluation: Bootstrap analysis, Interior branch testing.

MODULE II

Fossils & Molecular clock

Haplotype analysis: estimation of population structure, molecular diversity indices, mismatch distribution

Analyses of molecular variance (AMOVA); Migration analysis;

Phylogenetic dating: ρ-statistic; Bayesian analysis: Markov Chain Monte Carlo.

SEMESTER - II

Course Code: GS DSE 205

Course Name: Elective - Comparative Genomics

Total Credits: 4 **Marks: 50**

MODULE I

Organization and structure of genomes - size, complexity, gene-complexity, virus and bacterial genomes, organelle genome, architecture of mitochondrial genome, conserved chloroplast DNA; organization and nature of nuclear DNA in eukaryotes; transposable elements, retro-teaspoons, SINE, LINE, Alu and other repeat elements, pseudogenes, segmental duplication

MODULE II

Comparative genomics - orthologs and paralogs, protein evolution by exon shuffling; human genome project, comparative genomics of bacteria, organelles, and eukaryotes

Large scale mutagenesis and interference - genome wide gene targeting; systematic approach, random mutagenesis, insertional mutagenesis, libraries of knock-down phenocopies created by RNA interference; transcriptome analysis, DNA micro-array profiling, data processing and presentation

Expression profiling, proteomics - expression analysis, protein-protein interaction.

SEMESTER - II

Course Code: GS DSE 205

Course Name: Elective - Biomedical Genomics

Total Credits: 4 **Marks: 50**

MODULE I

Human Genome: Human Genome Project, ENCODE, Human Genome Organization, Genome analysis.

Genome based diagnostics: Genome wide association studies (GWAS) for identifying disease associated genes, single cell genomics, recurrent and rare cancer associated aberrations, microsatellite markers, DNA fingerprinting, DNA in forensics and medico-legal applications, SNPs, translocations, pedigree analysis, DNA specific identification.

Genome editing: Applications of CRISPR/Cas9 in cancer and genetic diseases, Applications of microarrays and NGS for studying human genetic diseases and cancer, Identifying gene fusions using RNA sequencing, recent research.

MODULE II

Models of diseases and cancer: Cancer cell lines, Patient derived xenografts (PDXs), transgenic mouse models for human diseases, examples of disease-specific mouse models, such as such as huntington's or alzheimer's disease, validation of disease-associatedgenes using *in vitro* and *in vivo* models by pharmacological inhibition, personalised/precision medicine

Molecular therapeutics: Principle, types and applications of gene therapy, genome based medicine, positional cloning for identifying disease genes, ethics in gene therapy, drug resistance mechanism(s)-targeted therapy using proteo-genomic analysis using pdx or other *in vivo* models.

Stem cells therapy: Stems cells for regenerative medicine, disease modeling, drug discovery and gene-correction, induced pluripotent stem cells for personalized medicine/therapy, tissue engineering.

SEMESTER - II

Course Code: GS COR211

Course Name: Advanced Molecular Biology Lab

Total Credits: 4 **Marks: 50**

1. Isolation of RNA from plant tissue
2. Construction of cDNA
3. Polymerase chain reaction
4. Elution of PCR product
5. Gene expression analysis through qRT-PCR
6. Gene Cloning
7. Analysis of protein by SDS-PAGE

SEMESTER - II

Course Code: GS COR212

Course Name: Biochemistry Lab

Total Credits: 4 **Marks: 50**

1. Quantitative analysis of amino acids
2. Protein estimation by Lowry
3. Total sugar estimation by phenol-sulphuric acid reagent method
4. Estimation of reducing sugar
5. pH metric titration of glycine for determination of pI
6. Ascorbic acid estimation from lemon juice
7. Chromatography techniques

SEMESTER - II

Course Code: GS COR213

Course Name: Computational Biology Lab

Total Credits: 4 **Marks: 50**

1. Introduction to Linux and common terminal commands
2. Information visualization using R
3. Acquisition and analysis of NGS data
4. Visualization of NGS data
5. Structural and functional annotation of variants
6. Pathway analysis
7. Molecular Modeling
8. Molecular Dynamic Simulation
9. Drug designing

SEMESTER - III

Course Code: GS COR301

Course Name: Animal Genomics

Total Credits: 4 **Marks: 50**

MODULE I

Basics of genomics and proteomics: Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast.

Genome sequencing projects: Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web.

MODULE II

Comparative genomics: Identification and classification of organisms using molecular markers 16S rRNA typing/sequencing, SNPs; use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs; determining gene location in genome sequence.

Functional genomics: Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in genome, gene function forward and reverse genetics, gene ethics; protein protein and protein DNA interactions.

SEMESTER - III

Course Code: GS COR302

Course Name: Plant Genomics

Total Credits: 4 **Marks: 50**

MODULE I

Introduction and concepts on Genomics : History and development in genomics, DNA, chromosomes, and genome.

Molecular markers: Molecular marker technologies, RFLP, RAPD, AFLP, SNP, SSR.

Forward genetics: Gene mapping, QTL mapping, Genome wide association studies.

Gene based cloning: Fine mapping, Positional gene cloning.

Review on Genome science: Sequencing technologies, Sanger and Illumina sequencing, Genome library and sequencing.

MODULE II

Genome science project: Genome annotation, Major plant genome

Reverse genetics: Concepts in functional genomics and reverse genetics, Mutation and gene silencing, RNAi Gene silencing.

Gene expression: Quantitative polymerase chain reaction, Plant transcription and Expression profiling, RNA sequencing

Gene editing: Introduction, concepts and uses, Plant transformation, Genetically modified (GM) crops, Genome editing tools, CRISPR-cas9 technology.

Application of plant genomics: Plant improvement using genomics tool, Recent research and advances in plant genomics.

SEMESTER - III

Course Code: GS COR303

Course Name: Research Methodology

Total Credits: 4 **Marks: 50**

MODULE I

Foundations of basic research: Meaning, objectives, motivation, concept, construct, definition, variable.

Problem identification and formulation: Research question, investigation question, measurement issues, hypothesis, qualities of a good hypothesis.

Variables: Concept of independent and dependent variables.

MODULE II

Qualitative and Quantitative Research: Qualitative research, quantitative research, nominal, ordinal, interval, ratio.

Research paper: Research Paper, types, stages of preparation, structures footnotes, bibliography, impact factor, i-10 index, H-index, journal selection technique, steps for publishing an article in a peer-reviewed journal.

SEMESTER - III

Course Code: GS COR304

Course Name: Bio-entrepreneurship, IPR and Bioethics

Total Credits: 4 **Marks: 50**

MODULE I

Bioethics: Introduction to ethics and bioethics, the responsible conduct of biotechnological research; research with human subjects; social commitment of a biotechnologist; Ethical legal and social issues (ELSI) in biotechnology.

Intellectual Property Rights (IPR): Patents and protection, Jurisprudential definition and concept of property rights, duties and their correlations, history and evaluation of IPR, distinction among the various forms of IPR, requirements of a patentable invention like novelty, inventive step and prior art and state of the art procedure, contents of patent specification and procedure for patents: a) obtaining patents, b) geographical indication c) WTO. Detailed information on patenting biological products.

MODULE II

Biosafety regulatory framework: The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national & international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, levels of safety, cooperational guidelines – WHO, guidelines of DBT (India), ICMR guidelines, Guidelines for an informed consent.

Entrepreneurship: Role of entrepreneurship in economic development, factors affecting entrepreneurial growth, developing and evaluating opportunities, developing start-up strategies, measuring market opportunities, role of knowledge centres.

SEMESTER - III

Course Code: GS SEC305

Course Name: Immunological techniques

Total Credits: 2 **Marks: 25**

Background: Basics of immunity, antigen-antibody reaction, isolation of immune cells, culture of immune cells.

Detection techniques: Surface marker detection and isolation of immune cells using MACS, FACS, antigen-antibody reaction study using RIA, ELISA, Western blot, visualization of Immune reaction using immunofluorescence, FISH, GISH, immunohistochemistry.

SEMESTER - III

Course Code: GS SEC306

Course Name: Elective - Personalized Medicine in Genomics

Total Credits: 2 **Marks: 25**

Clinical practice: Concept, personalized medicine approach for prescribing anti-psychotics, anti-depressants, anti-epileptics, anti-diabetics, cardiovascular drugs, NSAIDs, analgesic drugs, hypnotics, anxiolytics drugs, gastrointestinal drugs, immuno-suppressants, genetic counseling.

Commercial and regulatory aspects: Ethical issues of personal genetic information/ individualized medicine, economics of pharmacogenomics testing in clinical practice, regulatory guidelines involving pharmacogenomics, intellectual property and commercial aspects of pharmacogenomics.

SEMESTER - III

Course Code: GS SEC306

Course Name: Elective - Nanotechnology in Genomics

Total Credits: 2 **Marks: 25**

Background: Definition, features, types, synthesis and detection.

Applications in genomics: Nanomaterials interaction with proteins and nucleic acids, nanomaterials and devices currently used in diagnosis, nanomaterials and devices currently used in gene therapy.

SEMESTER - III

Course Code: GS SEC306

Course Name: Elective - Radiation Biology in Genomics

Total Credits: 2 **Marks: 25**

Radiation biology basics and definition: Elementary process involving in radiation and free particles, exposure dose, absorbed dose.

Effect of radiation: Effectiveness of different radiation LET, RBE, effect of radiation on whole organism, on cells, biomolecules, factors that modulate radiation response (temperature, oxygen effect, LET cell age, cell cycle, role of radiation protector and sensitizers), bystander effect, radiation protection, tumor radio therapy.

SEMESTER - III

Course Code: GS COR311

Course Name: Review Writing

Total Credits: 6 **Marks: 75**

A review is to be prepared on frontiers in Genome Science and the students need to give a presentation.

SEMESTER - III

Course Code: GS COR312

Course Name: Teaching Methodology

Total Credits: 4 **Marks: 50**

A class to be taken on a subject area of Genome Science of student's choice. Students need to give a presentation while taking the class.

SEMESTER - IV

Course Code: GS DSE 411

Course Name: Dissertation (Final)

Total Credits: 12 **Marks: 150**

Each student will undertake a major research project.

SEMESTER - IV

Course Code: GS DSE 412

Course Name: Seminar

Total Credits: 10 **Marks: 125**

Each student will be asked to deliver a seminar on the major research project undertaken.

SEMESTER - IV

Course Code: GS DSE 413

Course Name: Grand viva

Total Credits: 8 **Marks: 100**

Each student will face a grand viva, which will be asked from the whole MSc syllabus.