

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 mediated 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: ANALYSIS 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, Immunoelectrophoresis

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

Hypersensitivities, Autoimmunity and mechanism of generation of auto immune disorders, Autoimmune diseases – Hashimoto's thyroiditis, Rheumatoid arthritis, Systemic lupus erythematosus, IDDM. Immunodeficiencies [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, Thalassaemia, 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, Saunders 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 Practicals
(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, K_m and its significance, line-weaver Burk plot and its limitations and solutions (Eadie Hofstee and Hanes 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, Krebs'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. Derrickson, 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.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - VI
(Effective from 2020)
US06CGEN21 Genetic engineering II
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know –PCR, Gene sequencing, molecular markers, gene transfer and manipulation techniques

UNIT 1: POLYMERASE CHAIN REACTION

Polymerase chain reaction: Principle, procedure and applications. Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, advantages and disadvantage of each type. Primer designing (Chemical Synthesis of oligonucleotides)

UNIT 2: GENE SEQUENCING

Introduction to Genome Informatics: Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA. First Generation of Sequencing techniques: – manual & automated: Maxam and Gilbert and Sangers method. Drawbacks of the first generation sequencing methods.

Emergence second generation sequencing, 454 Pyro-sequencing, Illumina /Solexa sequencing, Genome Analyzer, Applied Biosystems Sequencing, Ion Torrent Sequencing, Chain termination method, Pyrosequencing

Third Generation of Sequencing technique: Pacific Biosciences SMRT sequencing, nanopore sequencing. Protein sequencing. Introduction and applications of Microarray technology.

Comparison of Next generation sequencing techniques, Significance and Drawbacks of NGS, NGS File formats, Softwares for NGS data analysis.

Microarray analysis definition, types of microarray, microarray analysis life cycle (sample preparation and labeling, hybridization, washing and image acquisition), microarray data analysis

UNIT 3: BIOCHEMICAL AND MOLECULAR MARKERS

Markers-Morphological, Biochemical, Molecular-(RFLP, RAPD, AFLP, SNP, SSR, SSCP, SCAR). DNA fingerprinting and its significance, Molecular genetic approach in Forensic sciences.

UNIT 4: GENE TRANSFER AND MANIPULATION TECHNIQUES

Site directed mutagenesis, Introduction to siRNA, siRNA technology; Micro RNA; Principle and applications of Gene silencing; Gene knockouts, Knockout mice, Antisense and ribozyme technology – initiation of splicing, polyadenylation, molecular mechanisms of antisense molecules, miRNA, siRNA, gene silencing.

REFERENCES:

1. Principles of Gene Manipulations - S. B. Primrose, Richard M. Twyman, R. W. Old, Wiley-Blackwell Publishing
2. Gene Cloning and DNA Analysis: An Introduction - T.A. Brown, John Wiley and Sons
3. Molecular Biotechnology - Glick. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, ASM Press
4. Modern concept of Biotechnology-H.D. Kumar, Vikas Publishing House Pvt. Ltd
5. Biotechnology Fundamentals and Applications - S.K. Mathur, S.S. Purohit, Agrobios (India)
6. Comprehensive Biotechnology-K. G. Ramawat & Shaily Goyal, S. Chand &Company Ltd

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - VI
(Effective from 2020)
US06CGEN22: Plant breeding and Plant Biotechnology
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know techniques of different plant tissue culture methods, transgenic plants, Principles of genetics and plant breeding

UNIT 1: PLANT CELL AND TISSUE CULTURE -1

Definition, Principle and Applications of plant tissue culture, Culture [Nutrient Media, Sterilization techniques], Culture of explants: Somatic embryogenesis, Synthetic seed, Embryo culture, Cell suspension culture. Haploid production-anther and pollen culture, Protoplast culture [Isolation, Purification and Regeneration of protoplast, Somatic hybridization: Protoplast fusion methods, Selection and production of somatic hybrids, Cybrids

UNIT 2: TRANSGENIC PLANTS

Development of transgenic plants for crop improvement: Transgenics with biotic (fungal and bacterial) and abiotic stress resistance, herbicide resistance (glycosinate and glufosinate), improved quality, Molecular Pharming / Farming or Transgenic plants as bioreactors, edible vaccines, Genetically engineered Male sterility (Barnase / Barstar system). Screening of transgenic plants (Scorable and selectable gene markers [opine synthase, CAT, GUS, GFP, EPSP, NPT-II, hpt.]. A brief introduction to GM food

UNIT 3: GENETICS AND PLANT BREEDING

Plant breeding: Introduction, History, PB as a technology, Objectives, Activities in plant breeding, Important achievements, potential and opportunities, Centers of origin, Gene pool concept - primary, secondary and tertiary gene pool and gene introgression, Plant genetic resources: Definition and importance, Germplasm collection and conservation. IPGRI, NBPGR, Organisation/Institutes for crop improvement –ICAR, IARI, ICRISAT, CAZRI, ILCA, CICR. Introduction, domestication and acclimatization. Genetic basis of Plant Breeding : Genetic consequences of self and cross fertilization, Heterosis - concept and theories, inbreeding depression.

UNIT 4: BREEDING METHODS

Methods of breeding self-pollinated, cross-pollinated and asexually propagated crops, Hybridization, Comparison between purelines, inbreds and clones, Hybrid varieties: use of CGMS system., Mutation breeding, Quality seed - classes, Seed certification and multiplication, seed purity standards, Cross breeding & Line breeding. Selection and Nonrandom Mating, Inbreeding, Inbreeding depression. Marker assisted selection .Use of molecular markers in breeding, Mapping strategies: NIL(near isogenic line)strategy, Bulk segregant analysis (BSA), Quantitative trait loci (QTL) analysis, Advantages of marker assisted selection.

REFERENCES:

1. A Textbook of Biotechnology - R.C. Dubey, S. Chand & Company Ltd.,
2. Elements of Biotechnology- P. K. Gupta. 1st Ed, Rastogi Publication
3. Introduction to Plant Biotechnology -H.S. Chawala, Oxford &IBH Publishing Pvt. Ltd.
4. Biotechnology -U. Satyanarayana, Books & Allied Publishers.
5. Cell biology ,Genetics, Molecular biology, Evolution & Ecology-Verma and Agrawal, S. Chand & Company Ltd
6. Plant tissue culture – Theory & Practice -S.S. Bhojwani and M.K. Razdan ,Elsevier Science
7. An introduction to Plant Tissue Culture - M. K. Razdan, Oxford &IBH Publishing Pvt. Ltd.
8. Plant tissue Culture: Techniques &Experiments- Roberta H. Smith, Academic press.

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - VI
(Effective from 2020)
US06CGEN23 ANIMAL BIOTECHNOLOGY AND ANIMAL BREEDING
(4 credit course – 4 hours/week,70Marks)

Course Outcome: Students will be able to know principles of animal breeding , embryo transfer technology and AI, Animal cell culture and transgenic animals.

UNIT 1: PRINCIPLES OF ANIMAL BREEDING

Livestock Breeding- History of Animal Breeding. Cattle and buffalo breeds of Gujarat: Classification of breeds. Economic characters of livestock and poultry and their importance. Bases of selection: individual, pedigree, family, sib, progeny and combined, indirect selection. Method of selection, Single and Multi trait. Classification of mating systems. Inbreeding coefficient and coefficient of relationship. Genetic and phenotypic consequences of inbreeding, inbreeding depression, application of inbreeding. Out breeding and its different forms. Genetic and phenotypic consequences of outbreeding, application of outbreeding, heterosis. Breeding strategies for the improvement of dairy cattle and buffalo. Operation Flood-NDDDB, AMUL.

UNIT 2: EMBRYO TRANSFER TECHNOLOGY AND AI

MOET, Embryo transfer technology - Methodology, Superovulation, Synchronization of estrus in animals, Embryo collection, Grading of embryo and Transfer in recipients – surgical and non surgical method. Importance of artificial insemination, Cryopreservation of Animal germplasm -semen, and embryos, *In vitro* fertilization, Brief account of mammalian embryonic development. Study of developmental stages of chick embryo. Study of developmental stages of fish.

UNIT 3: ANIMAL CELL AND TISSUE CULTURE

History of animal cell cultures, Requirements for animal cell and tissue culture, Media composition, Culture methods- short term and long term culture, Cell lines, Cell clones, their maintenance & preservation, Significance and applications of cell culture, Tissue engineering (skin regeneration), Cell viability and Toxicity .

UNIT 4: TRANSGENIC ANIMALS

Methods of gene transfer in animal cell. Transgenic animals: Mice, Sheep, Pigs, Goats, and Cows. SCNT –dolly sheep example, molecular pharming . Knock out mice and its significance. Introduction to IPR and Patents

REFERENCES:

1. Animal cell culture – R. Ian Freshney, John Wiley & Sons,
2. Biotechnology – B.D. Singh, Kalyani Publishers.
3. Molecular Biotechnology – Primrose. 2nd Ed, Blackwell Scientific Publications Ltd.
4. Notes on Applied animal reproduction - S.B. Kodagali
5. Animal Biotechnology-M.M. Ranga. 3rd Ed, Eastern Book Corporation.
6. Principles and Practise of Animal Tissue Culture – Sudha Gangal, Orient Longman Limited,
Universities Press (India) Pvt. Ltd
7. Text bok of Animal Husbandry –G.C Banerjee

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - VI
(Effective from 2020)
Course No.- US06CGEN24 Biomedical Genetics
(4 credit course – 4 hours/week,70Marks)
3 credit course – 3 hours/week

Course Outcome: Students will be able to know cancer genetics and cell signaling, cloning of disease causing genes, detection of mutation in disease genes, management of genetic diseases

UNIT 1: CANCER GENETICS AND CELL SIGNALING

Cancer: Common types of cancer, Multi-step development of cancer, Categories of genes controlling cell proliferation, Concept of proto-oncogene and conversion to oncogene, Cancer therapies

Cell signaling—basic characteristics of cell signaling & significance, second messenger, G protein, coupled receptors, role of calcium as intracellular messenger, Receptor tyrosine kinases in signaling pathway. Apoptosis mechanism and significance. Regulation and control, mechanism of action.

UNIT 2: CLONING OF DISEASE CAUSING GENES

Functional cloning: Examples of functional cloning & chromosomal anomalies, Positional cloning- Recruitment of affected families, genetic mapping and primary localization, Physical mapping, Identification of disease causing genes, first success, Future of cloning disease causing genes.

UNIT 3: DETECTION OF MUTATION IN DISEASE GENES

General strategies for detection of mutant genes, Mismatch detection by heteroduplex analysis, Detection of mitochondrial mutations. Chemical cleavage method, Multiplexed PCR-detection of deletions.

UNIT 4: MANAGEMENT OF GENETIC DISEASES

Replacement of proteins, vitamins as coenzymes and gene products, substrate restriction diet preventive therapy, Stem cells types and applications, role of stem cells in genetic disease, Recombinant protein. *In vivo* and *in-vitro* gene therapy, somatic cell and germ line gene therapy, Use of nanoparticles in drug delivery for disease treatment, Genetic counseling.

References:

1. Genomes- T.A. Brown. , Oxford: Wiley-Liss
2. An Introduction to Genetic Analysis - Griffiths AJF, Miller JH, Suzuki DT, et al. 7th Ed, New York: W. H. Freeman & Co.
3. Molecular cloning: A laboratory Manual -Sambrook, J. and Russell, D.W. Cold Spring Harbour Laboratory, Cold Spring Harbour, NY.
4. DNA Technology- I Edward Alcamo, Academic Press .

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

Course No.-US06CGEN25 Practicals
(6 credit course – 12 hours/week,105 Marks)

1. Gel electrophoresis- Agarose (for separation of DNA & RNA)
2. Southern blotting
3. SDS-PAGE
4. Media preparation (MS medium and Nitsch's medium)
5. Callus culture
6. Embryo culture
7. Anther culture.
8. Estimation of proline content in plants under stress.
9. Calculation of Relative water content in plants under water stress.
10. Seed viability test-tetrazolium salt test
12. Study of chromosomal aberrations using colchicines
13. Enzyme assay: effect of pH, temperature and incubation time on enzymatic activity.
14. Enzyme assay- Alkaline phosphatases
15. PCR amplification of target DNA
16. RAPD analysis
17. Isolation of genomic DNA from blood.
18. Study of various stages of chick foetal development .
19. Slide preparation of chick embryonic stage.
20. Isolation of auxotroph by replica plating method
21. Estimation of Haemoglobin
22. Karyotyping & chromosome banding (G-banding).
23. To study polymorphism in human DNA (through PCR).

SARDAR PATEL UNIVERSITY
B. Sc (Genetics) Semester - VI
(Effective from 2020)
Discipline specific

US06DGEN26 Instrumental Methods of Analysis
2 credit course – 2 hours/week 50 marks

Course Outcome: Students will be able to know techniques and instrumentation microscopy, centrifugation, chromatography, electrophoresis

UNIT 1: MICROSCOPY

Microscope: Definition. Properties of Light (Def. of Wavelength, Frequency, Amplitude, Polarization, Diffraction, Refraction, Magnification, Resolution) Compound microscope, Phase contrast microscope, Fluorescent microscope and Electron microscope (SEM & TEM), Tissue processing for electron microscope.

UNIT 2: CENTRIFUGATION AND SPECTROSCOPY

Basic principle of sedimentation – Relative centrifugal force (RCF), Sedimentation rate, Svedberg unit or Sedimentation coefficient, Types of Centrifugation: Analytical and Preparative, Differential, Density gradient, Types of Centrifuge & rotors. Overview of Electromagnetic radiation, Laws relating to absorption of radiation. Principle, Instrumentation and Applications of Colorimeters, Spectrophotometers – Ultraviolet and Visible Absorption Spectroscopy.

UNIT 3: CHROMATOGRAPHY

Principles of Chromatography (Distribution Coefficient), Types of Chromatography: Principles, Instrumentation and applications of - Thin Layer Chromatography (TLC), Column Chromatography, Ion-Exchange Chromatography, Affinity Chromatography, Gel permeation Chromatography, GLC, High Performance Liquid Chromatography (HPLC)

UNIT 4: ELECTROPHORESIS

Gel Electrophoresis: General Principles, Agarose gel electrophoresis, SDS-PAGE, Pulse Field Gel Electrophoresis (PFGE), Iso electric Focusing, Capillary Electrophoresis.

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. Derrickson, 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.

Programme out come B.Sc. Genetics : Students will be able to know

- Comprehensive, detailed understanding of the chemical basis of heredity, its transcription, molecular genetics techniques
- Comprehensive and detailed understanding of inheritance of traits, diseases traits in families and populations, mutation chromosomal aberrations - insight into cellular and molecular mechanisms.
- Understanding of genetic diseases management, genetic testing, cloning of disease causing genes
- Understanding human genome organization, mapping and applications of bioinformatics
- The knowledge required to design, execute, and analyze the results of genetic experimentation in animal and plant model systems, plant tissue culture and plant breeding
- Concepts of animal breeding, MOET and AI. Animal cell culture and methods of gene transfer in animal cell.
- Concept of Immuno genetics and antibody diversity, Autoimmune diseases, transplantation, vaccine and its types