Course Title: Genomics and Proteomics  
Credits: 3

Course No: Zoo 569  
Lecture hrs: 48

Nature of the Course: Theory  
Full Marks: 75

Pass Marks: 37.5

Course Objectives
- To impart advanced and innovative knowledge of present day in genomics and proteomics.
- To provide knowledge on some important techniques in genomics and proteomics.

Course Contents

A. Genomics  
24 hrs

1. **Concept:** DNA-Gene-Genome, Coining of the term genome, Coding and non-coding region of gene. Nuclear genome, Mitochondria genome, Chloroplast genome. (2)

2. **Genome compositions:** Repetitive and non-repetitive DNA, Properties of repetitive and non-repetitive DNA. (1)

3. **Genome:** Types of organisms and sizes of genomes (from viruses to human). (2)

4. **Genomics:** Basic concept of genomics and its history. (1)

5. **Human genome project:** History and significance, Highlights, Merits and demerits. (1)

6. **Types of genomics based on evolution:** Prokaryotic and Eukaryotic genomics. (2)

7. **Types of genomics based on organisms:** Human genomics, Animal Genomics, Plant Genomics, and Microbial Genomics. (2)

8. **Classification of genomics:** Functional genomics, Structural genomics, Comparative genomics, Biochemical genomics, Evolutionary genomics, Phylogenomics, Physiological genomics, Epigenomics, Metagenomics, Conservation genomics. (2)

9. **Genome Studying and Mapping** Studying DNA, Enzyme for DNA manipulation, DNA cloning, the Polymerase Chain Reaction (PCR), Genetic and physical Mappings. (2)

10. **Genome analysis: and evolution:** 1. Sequencing and its types. 2. Assembly, 3. Annotation 4. Sequencing pipelines and database. Genome evolution in the first 10 billion years, Human genome evolution in the last 5 million years. (4)

11. **Applications of genomics:** 1. Genomic medicine, 2. Synthetic biology and bioengineering 3. Convervation genomics. (1)

12. **Wildlife Genomics:** Introduction, Landscape genetics, Conservation genomics, Population genomics, Genetics for migration ecology, Disease ecology, Non-invasive and trace DNA, Population size estimates, Bottlenecks, Species identification, Individualization, Conservation and small
population management, Bar coding of important species, Molecular kinship reconstruction, Genetic diversity, Assessing impacts of disease on populations. (4)

B. Proteomics  24 hrs

1. **Concept:** Central dogma: DNA-RNA-Protein interface. DNA as genotype and Protein as phenotype. Transcriptome, proteomics and “Omics” revolution. (2)

2. **Proteome Analysis:** (1) Protein-expression proteomics, (2) Structural proteomics, (3) Functional proteomics. (2)

3. **Methods of studying proteins**
   i. Protein detection with antibodies (immunoassays)
   ii. Antibody-free protein detection: Detection methods and Separation methods.
   iii. Hybrid technologies
   iv. Current research methodologies
   v. High-throughput proteomic technologies: Mass spectrometry and protein profiling, Protein chips and Reverse-phased protein microarrays

4. **Protein structure, function and folding**  (10)
   - **Basic concept:** Biochemistry of Protein: Amino acids and Khorana’s dictionary of triplets. **Protein synthesis:** Biosynthesis and chemical synthesis
   - **Protein structure:** Primary, secondary, tertiary and quaternary structures, Protein structure determination, protein sequence analysis, Computational prediction of protein structure.
   - **Protein functions:** Cellular functions, Enzymes, Cell signaling and ligand binding, Structural proteins, Hormones.
   - **Protein folding:** Process of protein folding: Primary, secondary, tertiary, and quaternary; Driving force of protein folding: Hydrophobic effect and Chaperones.
   - **Computational methods for studying protein folding:** Energy landscape of protein folding and Modeling of protein folding.
   - **Experimental techniques for studying protein folding:** X-ray crystallography, Fluorescence spectroscopy, Circular dichroism, Vibrational circular dichroism of proteins, Protein nuclear magnetic resonance spectroscopy, Dual polarisation interferometry, Studies of folding with high time resolution, Proteolysis, Optical tweezers.
   - **Incorrect protein folding and neurodegenerative disease:** Levinthal's paradox and kinetics.

5. **Applications of proteomics:** 1. Post-translational modifications: (a) Phosphorylation, (b) Ubiquitination, (c) Additional modifications, (d) Distinct proteins under distinct settings  2. Protein-protein interactions, 3. Protein expression profiling, 4. Molecular medicine: Tuber metastasis, Renal disease diagnosis, Neurology, Urological cancer research, Antibody profiling for study and treatment of disease, Nutrition research, Diabetes research, Fetal and maternal medicine. (2)

6. **Research methodology:** DNA/protein sample collection, preservation, DNA extraction, Electrophoresis, DNA/Protein Analysis, Proposal, thesis, report and scientific paper writing. (4)
Suggested Readings:


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Tribhuvan University
Institute of Science and Technology
M.Sc. Zoology (Semester System)
SEMESTER II
GENOMICS AND MOLECULAR BIOLOGY

Course Title: Bioinformatics and Molecular Systems Biology
Course No: Zoo 570
Nature of the Course: Theory

Credits: 3
Lecture hrs: 48
Full marks: 75
Pass marks: 37.5

Objectives

- To impart advanced and innovative knowledge of present day in Bioinformatics and Systems Biology.
- To provide knowledge on some important tools of Biological data analysis in Bioinformatics and Systems Biology.

Course Contents

A. Bioinformatics 24 hrs

1. **Concept:** Bioinformatics and its use in the laboratory to study genomes, transcriptomes, and Proteomes.

2. **Scoring matrices:** Introduction, The basics of scoring methods: 1. Initialization, 2. Fill or induction, 3. Track back. Types of scoring matrices, Relations between PAM and BLOSUM.

3. **National Center for Biotechnology Information Entrez (NCBI Entrez):** Introduction, Public Databases at NCBI Entrez with its various modules for searches, Ten major databases of Bioinformatics.


7. **Eavesdropping on the transmission of genetic information**: Identification of genes associated with inherited diseases, Genome-wide association studies, Genome sequence projects.


11. **Bioinformatics software and its applications**: List of bioinformatics softwares.

12. **CCG Wisconsin Package**: Wisconsin package programs.

B. **Molecular Systems Biology**

1. **Concept and history**: Molecular systems biology as a tripartite confluence of system sciences, life sciences and information sciences, Mol.systems biology as holism vs. reductionism, Systems biology and “omics” as associated studies (Genomics, functional genomics, structural genomics, proteomics, functional proteomics, proteogenomics, metagenomics, neurogenomics, personal genomics, epigenomics, lipidomics, immunoproteomics, nutriproteomics, foodomics, nutrigenomics, transcriptomics, metabolomics, metabonomics, pharmacogenomics, pharmacomicrobiomics, toxicogenomics, pycrogenomics, stem cell genomics, connectomics, microbiomics, cellomics, etc about 40.
2. **Networks for Molecular systems biology:** Networks and graphs, Connectivity in networks, Dynamics, stability and robustness, Integrative genome-scale biology, Metabolic and regulatory networks, Evolution of genomes and biological networks, Clinical and translational systems biology, Synthetic biology and genome-scale biological engineering. (5)


4. **Metabolic pathways:** Classification and Assignment of Protein function: 1. The enzyme commission, 2. The gene ontology consortium protein function classification. **Catalysis by enzymes:** Active sites and co-factors. Protein–ligand binding equilibria, Enzym kinetics, Measurement of effectiveness of enzymes. **Databases of metabolic pathways:** EcoCyc and The Kyoto encyclopedia of genes and genomes. **Evolution and phylogeny of metabolic pathways:** Pathway comparison, **Alignment of metabolic pathways:** 1. Comparing linear metabolic pathways, 2. Comparing non-linear metabolic pathways: the pentose phosphate pathway and the Calvin-Benson cycle. **Dynamics of Metabolic networks:** 1. Robustness of metabolic networks, 2. Dynamic modeling of metabolism. (6)


6. **The genetic switch of bacteriophage lamda:** 1. What are the characteristics of the switch that must be implemented by DNA-protein interactions? 2. The materials, 3. How to throw the switch. (2)

6. **The Genetic regulatory network of Saccharomyces cerevisiae:** Adaptability of the yeast regulatory Network. (1)

**Suggested Readings**


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Tribhuvan University  
Institute of Science and Technology  
M.Sc. Zoology (Semester System)  
SEMESTER II  
GENOMICS AND MOLECULAR BIOLOGY

Course Title: Related to Zoo 569 & 570  
Course No: Zoo 571  
Nature of the Course: Practical

Credits: 2  
Lecture hrs: 90

Full marks: 50  
Pass marks: 25

Course Objectives
To impart practical knowledge on topics of Zoo 569 & 570.

Course Contents
Field and Laboratory works:

Genomics and Proteomics  
Credit: 1
1. DNA extraction methods: NaI Method and Phenol Chloroform Method, Operation of PCR, gel electrophoresis, and DNA cloning  
2. Protein extraction, quantification, identification….?
3. Students will also learn how to analyze DNA and entire or section of genomes using computational biology.
4. Sequence comparison programs by the use of “Blast, GCG, MacVector or other useful programs” will also be carried out.
5. Eventually, the students will learn about the threats and issues of most endangered wild species leading to extinction and will take part in the protection and recover of these animals.

Bioinformatics and Molecular Systems Biology  
Credit: 1
1. Researching the background of the experiment: searching literature databases such as MEDLINE, or sequence databases.
2. Planning the experimental details, for example, using software to design PCR primers or identify good restriction enzymes for sub-cloning.
3. Collecting the experiment data, for example, using a computer attached to lab instrumentation.
4. Managing the experimental data, for example, assembling sequences from several DNA sequencing runs into one sequence.
5. Analyzing the experimental data, for example, analyzing the DNA sequence, identifying its function, etc.
6. Publishing the results: submitting a sequence to a sequence database, using a word processor to write a thesis or a paper.
7. Taking Homo sapiens as a model species and work on its functional genomics/proteomics or metabolic pathways to make an outcome oriented report.


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Tribhuvan University
Institute of Science and Technology
M.Sc. Zoology (Semester System)
SEMESTER III
GENOMICS AND MOLECULAR BIOLOGY

Course Title: Molecular Biochemistry
Course No: Zoo 625
Nature of the Course: Theory

Credits: 3
Lecture hrs: 48
Full marks: 75
Pass marks: 37.5

Course Objectives
- To impart advanced and innovative knowledge of present day in molecular biochemistry.
- To provide knowledge on some important techniques in molecular biochemistry.

Course Contents

1. **Basics of molecular biochemistry:** Concept and history of molecular biochemistry, Types of living cells, Marker enzymes, Metabolic functions of organelles, Shapes of some small molecules, Drawing chemical and molecular structures, 3-D molecular structure of organic compounds (Isomerism, stereoisomerism, and optical activity and resolution), Aromaticity and natural aromatics, Chemical synthesis of biological molecules (Peptide synthesis and Oligonucleotide synthesis). (6)

2. **Introduction to proteins and peptides:** The role of amino acids in the cell, structure of amino acids, Asymmetry in biochemistry, Ionic properties of amino acids, Peptide structure and peptide bond, Ionic properties of peptide, Purification of proteins and determination of relative molecular mass, Methods for the determination of the amino acid sequence of proteins, Protein structural hierarchies, Protein denaturation and renaturation, Peptides, structure and biological activities. (4)

3. **Nucleic acids and protein synthesis:** Replication, transcription, and translation, Nucleic acid structure and synthesis, Biosynthesis of Proteins (translation), Protein targeting, Protein glycosylation. (3)

4. **Protein structure and function with hemoglobin and myoglobin as examples:** The properties of proteins, The folding of globular proteins, Structure and properties of myoglobin and hemoglobin, General principles of protein folding. **Specialized functions of Proteins:** Plasma proteins, Collagen, The immune system and the immunoglobulins, Proteins of molecular motors. (4)

5. **Structure and function of enzymes:** The properties of enzymes, Enzymes kinetics, Metabolic regulation and control, Enzyme phosphorylation and dephosphorylation, Second messengers,
Allosteric properties of enzymes, Metabolic control analysis, Genetic diversity of enzymes, Coenzymes and water-soluble vitamins.

6. **Carbohydrate structures and their inter-conversions:** Monosaccharides and disaccharides, Polysaccharides, Inter-conversions of monosaccharides.

7. **Nitrogen metabolism:** Protein breakdown and excretion of nitrogen, The supply of amino acids, Catabolism of essential amino acids and the formation of adrenaline, histamine, thyroxine and serotonin, The biosynthesis and metabolism of heme and chlorophylls.

8. **Oxidative catabolism of glucose and fatty acids:** β-Oxidation and glycolysis, The citric acid cycle, The electron transport chain, Oxidative phosphorylation, Other mitochondrial topics.

9. **Carbohydrate and Lipid metabolism in the fasting and absorptive states:** Metabolism in the fasting state, Glycogen and its degradation, Gluconeogenesis, Ketone body formation and utilization, Control of the blood glucose concentration in health and disease, The process of absorption, Glycogenesis, Lipogenesis.

10. **Plasma lipoproteins, cholesterol metabolism and atherosclerosis:** Plasma lipoproteins and cholesterol metabolism, Elevated blood lipids and atherosclerosis, Metabolism of triacylglycerols.

11. **The action of hormones and other effectors in regulating glycogen and glucose metabolism, ketogenesis and lipogenesis:** Whole body interactions, The regulation of glycogen metabolism, Regulation of glycolysis and gluconeogenesis, Regulation of lipid metabolism.

12. **Phospholipids, other lipid substances and complex carbohydrates:** Phospholipids, Lipid-soluble vitamins, Other lipid compounds, complex carbohydrates.

13. **Biomembranes, receptors and signal transduction:** The basis of membrane structure, Membrane receptors, G-proteins, Cell signaling systems, Receptor traffic, The cytoskeleton, Membrane transport, Cell adhesion.

14. **Spectroscopic techniques, Mass spectrometric techniques, Chromatographic techniques:** (1) **Spectroscopic techniques:** Concept and history, Theory, Properties of electromagnetic radiation, Interaction with matters, spectrum, the types of Spectroscopy, applications. (2) **Mass spectrometric techniques:** Concept and history, Components or parts of a mass spectrometer, Creating ions, Mass selection, Analysers, Detectors, Tandem mass spectrometry, Common mass spectrometer configurations and techniques Separation techniques with Chromatography combined with mass spectrometry, Data and analysis, and applications. (3) **Chromatographic techniques:** Concept and history, Theory, Distribution coefficients, modes of chromatography, Performance of chromatography, quantification, internal and external standards, Types and applications.

**Suggested Readings**


Tribhuvan University  
**Institute of Science and Technology**  
**M.Sc. Zoology (Semester System)**  
**SEMESTER III**  
**GENOMIC S AND MOLECULAR BIOLOGY**

<table>
<thead>
<tr>
<th>Course Title: Molecular Immunology</th>
<th>Credits: 3</th>
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<td>Lecture hrs: 48</td>
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<td>Nature of the Course: Theory</td>
<td>Full marks: 75</td>
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**Course Objectives**

- To impart advanced and innovative knowledge of present day in molecular immunology.
- To provide knowledge on some important diagnostic techniques in molecular immunology.

**Course Contents**

1. **The nature of immunity:** Concept, Variolation and vaccination, Cardinal feature of immune responses (Biological recognition systems), Recognition and defence: a minimal model. Immunological recognition (T and B lymphocytes), Immunological defence, an overview of immune system, Immunopatholog. (3)

2. **Antigen recognition:** Factors governing immunogenicity (Nature of the antigen, Expose to the antigen, Nature of the recipient, Receptor-antigen interactions), Antigen receptors of B and T lymphocytes, Antigen recognition by B and T lymphocytes, The HLA systems and its proteins (The structure of HLA molecules, The HLA complex of genes, HLA polymorphism). (5)

3. **Lymphocyte development and differentiation:** B cell development, B cell activation and maturation, T-cell development and education, T-cell subpopulation (Large granular lymphocytes). (2)

4. **Lymphocyte interactions and the lymphoid systems:** Cytotoxic T cells (Helper T cells, Costimulation of lymphocyte activation), The lymphoid system, Lymphocyte recirculation and homing, Lymphocyte selection and maturation (Regulation of lymphocyte responses), Laboratory methods (Identification and isolation of lymphocytes, Stimulation of lymphocytes). (4)
5. **Cytokines**: Sources and functions of immunological cytokines (Activation of cells of the immune system, TH1 Versus TH2 cells, Haemopoiesis, Inflammation, Cytostatic, cytotoxic, and anti-viral activities), The cytokine network, Cytokines and therapy.

6. **Immunoglobulins**: Structure (Variable and constant domains, The antigen-combining site, Affinity and avidity), Classes and sub-classes (IgG, IgA, IgM, IgD, IgE), Triggering of effector systems, Immunoglobulin genes (The origin of diversity, Allelic exclusion and clonal selection, Isotype switching, T cell receptor genes), Exploiting the properties of immunoglobulins (Laboratory methods, Monoclonal antibodies from hybridomas).

7. **Complement**: The classical pathway (C3 conversion, Solubilization of immune complexes), The alternative pathway, The membrane attack pathway (Inadequate regulation of complement activation: Hereditary angio-oedema, Paroxysmal nocturnal haemoglobinuria, Nephritic factor, Complement polymorphisms and deficiencies).


9. **Mast cells, basophils and eosinophils**: Triggering of mast cells and basophils, Mast cell mediators (Preformed mediators, Secondary mediators, Cytokines), Eosinophils (Eosinophil products, Hypereosinophilic syndrome).

10. **Killer cells**: Mechanism of target cell recognition (Cytotoxic T cells, Large granular lymphocytes, Antibody–dependent cellular cytotoxicity), Mechanism of target cell killing (Secreted proteins, Membrane ligands), Cooperation between killer cells and interferons.


12. **The antigen-antibody reaction**: Introduction, Antigen-antibody binding, Kinetics of antigen-antibody reaction.


14. **Isotopic and Non-isotopic Immunoassays**: Introduction, Radioimmunoassay (RIA), Manufacture and use of RIA kit, Non-isotopic immunoassays, Enzyme immunoassay, Enzyme linked immunosorbent assay (ELISA), Clinical application of ELISA, Fluoroimmunoassay, Luminescent immunoassay, Recent development.

15. **Immunocytochemical techniques**: Introduction, immunofluorescence, Gold labeling, Cell separation techniques, immunosensors, Recent development.

16. **Case studies in immunology**: MHC Class I and II Deficiencies, AIDS, Allergic asthma, Kidney Graft in IDDM, Systemic Lupus Erythematosus, Drug-Induced Serum Sickness, Multiple Myeloma.
Suggested Readings


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Tribhuvan University
Institute of Science and Technology
M.Sc. Zoology (Semester System)
SEMESTER III
GENOMICS AND MOLECULAR BIOLOGY

Course Title: Molecular biology and Bionanotechnology
Course No: Zoo 627
Nature of the Course: Theory
Credits: 3
Lecture hrs: 48
Full marks: 75
Pass marks: 37.5

Course Objectives
• To impart advanced and innovative knowledge of present day in molecular biology.
• To impart advanced and innovative knowledge of present day in bionanotechnology.
• To provide knowledge on some important techniques in molecular biology and bionanotechnology.

Course Contents
A. Molecular Biology 24 hrs
1. Prokaryotic and eukaryotic chromosome structure: Prokaryotic chromosome structure, Chromatin structure, Eukaryotic Chromosome structure, Genome complexity. (2)
2. DNA replication: DNA replication-an overview, Bacterial DNA replication, Eukaryotic DNA replication, the genetic code and tRNA structure and function. (2)
3. DNA damage, repair and recombination: Mutagenesis, DNA damage, DNA repair, The clinical importance of DNA repair mechanisms, Recombination. (2)
4. Gene manipulation and cloning vectors: DNA cloning-an overview, Preparation of Plasmid DNA, Restriction enzyme and electrophoresis, Ligation, transformation, and analysis of recombinants. Design of plasmid vectors, Bacteriophage vectors, Cosmids and YACs, Eukaryotic vectors. (2)
5. **Molecular techniques:** DNA extraction, Electrophoresis, PCR-RFLP, PCR-SSCP, PCR-DNA-PAGE, RT-PCR and PCR-sequencing. (2)

6. **Gene libraries, screening, analysis cum uses of cloned DNA:** Genomic libraries, cDNA libraries, Screening procedures, Characterization of clones, Nucleic acid sequencing, Polymerase chain reaction, Organization of cloned genes, Mutagenesis of cloned genes, Applications of cloning. (2)

7. **Recombinant DNA technology:** Introduction, Restriction enzymes, Gel electrophoresis, Enzymatic method of DNA sequencing, Southern blotting and prenatal testing for sickle cell anemia, Isolating a human gene with DNA cloning, polymerase chain reaction (PCR), Producing a protein from a cloned gene, Site-directed mutagenesis and transgenic animals, methods of transgenic animals. (2)

8. **Mutations of the DNA sequence:** Silent mutations, Missense mutations, Nonsense mutations, Frameshift mutations, Translocation mutations, RNA splicing mutations, Transposable element mutations, Trinucleotide repeat mutations. (1)

9. **Molecular oncology:** Proto-oncogenes, Oncogenes, and anti-oncogenes: Definitions, Designations, Classification of oncogenes, Mechanism of action of the ras proto-oncogene, Anti-oncogenes (tumor-suppressor genes), Molecular pathology of colorectal cancer, Phases of cell cycles, Control of cell cycle, Stages of M phase. (3)

10. **Mitochondrial genes:** Introduction, Gene products that are encoded by mitochondrial DNA (mtDNA), Other mitochondrial proteins, Mitochondrial diseases. (2)

11. **Receptors and signal transduction:** Ion channel-linked receptors, G-protein-linked receptors, Enzyme-linked receptors, Steroid hormone (intracellular) receptors, Receptors types, Nitric oxide (NO), Receptor-mediated endocytosis. (2)

12. **Recent trends in molecular biology:** Molecular ethnobiology and gene geography; Telomere, molecular aging, and longevity; Apoptosis; Molecular epidemiology of genes and diseases. (2)

### B. Bionanotechnology

#### 1. Fabulous world of bionanotechnology:** History and concept of bionanotechnology, Nature as the bionanotechnologist, Unique properties of bionanomaterials, Benefits and classification of bionanomaterials (DNA, Amyloid fibrils, Actin filaments, Aromatic peptides, Bacteriophages, Minerals, Viruses, Enzymes and nucleic acids). (2)

#### 2. Basics of Bionanotechnology:** Nanomaterials, bionanomaterials, biosensors, bionanosensors, nanodevices, bionanoelectronics, bionanomechanics, biological machines, molecular motors, mechanism of transport, nanoparticles, nanoscale phenomena, new nanotools, peptoid nanosheet, cantilever array sensor, nanophotonics. (2)

4. **Biomachines in action**: The Unfamiliar world of bionanomachines., Negligible gravity and inertia at the nanoscale., Atomic granularity in nanomachines Thermal motion as a significant force at the nanoscale, Requirement of Water environment for bionanomachines, Modern biomaterials. Composition of most natural bionanomachines as proteins, Lipids for infrastructure and Polysaccharides in specialized structural roles. Evolution and Significant limitations on the properties of natural biomolecules.


**Suggested Readings**


Murty, B.S; Shanker, P; Raj, B; Rath, B. B; Murday, J. (2016): Textbook of Nanoscience and Nanotechnology. Published by University Press (India) Private Limited, 3-6-747/1/A & 3-6-754/1, Himayatnagar, Hyderabad 500 029, Telangana, India.


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Course Title: Applied Medico-genomics
Course No: Zoo 628
Nature of the Course: Theory

Course Objectives
- To impart advanced and innovative knowledge of present day applied medico-genomics.
- To provide knowledge on some important diagnostic techniques in applied medico-genomics.

Course Contents

1. **Forensic Science:** Origins of forensic science, Early methods, Toxicology and ballistics, Anthropometry, Fingerprints, Uhlenhuth test (antigen–antibody precipitin test), body fluid analysis, blood pattern interpretation, investigation of assaults and sexual offences, Human osteology. (5)

2. **DNA profiling:** Alec Jeffreys and DNA testing, Applications of DNA Fingerprinting, DNA technologies used in molecular forensic investigation (Restriction Fragment Length Polymorphism-RFLP, PCR analysis, STR analysis, Mitochondrial DNA analysis, Y-chromosome analysis), **Sixteen Core STR loci** (DNA markers/identifiers) with their chromosomal positions (D8S1179, D21511, D7S820, CSF1PO, D3S1358, THO1, D13S317, D16S539, D2S1338, D19S433, VWA, TPOX, D18S51, AMELOGENIN, D5S818, FGA). **Forensic DNA typing:** Five steps of DNA fingerprinting in the laboratory (Isolation of DNA, Cutting, sizing, and sorting/Quantifying, PRC and then Transfer of DNA to nylon, Typing/Probing, DNA fingerprint/Interpretation), DNA fingerprint in a family, DNA fingerprint in a rape case. (5)

3. **Pharmacogenomics:** Concept and history, Drug metabolizing enzymes: Cytochrome P450s, The vitamin K epoxide reductase complex subunit 1 (VKORC1), Thiopurine methyltransferase (TPMT), Predictive phenotypes and metabolic activities (Ultra-Rapid Metabolizer, Extensive Metabolizer, Intermediate Metabolizer, Poor Metabolizer), Pharmacogenomic biomarkers and Drug labeling, Reduction of polypharmacy in pharmacogenomics, Challenges of Pharmacogenomics, Future of Pharmacogenomics, Applications of pharmacogenomics. (5)

4. **Personalized medicine:** Development, methods, Challenges, Applications of Personalized medicine. (2)

5. **Precision medicine:** Precision medicine initiative, Development, Methods, Progress and Challenges, Applications of precision medicine, Difference between Personalized medicine and precision medicine. (2)

6. **Molecular medicine:** Development, Methods, Trends in molecular medicine, Challenges, Applications of molecular medicine. (2)

7. **Genomic Detection, prognosis and treatment of inborn errors of metabolism:** (a) **Carbohydrate metabolism (Glycogen storage disease):** Type I to VII, but more focus on Type I (Von Gierkes Disease), Type II (Pompe’s disease), Type III (Limit Dextrinosis), and Type VI (Her’s disease),
Pentosuria, Galactosuria.  (b) **Protein metabolism**: Alkaptonuria, Phenylketonuria.  (c) **Lipid metabolism**: Niemann-Pick disease, Tay-Sach’s disease, Gaucher’s disease.  (d) **Nucleic acid metabolism**: Lesch-Nyhan syndrome, Hereditary Xanthinuria.

8. **Genomic Detection, prognosis and treatment of Monogenic disorders**:  
   - **Autosomal dominant disorders** (Marfan syndrome, Neurofibromatosis).  
   - **Autosomal recessive disorders** (Sickle cell disease, Cystic fibrosis).  
   - **X-linked dominant disorders** (Xg blood group, Vitamin D-resistant rickets).  
   - **X-linked recessive disorders** (Muscular dystrophy, Hemophilia A and B).  
   - **Y-linked disorders** (Male fertility).  
   - **Mitochondrial inheritance** (Leber’s hereditary optic neuropathy-LHON).  
   - **Genomic imprinting** (Prader-Willi syndrome via father and Angelman syndrome via mother).

9. **Genomic Detection, prognosis and treatment of polygenic/multi-factorial disorders**:  
   - Atherosclerosis, Autoimmune diseases, Cancers, Diabetes mellitus, Hypertension, Obesity, Peptic ulcer disease, Spina bifida.

10. **Genomic detection, prognosis and treatment of neurodegenerative diseases**: Alzheimer’s disease, Parkinson’s disease, Huntington’s Disease, Creutzfeldt-Jakob Disease (Prion disease), Amyotrophic lateral sclerosis (ALS), Multiple sclerosis (MS), Epilepsy, Schizophrenia.

11. **Trinucleotide repeats**: Type I of CGG repeat in Fragile X syndrome, Type II of CAG repeat in Huntington disease and Type III of CTG repeat in Myotonic dystrophy.


**Suggested Readings**


Tribhuvan University
Institute of Science and Technology
M.Sc. Zoology (Semester System)
SEMESTER III
GENOMICS AND MOLECULAR BIOLOGY

Course Title: Related to Zoo 625 & 626
Course No: Zoo 629
Nature of the Course: Practical

Credits: 2
Lecture hrs: 90
Full marks: 45
Pass marks:

Course Objectives
To impart practical knowledge on topics of Zoo 625 & 626.

Course Contents
Molecular Biochemistry
Credit: 1
1. Performing qualitative tests for Carbohydrate.
2. Estimation of Blood glucose.
3. Solubility test for Lipid
4. Extraction of Lipid
5. Estimation or Isolation of Protein
6. Estimation of Nucleic acid
7. Performing some practical related to the enzymatic activities in the lab.
8. Studying the use and function of spectroscopy, spectrometry and chromatography in the available institution.

Laboratory: Molecular Immunology
Credit: 1
1. Antigen and antibody reactions.
2. Antigen preparation with complete adjuvant.
3. Antigen preparation with incomplete adjuvant.
4. Identification and isolation of lymphocytes.
5. Conducting Eliza test

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Course Title: Related to Zoo 627 & 628
Course No: Zoo 630
Nature of the Course: Practical

Course Objectives
To impart practical knowledge on topics of Zoo 627 & 628.

Course Contents
Molecular biology and Bionanotechnology
Credit: 1
1. Performing the following molecular techniques: DNA extraction, Electrophoresis, PCR-RFLP, PCR-SSCP, PCR-DNA-PAGE, RT-PCR and PCR-sequencing etc.
2. Studying the detailed structure of some protein of interest using visualization software.
3. Visualizing the cytoskeleton actins protein in some cell lines of interest using fluorescence microscope.
4. Counting the number of axons in differentiated neural cell using bright field microscope.
5. Studying the morphology of blood cells by bright field microscope.

Applied Medico-genomics
Credit: 1
1. Taking some measures on different ethnic groups i.e. anthropometry.
2. Conducting some practicals on fingerprints.
3. Carrying out Uhlenhuth test.
4. Detecting some genomic basis for monogenic diseases in general.
5. Detecting some viruses, bacteria, fungi and protozoa in the collected samples of interest.

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