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) analaysis, 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-NDDB, 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 anamolies, 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 hetroduplex analysis, Detection of mitochondrial mutations. Chemical cleavage method, Multiplexes 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 electropheresis- 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. 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.

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