SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)

Course No.-US05CGEN21 :MOLECULAR GENETICS
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know - DNA replication repair, Eukaryotic transcription and translation

UNIT1: DNA BINDING PROTEINS

DNA binding proteins, Binding motifs, helix turn helix, loop helix, Zinc finger motif, leucine zipper DNA protein interaction, DNA Supercoiling, linking number-topological structure of DNA organization and expression of mitochondrial and chloroplast genome.

UNIT 2: REGULATION IN EUKARYOTES

Regulatory strategies in eukaryotes, gene alteration (gene loss, gene amplification, gene rearrangement: the joining of coding sequences in the immune system).Transcriptional control by hormones, regulation mediate through transcription factors, regulation of enhancer activity, methylation, regulation of processing, translational control, regulation of gene expression in plants by light.

UNIT 3: DNA REPLICATION AND DNA REPAIR

DNA reassociation kinetics (Cot curve analysis).Different kinetics, unique sequences, moderately repetitive sequences, highly repetitive sequences.DNA Replication in eukaryotes,, DNA repair mechanisms: Photoreactivation, Excision repair, Mismatch repair, Post replication repair, SOS repair.

Unit 4: EUKARYOTIC TRANSCRIPTION AND TRANSLATION

Transcription in eukaryotes- Promoters for RNA pol I, II and III, initiation, elongation and termination. Types of introns, post-transcriptional modifications & processing of rRNA, tRNA, and mRNA. Translation and post translational modifications.

REFERENCES:

1. Genes IX - Benjamin Lewin, Oxford University Press.
2. Molecular Biology of the Gene - Watson & Hopkins, Benjamin/Cummings Publishing Company.
3. Molecular Biology of the Cell - Alberts Bray, Lewis, Raff, Roberts & Watson G.S. 3rd Ed, Garland Science- Taylor & Francis Inc.
4. Cell and Molecular Biology - Concept & Experiments – Gerald Karp. 6th Ed, John Wiley & Sons.
5. Genetics – Klug & Cummings. 4th Ed, Lightning Source Inc.
6. Principles of Genetics – D. Peter Snustad & Michael J. Simmons, John Wiley & Sons. Inc.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)
Course No.- US05CGEN22 :Genetic engineering I

Semester-V (Effective from 2020)
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know – Isolation of nucleic acids, Restriction and Modifications of DNA, Cloning vectors, Gene cloning and analysis of cloned genes.

UNIT 1: RESTRICTION AND MODIFICATION OF DNA
Isolation of Genomic DNA and Plasmid DNA, Isolation of RNA, (Rationale behind usage of various chemicals and reagents, Precautions in handling DNA & RNA. Restriction enzymes, Nucleic acid modifying enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase,Polynucleotide kinase, Alkaline phosphatase, Cohesive and blunt end ligation(Linkers; Adaptors, Homopolymer tailing) .

UNIT 2: CLONING VECTORS
Cloning vectors and their properties, Plasmid based vectors (PBR-322, PUC), Ti-plasmid based vectors-cointegrate and binary vector, Yeast Plasmid based vector(YAC, YCP, YEP and shuttlevector). Bacteriophage vector-insertional and replacement vector, Virus based vector- SV40 and retrovirus, Role of vectors in Genetic-Engineering.

UNIT 3: GENE CLONING
Transformation in bacterial cells Recombinant selection &screening. Safety measures and regulation of recombinant DNA technology. Methods of gene transfer in plants and animals vector mediated and Vector less gene transfer (Physical and chemical methods). Gene cloning and its significance. Biosafety: Introduction, Historical Background, Biosafety guidelines ,Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture.

UNIT 4: ANANLYSIS OF CLONED GENES
Construction of Genomic & cDNA library and Colony hybridization, Nucleic acid probes (Radioactive and non-radioactive) and their applications, Hybridization, Detection of labeled (Autoradiography) and non-radioactive probes (coloured & chemiluminent detection), *In situ* hybridization, FISH, Hybridization techniques: Northern, Southern and Western blot techniques.

REFERENCES:
1. Principles of Gene Manipulations - Sandy B. **Primrose**, Richard M. Twyman, Robert W. **Old**.
Blackwell Publishing
2. Gene cloning-T.A. Brown, Blackwell Publishing.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA- Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. 4th Ed, ASM Press
4. Biotechnology: Fundamentals and Applications - S.K. Mathur, S.S. Purohit, Agrobios (India)
5. Analysis of Genes & Genomes – Richard C. Reece, John Wiley & Sons.
6. Modern concepts of Biotechnology- H.D. Kumar, Vikas Publishing House Pvt. Ltd
7. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)

Course No.- US05CGEN23: Immunogenetics
Semester-V (Effective from 2020)
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know – Antigen antibody reactions, Genetics of antibody diversity, structure and role of MHC, Transplantation and immuno suppression.

UNIT 1: DIAGNOSTIC IMMUNOLOGY

Introduction to Antigen-Antibody, Epitopes, Haptanes, Adjuvant. Non Specific Resistance to Diseases. Specific Resistance, types of immunity Cell Mediated and Antibody Mediated Immunity. Immunoglobulin structure and classes, Antigen-Antibody reactions : Agglutination, Precipitation, Complement fixation tests, Radioimmunoassay: Enzyme Linked Immunosorbent assay, Immunofluorescence, Immunoelectrophresis

UNIT 2: GENETICS OF Ab DIVERSITY

BCR & TCR, Clonal-selection theory, Genetic basis of Antibody diversity, Theories for Antibody diversity, Means for Antibody diversity, Rearrangement and expression of immunoglobulin genes, Monoclonal antibodies, Hybridoma technology.Cytokines (IL2,TNF α and β, Chemokines and interferons).Introduction and role of cytokines in immune response.

UNIT 3: MHC, CYTOKINES & TRANSPLANTATION

Phagocytosis & inflammation, MHC-structure, function & types, Antigen processing and presentation, complement system-Alternative & classical pathway, and their role in immune response, Transplantation and Immunosuppression

UNIT 4: IMMUNE SYSTEM IN HEALTH AND DISEASE

Hypersensitivitites, Autoimmunity and mechanism of generation of auto immune disorders, Autoimmune diseses –Hashimitos thyroiditis, Rheumatoid arthritis, Systemic lupus erythematosus, IDDM. Immunodefeciencies [Primary and Acquired immunodeficiency] SCID & AIDS. Vaccines: introduction, types [live, attenuated, toxoid, edible, non edible, recombinant] and importance.

REFERENCES:

1. Essentials of Immunology - Roitt, Blackwell Scientific Publications
2. Immunology –Janis Kuby, W.H .Freeman & Co.
3. Immunology and Serology- Philip L. Carpenter. 3rdEd, Harcourt College Publishers
4. Immunology – C.V. Rao, Narosa Publishers.
5. A Textbook of Immunology & Immunotechnology - B.Annadurai, S. Chand &Company Ltd.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)

Course No.-US05CGEN24: Human Genetics and Bioinformatics
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know –Human genome organization, mapping of human genome, important genetic diseases, genetic testing and advanced bioinformatics

UNIT 1: GENOME ORGANIZATION and MAPPING METHODS

History and Scope of Human Genetics, Nuclear genome: General feature of human genome, unique sequences and hypervariable region, coding and non-coding sequences, Genes (polypeptide encoding and RNA) and gene families. Human genome project: overview and significance.

Mapping methods for Human genome, Physical maps–cytogenetic map, contig map, restriction map, landmarks on chromosomes generated by various mapping methods, BAC libraries and shotgun libraries preparation, Chromosomal location of genes-chromosome walking and chromosome jumping.

UNIT 2: GENETICS DISORDERS

List of Syndromes and disorders due to genetic defects, Definition and the genetic basis of monogenic diseases: Tay Sach's Syndrome, Marfan Syndrome, Sickle cell anemia, Thalassemia, Haemophilia, Cystic fibrosis, Inborn errors of metabolism: Phenylketonuria & Galactosemia, Neurogenetic disorders: Alzheimer's disease, Parkinson's. Multifactorial disorders: Diabetes mellitus, Obesity. Chromosomal aberrations syndromes- trisomy, turners, Klinefelters.

UNIT 3 : GENETIC TESTING

Definition, Types [diagnostic and predictive], Importance, Contexts in which diagnosis is done: prenatal screening, neonatal screening & others. Commonly used tests for screening of genetic disorders based on urine and blood analysis [Ferric chloride test, Guthrie bacterial inhibition assay],[maternal serum alpha fetoprotein (MSAFP)-Quad test], Fetal chromosome (karyotype) testing, SAGE [serial analysis of gene expression].

UNIT 4 :ADVANCE BIOINFORMATICS

Protein structure prediction: Introduction to protein structure, protein folding and protein misfolding. Principles of protein structure prediction, Secondary structure prediction- Chou Fasman and GOR method. Prediction of tertiary structures of proteins using Homology Modeling

Phylogeny: Introduction to phylogeny and various types of trees, methods and applications for phylogenetics analysis.

Gene prediction: Basic concepts, Prediction of promoters, splice sites and regulatory regions Detecting Open Reading Frames in sequences and application of gene prediction.

REFERENCES:

1. Genomes3 – T.A. Brown, Garland Science Publishing
2. Biotechnology – John E. Smith, Cambridge University Press
3. Molecular cloning: A Laboratory Manual - Sambrook, Fritsch & Maniatis, Cold Spring Harbor Lab
4. Human molecular genetics- Tom Strachan & Andrew P. Read.3rd Ed, Garland Science Publishing
5. Human molecular genetics. –Peter Sudbury, Pearson Publications
6. Thompson & Thompson Genetics in Medicine - Robert L. Nussbaum, Roderick R. McInnes Huntington F. Willard.6th Ed, Sauders publication
7. Genetics: A conceptual approach - Benjamin A. Pierce. 3rd Ed, W.H. Freeman & Company .
8. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
9. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
10. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
11. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
12. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)

Course No.-US05CGEN25 Praticals
(6 credit course – 12 hours/week,105 Marks)

1. Separation and identification of Amino Acids by Paper Chromatography.
2. Separation and identification of Amino Acids by Thin Layer Chromatograph
3. Plaque assay.
4. Isolation of fungal and plant genomic DNA
5. Isolation of Plasmid DNA.
6. Restriction digestion
7. Ligation
8. Preparation of competent cell and Transformation
9. Dot ELISA
10. Precipitation curve
11. Radial Immunodiffusion
12. Widal Test
13. Chemical analysis of Urine –reducing sugar, protein, ketone bodies, bilirubin
14. Determination of serum cholesterol.(Wybinga & Pilleggi method)
15. Quantitative estimation of carbohydrates by Nelson-Somogyi method.
16. Quantitative estimation of fats by Dichromate method.
17. Estimation of Vitamin C by Dichlorophenol Indophenol blue dye method
18. Estimation of Iron by Wong's method.
19. Determination of urine or serum uric acid / creatinine, urea
20. Determination of blood glucose by GOD/POD method
21. To perform primary structure analysis of protein using Protparam.
22. To perform secondary structure analysis using GOR.
23. Gene identification using ORF Finder at NCBI.
24. Phylogenetics tree construction using PhyML.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - V
(Effective from 2020)
Discipline specific
Course No.-US05DGEN26
Course Title- Biological Chemistry and Metabolism
2 credit course – 2 hours/week 50 marks

Course Outcome: Students will be able to know about Vitamins, enzymes, lipids and metabolism

UNIT 1: VITAMINS
Vitamins: Definition, Overview of General characteristics, Properties, Metabolism , Effects of deficiencies of water soluble & fat soluble vitamins, Vitamin related co-enzymes and chemical reactions. Structure and Hydrolysis of ATP & introduction to energy rich compounds- Biological oxidation-reduction reactions and Redox potential.

UNIT 2: ENZYMES
Definition, Nomenclature and Classification of enzymes, Introduction to Allosteric enzymes, Inhibitors, Active site (lock and key theory, induced fit theory). Enzyme kinetics- Derivation of Michaelis-Menten equation, Km and it significance, line-weaver Burk plot and its limitations and solutions(Eadie Hofstee and Hannes Woolf's curve and equations).

UNIT 3: LIPIDS
Lipids: Definition, Overview of [Importance, Nomenclature, General Structure of Fatty acids (Saturated, Unsaturated, Hydroxy and Cyclic)], Biological Roles of Lipids, Lipid metabolism (β , α ,ω oxidation, lipolysis, , fatty acid synthesis)

UNIT 4: METABOLISM
Carbohydrate metabolism (Glycolysis,Kreb's cycle) . Nucleic acid metabolism: *de novo* synthesis and degradation of purines and pyrimidines Proteins: General features of Trans-amination, Trans-deamination and Urea cycle.

REFERENCES:
1. Biochemistry – J. M. Berg, John L. Tymoczko, Lubert Stryer W. H. Freeman & Co.
2. Essentials of Biochemistry- David Lee Nelson, Albert L. Lehninger, Michael M. Cox . W. H. Freeman & Co.
3. Principles and Techniques of practical biochemistry - Keith Wilson, Cambridge University Press.
4. Principles of Anatomy and Physiology- Gerard J. Tortora & B. H. Derrikson, John Wiley & Sons.
5. Outlines of biochemistry-Conn & Stumpf 5th Ed, John Wiley & Sons,
6. Biochemistry - U. Satyanarayana. 2nd Ed, New Central Book Agency (p) Ltd.
7. Medical Biochemistry - Chhaterjee and Ranashinde.7th Ed, Jaypee Publishers
8. Fundamentals of Biochemistry: Life at the Molecular level- Voet Donald , John Wiley & Sons.