Bhavan's Vivekananda College of Science, Humanities and Commerce, Sainikpuri Autonomous College (Affiliated to Osmania University)
Re Accredited with "A" Grade by NAAC

Template for B Sc Programme under CBCS
Prescribed by TSCHE for implementation from 2023-24 onwards

BSc GENETICS

FIRST YEAR- SEMESTER I

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	Environmental Science	AECC-1	2		2	2		2
	English	CC-1A	4		4	4		4
	Second language	CC-2A	4		4	4		4
GT132/GT132P	**Optional I- Transmission Genetics**	DSC-1A	4	3	7	4	1	5
	Optional II	DSC-2A	4	3	7	4	1	5
	Optional III	DSC-3A	4	3	7	4	1	5
	TOTAL				**31**			**25**

FIRST YEAR- SEMESTER II

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	Computer Skills	AECC-2	2		2	2		2
	English	CC-1B	4		4	4		4
	Second language	CC-2B	4		4	4		4

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GT 232/GT232P	Optional I- **Molecular Genetics & Genetic Engineering**	DSC-1B	4	3	7	4	1	5
	Optional II	DSC-2B	4	3	7	4	1	5
	Optional III	DSC-3B	4	3	7	4	1	5
	TOTAL				**31**			**25**

SECOND YEAR- SEMESTER III

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
SE332	**Medicinal Plants**	SEC-I	2		2	2		2
	Communication Skills	AECC-3						
	English	CC-1C	3		3	3		3
	Second language	CC-2C	3		3	3		3
GT 332 /GT332P	Optional I- **Biostatistics & Bioinformatics**	DSC-1C	4	3	7	4	1	5
	Optional II	DSC-2C	4	3	7	4	1	5
	Optional III	DSC-3C	4	3	7	4	1	5
	TOTAL				**31**			**25**

SECOND YEAR- SEMESTER IV

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
SE432	**Genetic Counselling**	SEC-2	2		2	2		2

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	Universal Human values	AECC-4	2		2	2		2
	English	CC-1D	3		3	3		3
	Second language	CC-2D	3		3	3		3
GT 432/GT432P	Optional I- **Population Genetics & Evolution**	DSC-1 D	4	3	7	4	1	5
	Optional II	DSC-2 D	4	3	7	4	1	5
	Optional III	DSC-3 D	4	3	7	4	1	5
	TOTAL				**31**			**25**

THIRD YEAR- SEMESTER V

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	English	CC-1E	3		3	3		3
	Second language	CC-2E	3		3	3		3
GE532	**Basic & Applied Genetics**	GE	4		4	4		4
GT532A/GT532AP GT532B/GT532BP	**Optional I- A/B** **A. Plant Genetics & Biotechnology** **(OR)** **Animal Cell Technology & AnimalGeneticA**	DSE -1E	4	3	7	4	1	5
	Optional- II **A/B**	DSE -2E	4	3	7	4	1	5
	Optional- III **A/B**	DSE -3E	4	3	7	4	1	5
	TOTAL				**31**			**25**

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THIRD YEAR- SEMESTER VI								
Code	**Course Title**	**Course Type**	**Hours per week**			**Credits**		
			Theory	Practical	Total	Theory	Practical	Total
GT632_PW GT632_O	**Project in Genetics/Advanced Techniques in genome Analysis (Optional)**		4		4	4		4
	English	CC-1F	3		3	3		3
	Second language	CC-2F	3		3	3		3
GT 632A/632AP GT632B/GT632BP	**Optional I- A/B** **A. Human Genome & Human Genetics** **(or)** **Cellular & Molecular Immunology**	DSE-1F	4	3	7	4	1	5
	Optional- II **A/B**	DSE -2F	4	3	7	4	1	5
	Optional- III **A/B**	DSE -3F	4	3	7	4	1	5
	TOTAL				**33**			**25**

Total credits= 164-12 (AECC 4 + SEC 8) =15

AECC: Ability **E**nhancement **C**ompulsory Course
***SEC: S**kill **E**nhancement **C**ourse*
***DSC: D**iscipline **S**pecific **C**ourse*
***DSE: D**iscipline **S**pecific **E**lective*
***GE: G**eneric **E**lective*

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Department of Genetics and Biotechnology

Subject: Genetics

(BSc. Life Sciences)

Semester –V CBCS

W.e.f 2023-24 onwards

Paper V Theory

Title–ANIMAL GENETICS AND BIOTECHNOLOGY

Credits: 4
Paper Code: GT532
No of Hours: 60 (4hr/wk)

Employability: Knowledge of Genetics of lab animals like rabbits, mice etc, will be helpful in Industries working on vaccine development. Maintenance and cloning of lab animals will be useful to take up a career in Genetic Engineering and Genomics.

Course Objective: To examine the principles of Genetics in breeding systems for livestock, marker assisted selection, maintenance of laboratory animals, use of mice as models for human diseases, animal cell culture and production of transgenic animals

Cob 1: To discuss breeding systems for different livestock, use of DNA markers in artificial selection, and methods used for livestock improvement.

Cob 2: To examine the concepts of maintenance, mating methods and ethics for management and use of laboratory animals.

Cob 3: To compare the mouse and human genome and describe methods for development of transgenic mouse models to study human diseases.

Cob 4: To identify methods used in animal cell culture, importance of DNA based diagnostics and genetically engineered vaccines to protect livestock from diseases.

Unit 1: Livestock Genetics **15**

1.1. Domestication of livestock, important breeds of livestock with economic importance (cattle, sheep, goat, poultry etc). 2

1.2. Mating systems for different livestock - genetic and phenotypic consequences and applications of inbreeding and outbreeding. 3

1.3. DNA markers (RAPD, SNPs), genotyping for identification, parentage verification, and determination of specific homozygous/heterozygous gene mutations in animals for diseases and physical traits-marker assisted selection. 3

1.4. Livestock improvement Role of Artificial Insemination/frozen semen/embryo transfer/ONBS/MOET in animal breeding; embryo sexing 3

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1.5. Animal genetic resources in India - evaluation and characterization of indigenous breeds of livestock, ex-situ and in situ conservation of genetic resources- cryogenic preservation of animal germplasm 4

Unit 2: Laboratory Animal Genetics **15**

2.1. Laboratory animal species-mice, rat, rabbit - chromosome number, genome size-major genes. 3

2.2. Physiological, nutritional and reproduction parameters of mice, rat and rabbit 3

2.3. Pedigree recording, planned mating, selection and mating methods, monogamous, polygamous 3

2.4. Ethics and legislation for management and use of laboratory animals; Institutional Animal Ethical committee guidelines 3

2.5. Importance of Laboratory Animal Genetics in health, genetic and environmental monitoring. 3

Unit 3: Mouse models for Human disease **15**

3.1. Mouse as model-advantages of mouse models - similarities and differences of mouse and human genomes 3

3.2. Nomenclature of strains, inbred lines in mice. 3

3.3. Methods of generating mouse models-non-targeted and targeted strategies-knock in and knock-out mouse 3

3.4. Transgenic mouse models in cancer-Oncomouse 3

3.5. Mouse models for human genetic diseases—Neurodegenerative disease (Alzheimer's & Parkinson's disease) 3

Unit 4: Animal Cell Culture & Biotechnology **15**

4.1. Animal cell culture types of animal cell culture, cell lines, culture media Applications of animal cell culture. 3

4.2. Stem cell-properties of stem cells, embryonic stem cells, adult stem cells, tissue engineering. 3

4.3. DNA based diagnostics and genetically engineered vaccines for animals - rabies virus-commercial DNA rabies vaccines, West Nile virus – commercially available WNV vaccines, Vaccines against bovine respiratory syncytial virus & Vaccines against bovine viral diarrhoea disease. 4

4.4. Cloning adult animals by somatic cell nuclear transfer-significance of Dolly experiment. 2

4.5. Transgenic animals-methods for producing transgenic animals, examples of transgenic animals Super fish, Glo fish and Enviro pig. Transgenesis in the

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improvement of production traits: growth and meat traits, wool production, milk composition. 3

Course Outcome: Students appraise the concepts of Animal Genetics in selection and breeding methods of livestock, maintenance of laboratory animals, applications of transgenic mouse models, animal cell culture and development of transgenic animals for improved traits.

CO1: They identify the importance of selection and breeding methods in animals and relate to modern methods of livestock improvement such as AI and embryo transfer technology.

CO2: They examine the importance of Animal Genetics in human health, genetics and environmental monitoring.

CO3: They interpret the role of transgenic mouse models in the study of human diseases like cancers and Alzheimer's disease.

CO4: They value the development of improved varieties of livestock using transgenic technology.

Paper V Practicals

Credits: 1
Paper Code: GT532P
No of Hours: 45 (3hr/wk)

Skill Development: The students will be able to maintain and manage lab animals like Utility Mice and rats. They will be able to prepare animal tissue culture media and maintain cell lines.

Course Objective: To appraise the guidelines for maintenance of laboratory animals, ethics and legislation regarding management and use of laboratory animals; to demonstrate the basic procedures used in animal cell culture.

1. Laboratory animal species maintenance and specific utility-mice and rat
2. Management and use of laboratory animals-ethics and legislation.
3. Strains and inbred lines-nomenclature
4. Preparation of animal cell culture media.
5. Sterilisation of cell culture media
6. Cell counting by microscopy

Course Outcome: Students value the contribution of laboratory animals to Bioscience research and examine the procedures used in animal cell culture.

REFERENCE BOOKS

1. Text book of Animal Biotechnology by BSingh. The Energy and Resources Institute (TERI)

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2. Genetics for Animal Sciences by WH Freeman, Van Vleck LD, Pollak EJ &Bltenacu EAB, 1987.
3. Cancer Cell Culture: Methods and Protocols: 731 (Methods in Molecular Biology) Humana: 2nd ed. 2011 edition (28 April 2011)
4. Genetic Engineering by V.K.Agarwal and P.S. Varma, S. Chand & Company Ltd. 2009

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Subject: Genetics

(BSc. Life Sciences)

Semester –V CBCS

W.e.f 2023-24 onwards

Paper VA Theory

Title–PLANT GENETICS & BIOTECHNOLOGY

Credits: 4
Paper Code: GT532A
No of Hours: 60 (4hr/wk)

Employability: Knowledge of Plant Tissue Culture will help in pursuing a career in Plant Biotechnology based Research Labs & Plant tissue culture companies. Knowledge of plant breeding will be useful in a career in Agriculture based companies like Nagarjuna Seeds, Syngenta to name a few.

Course Objective: To examine the principles of plant biotechnology in tissue culture, plant breeding methods and creation of genetically modified crops.

Cob 1: To analyse the basics of plant life cycle, Plant growth hormones and plant nuclear and organellar genome.

Cob 2: To apply the principles of plant tissue culture in callus induction, protoplast culture and somatic embryos.

Cob 3: To examine plant breeding methods in self-pollinating and cross-pollinating species and hybrid seed production.

Cob 4: To identify methods used in creation of transgenic plants.

Unit 1: Basics of Plant Life Cycle and Genetics 15

1.1. Overview of plant development and life cycle sporogenesis, gametogenesis, pollination, fertilisation, embryogenesis (development of monocot & dicot embryos) 2

1.2. Seed (monocot & dicot) development and seed germination 2

1.3. Meristems-root apical meristems & root development; shoot apical meristems & leaf development; flower and fruit development 2

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1.4. Plant hormones and their actions- auxins, cytokinins, gibberellins, abscisic acid. ethylene, brassinosteroids 3

1.5. Plant Nuclear Genome Organisations - General features, Variation of Genome size among plants, fine structure of plant gene 3

1.6 Plant Organellar Genome Organisation - Mitochondria, Chloroplast 3

Unit 2: Plant Tissue Culture **15**

2.1. Media and culture conditions, sterile technique. 2

2.2. Regeneration methods of plants in culture - organogenesis, somatic embryogenesis; Somaclonal variation 2

2.3. Induction of callus and cell suspension cultures. 3

2.4. Protoplast culture conditions, sterile technique 2

2.5. Anther/microspore culture - production of haploids and double haploids and their uses 3

2.6 Somatic embryo culture and production of synthetic seeds. 3

Unit 3: Plant breeding & Hybrid seed production **15**

3.1. Mating Systems - self-fertilization, Cross fertilization and Apomixis. 2

3.2. Methods of breeding in Self-pollinating species - pedigree breeding, single-seed descent, bulk breeding method. 3

3.3. Methods of breeding in Cross-pollinating species - mass selection, recurrent selection. 3

3.4. Hybrid seed production - genetic male sterility (procedure for hybrid seed production by using GMS) 3

3.5. Hybrid seed production based on cytoplasmic genetic male sterility (seed production of CMS lines (A), maintainer line (B), restorer line (R) 2

3.6 Hybrid seed production based on functional male sterility system - gametocides and their use in hybrid seed production. 2

Unit 4: Transgenic plants production and applications **15**

4.1. Transformation based transgenic plants production - Agrobacterium tumefaciens and viral vectors. 2

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4.2. Direct gene transfer based transgenic plants production - particle bombardment, electroporation, silicon carbide whiskers, sonication, laser micro puncture, nanofiber arrays, chemical methods. 3

4.3. Genetically modified crops for insect resistance - Bt crops, microbes and plant derived toxins. 3

4.4. Genetically modified crops for Virus resistance - coat protein mediated cross protection, antisense and sense mediated resistance, satellite RNA protection pathogen targeted protection. 2

4.5. Genetically modified crops for Disease resistance - pathogenesis related proteins, anti-microbial proteins, engineering toxin insensitivity, phytoalexins, manipulation of disease resistance genes. 3

4.6. Transgenic plants for product quality - improved storage, longer shelf life, nutritional quality (Golden Rice) 2.

Course Outcome: Students value the concepts of Plant Genetics and Biotechnology in tissue culture, plant breeding and creation of genetically modified crops.

CO1: They identify the importance of basics of plant life cycle, Plant growth hormones and plant nuclear and organellar genome.

CO2: They examine the importance of principles of plant tissue culture in callus induction, protoplast culture and somatic embryos.

CO3: They value the role of plant breeding methods in self-pollinating and cross-pollinating species and hybrid seed production.

CO4: They evaluate methods used in creation of transgenic plants.

Paper V A Practicals

Credits: 1
Paper Code: GT532AP
No of Hours: 45 (3hr/wk)

Skill Development: Students learn media preparation, callus induction, micropropagation and anther culture.

Course Objective: To design the methods used in plant tissue culture like callus induction, anther culture and production of artificial seeds.

1. Histological studies of embryos at different stages

2. Seed testing for germination

3 Introduction to Plant tissue culture laboratory-equipment

4. Sterilisation methods in plant tissue culture laboratory -aseptic technique

5. Preparation of stock solutions of MS basal medium and plant growth regulators

6 Isolation of explants, establishment and maintenance of callus

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7. Culture of anthers and establishment of haploid plants

8. Preparation of synthetic seeds

Course Outcome: Students are able to develop procedures for callus induction, anther culture and production of artificial seeds.

.RECOMMENDED BOOKS

1. Principles of Plant Genetics and Breeding (2012) by George Acquaah, Second Edition Wiley-Blackwell Publishers.
2. Plant Tissue Culture: Techniques and Experiments (2013) by Roberta H. Smith, Academic Press, U.K
3. Plant Tissue Culture and Biotechnology: Emerging Trends (2003) P.B. KaviKishor, Universities Press
4. Plant Tissue Culture: Basic and Applied (2005) by Timir Baran Jha, Universities Press
5. Plant Biotechnology: Practical Manual (2007) by C. C. Giri, Archana Giri, I.K International Publishers
6. From Plant Genomics to Plant Biotechnology (2013) edited by PalmiroPoltronieri. NatalijaBurbulis, CorradoFogher, Woodhead Publishing Limited, New Delhi
7. Plant Genomics and Biotechnology (2016) Isabelle Nickel. Syrawood Publishing House
8. Plant Biotechnology and Agriculture: Prospects for the 21st Century (2012) edited by Arie Altman, Paul M. Hasegawa, Elsevier
9. PlantCell Biotechnology by Rudolf Endress, Springer-Verlag Berlin

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Department of Genetics and Biotechnology

Subject: Genetics

(BSc. Life Sciences)

Semester –V CBCS

W.e.f 2023-24 onwards

Generic Elective

Title– BASIC & APPLIED GENETICS

Credits: 4
Paper Code: GE532
No of Hours: 60 (4hrs/week)

Course Objectives:To analyse the concepts of basic Genetics with respect to Mendel's Laws of inheritance, Structure of Nucleic Acids, Cell structure, Cell division, Genetic Engineering and Genetic Diseases.

Cob 1: To examine the patterns of Mendelian Inheritance.

Cob 2: To analyse structure of Nucleic Acids, Cell Structure and Cell Division.

Cob 3: To evaluate the principles and applications of Genetic Engineering.

Cob 4: To interpret the mechanisms that cause various Human Genetic Diseases

Unit 1: Introduction to Genetics	**15**
1.1. Genotype & phenotype; homozygous & heterozygous; dominant & recessive; gene & allele	2
1.2. Mendelian genetics-Principle of dominance, Principle of segregation, Principle of Independent Assortment	3
1.3. Trait Inheritance ABO blood groups in human; eye colour in Drosophila	2
1.4. Polygenic Inheritance -Kernel colour in Maize, skin colour in man	3
1.5. Sex-linked Inheritance - haemophilia and colour blindness in man	2
1.6. Non-Mendelian inheritance-Maternal inheritance-Variegation in leaves of higher plants-Mirabilis Jalapa	3

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Unit 2: Cellular & Molecular basis of Inheritance:	**15**
2.1. DNA structure and its alternative forms (A, B & Z)	3
2.2. RNA-types of RNA (rRNA, mRNA & tRNA)	2
2.3. Ultra-structure of prokaryotic cell (cell membrane and plasmids, Nucleoid)	2
2.4. Ultra-structure of eukaryotic cell (nucleus, mitochondria, chloroplast, endoplasmic reticulum, golgi apparatus)	3
2.5. Chromosomes: Packaging of DNA into Chromosomes, structure(centromere and telomere), karyotype	3
2.6. Cell division stages of mitosis, meiosis I & II & fertilisation	2
Unit 3: Genomes & Genetic Engineering	**15**
3.1. Prokaryotic genomes-genome size & organisation	2
3.2. Eukaryotic genomes-features of eukaryotic nuclear and organellar genomes	2
3.3. Human genome project-goals and achievements	3
3.4. Genetic Engineering - Transgenic plants-Bt cotton, Golden rice	2
3.5. Genetic Engineering - Transgenic animals -Molecular pharming-Buffalo and Goat	3
3.6. Genetic Engineering: Environment- bioremediation	2
3.7 Vaccines- Indigenous Covid vaccines	1
Unit 4: Human Genetics	**15**
4.1. Human nuclear genome -general features, protein coding genes. RNA coding genes, non-coding DNA 2	
4.2. Human chromosome anomalies: Down's syndrome and Klinefelter's syndrome	2
4.3. Single gene disorders-Hemoglobinopathies(Sickle cell disease,Thalassemias)	2
4.4. Complex genetic diseases-Hypertension. Diabetes mellitus	3
4.5. Genetic testing: Prenatal screening (Invasive methods and non-invasive techniques). Neonatal screening (PKU), Preclinical screening (Alzheimer's)	3
4.6. Therapeutics: Conventional treatment modalities- PKU; Gene therapy: Types-somatic and germ line gene therapy, Gene therapy trials: ADA deficiency3	

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Course Outcome:Students distinguish the inheritance of different traits, types of nucleic acids, mitotic & meiotic cell division, types of genetic disorders and value the applications of Genetics to agriculture, animal husbandry, human health and medicine.

CO1: They recognize Mendel's laws of inheritance and different inheritance patterns.
CO2: They compare the structure and function of different types of nucleic acids, prokaryotic and eukaryotic cells, mitotic and meiotic cell division.
CO3: They appraise the importance of transgenic plants& transgenic animals in addressing global issues like food scarcity, nutrient deficiency etc. and bioremediation to reduce environmental pollution.
CO4: They identify different types of human genetic diseases, techniques of genetic testing and treatment strategies.

RECOMMENDED BOOKS

1. The Foundations of Genetics by F.A. I. Crew, Elsevier, 2014

2 Concepts of Genetics, 7/E by Klug, Pearson Education India, 2002

3 Genetics byKarvita B. Ahluwalia, New Age International, 2009

4. Genetics by M. Yadav, Discovery Publishing House, 2003

5. Human Genetics: The Basics byRicki Lewis Taylor & Francis, -2016

6. Essentials of Human Genetics by Bhatnagar, S.M. Orient Blackswan, 1999

7. DNA Technology: The Awesome Skill by I. Edward Alcamo, Gulf Professional Publishing, 2001

8. Recombinant DNA Technologyby KeyaChaudhuri, The Energy and Resources Institute (TERI), 2013

9. Recombinant DNA Technology edited by Sardul Singh Sandhu, I.K. International Pvt. Ltd, 2010

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Department of Genetics and Biotechnology

Subject: Genetics

(BSc. Life Sciences)

Semester –VI CBCS

W.e.f 2023-24 onwards

Paper VI Theory

Title–Human Genome & Human Genetics

Credits: 4
Paper Code: GT632
No of Hours: 60 (4hr/wk.)

Employability: Knowledge of Human Genome and Human Genetics will be helpful in pursuing research/career in National institutes like CCMB & CDFD; Genetic testing & diagnostic laboratories like MedGenome, Mapmygenome, and GeneTech; Genetic Counselling in multi speciality hospitals such as Apollo & KIMS; and research labs that specialise in molecular medicine & gene therapy like Roche.

Course Objectives:To examine the basic concepts and developments in the field of Human Genetics with respect to the human genome organisation, the Human Genome Project, types of genetic diseases, prevention and management of genetic diseases including gene therapy.

Cob 1: To distinguish the important features of human genome organisation, gene families and the types of sequences.

Cob 2: To appraise the achievements of the Human Genome Project and the emergence of the 'omics' era (genomics, proteomics, transcriptomics, epigenomics and pharmacogenomics).

Cob 3: To differentiate types of human genetic disorders.

Cob 4: To recognize the importance of screening, prenatal diagnosis, genetic counselling and treatment strategies in the prevention and management of human genetic diseases

Unit 1: The Human Genome 15

1.1. Human nuclear genome organisation - gene size and density, organisation of protein coding genes 3

1.2. Gene families - globin gene family, histone gene family 2

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1.3. Non - coding RNA genes - rRNA, tRNA &micro-RNA 2

1.4. Repetitive elements - LINES, SINES, LTR elements, satellites, minisatellites, microsatellites, Transposons 3

1.5. Human Mitochondrial genome organisation 2

1.6 Human Genome Variation - DNA Sequence variants, genetic polymorphisms, gene duplication and evolution. 3

Unit 2: Human Genome Project - Applications **15**

2.1. Human genome project - Goals and achievements, Applications and Ethics 2

2.2. Comparative genomics - evolutionary constrained sequences, diversified sequences, G-valve paradox. 3

2.3. Transcriptomics - Transcriptome analysis - Microarrays, RNA sequencing (RNA-Seq), Gene expression profiling. 3

2.4. Epigenomics - Epigenetic modifications (DNA methylation, Histone Modifications); genomic imprinting. 3

2.5. Proteomics - Proteome analysis, Protein arrays and their applications. 2

2.6 Pharmacogenomics - role of SNP in drug response Ex. G6PD 2

Unit 3: Chromosomal & Genetic defects in Human **15**

3.1. Human chromosomal disorders - Disorders due to Autosomes and sex chromosomes: Abnormalities due to Chromosome Number and structure 3

3.2. Inborn errors of metabolism - Amino acid metabolism (Phenylketonuria), Protein metabolism (Duchenne muscular dystrophy) 2

3.3.Single gene disorders - Pattern of inheritance - Autosomal disorders: Dominant - Huntington's disease, Recessive-Haemophilia; X-linked disorders: dominant - Fragile X syndrome, Recessive - DMD. 3

3.4. Complex disorders - Multifactorial inheritance (Diabetes mellitus, Hypertension), threshold effect. 2

3.5. Genetics of cancer- Types of genes- proto-oncogenes, oncogenes, tumour suppressor genes - Breast and Colon cancers. 3

3.6 Mitochondrial inheritance and associated disorders - Leber's Hereditary Optic Neuropathy, Kearns-Sayers syndrome. 2

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Unit 4: Genetic counselling, testing and therapeutics **15**

4.1. Genetic counselling and risk assessment for autosomal dominant, autosomal recessive, sex linked inherited diseases. 2

4.2. Prenatal diagnosis – invasive(Amniocentesis, Chorionic villus sampling) and non-invasive (Ultrasonography, fetoscopy) 2

4.3. New-born screening (PKU), Preclinical screening - Sickle cell anaemia. 3

4.4. Ethical, legal and Social Issues of genetic testing and screening 3

4.5. Traditional treatment modalities - PKU, ADA 2

4.6 Gene therapy: Types-somatic and germ line gene therapy; Gene therapy trials: ADA deficiency, Cystic Fibrosis. 3

Course Outcome:Students recognise the basic concepts and advancements in the field of Human Genetics and its role in human health and medicine.

CO1: They identify the important features of the human genome organisation, gene families and types of sequences in the human genome.

CO2: They interpret the advancements in Human Genetics as a consequence of the efforts and success of the Human Genome Project.

CO3: They differentiate the mechanisms involved in causing human genetic defects/diseases.

CO4: They value the role of genetic screening, genetic testing, prenatal diagnosis, genetic counselling, and various treatment strategies in reducing the burden of genetic disease in society.

Paper VI Practicals

Credits: 1
Paper Code: GT632P
No of Hours: 45(3hr/wk)

Skill Development: Students learn the method of karyotyping, identification of the mode of inheritance from pedigrees, risk estimation using the concept of probability & Bayes theorem and amplification of DNA using PCR.

Course Objective:To demonstrate the role of karyotyping in identification of chromosomal disorders, inactivation of one X chromosome in normal females, identification of mode of inheritance by pedigree analysis, risk estimation and use of PCR in disease diagnosis.

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1. Karyotyping (normal male/normal female)

2. Leucocyte culture and G-banding

3. Isolation of genomic DNA from blood sample.

4. Screening for Barr bodies

5. Construction of pedigrees and identification of mode of inheritance of a trait

6. Estimation of risk analysis using pedigrees

7. Diagnosis of diseases by PCR based methods

Course Outcome: Students examine karyotyping procedure, chromosomal abnormalities in Idiograms, different modes of inheritance of traits, risk estimation using rules of probability and disease diagnosis based on PCR.

RECOMMENDED BOOKS:

1. A.G. Motulsky and F. Vogel (1986) HumanGenetics

2. R. F. Mueller and LD Young (2001) Emery's Elements of Medical Genetics

3. Curt Stern (1960) Principles of Human Genetics

4. Gardner, A. and Davies, T. (2009) Human Genetics-Scion Publishing, 2nd ed.

5. Lewis, R.(2008) Human Genetics: Concepts and Applications, McGraw Hill Publishing. New York, 8th ed.

6. Lewis, R. (2011). Human Genetics-The Basics, Routledge, London

7. Mange. E.J. and Mange, A.P. (1999). Basic Human Genetics, Sinauer, Sunderland

8. Scriver, C.R.A.L. Beudit. W.S. Sty and D. Valle, Molecular Basis of Inherited Diseases. (6th Edition 1989) by EdsO McGrawHill, New York.

9. Tom Strachan and Andrew Read (1996) Human Molecular Genetics

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(Accredited with 'A' grade by NAAC)

Department of Genetics and Biotechnology

Subject: Genetics (Optional)

(BSc. Life Sciences)

Semester –VI CBCS

W.e.f 2023-24 onwards

Paper VI A Theory

Title–Cellular & Molecular Immunology

Credits: 4
Paper Code: GT632A
No of Hours: 60 (4hr/wk)

Employability: Study of Cellular and Molecular Immunology helps students to pursue a career in vaccine producing companies like Indian Immunologicals, Bharat Biotech, Serum Institute of India, to name a few. They can also pursue research & career in immunology based laboratories such as National Institute of Virology, Pune, National Institute of Immunology, New Delhi etc.

Course Objectives:To differentiate innate and adaptive immunity, cellular and humoral, interpret the functioning of MHC, causes of hypersensitivity, auto immunity, immunodeficiency disorders and identify the uses of various immunological techniques.

Cob 1: To recognise basics concepts of the immune system and types of immunity.

Cob 2: To describe the humoral and Major Histocompatibility Complex (MHC) components of the immune system.

Cob 3: To distinguish cellular immune response, mechanisms involved in hypersensitivity, auto-immunity; immunodeficiency disorders and types of vaccines.

Cob 4: To examine the different techniques used in immunology.

Unit 1: Innate and Adaptive Immunity 15

1.1. Introduction to Immune System, types of immunity-innate and adaptive 2

1.2. Innate immunity - anatomical barriers and physiological barriers, phagocytic barrier 2

1.3. Cellular components of immunity - Lymphoid Cells (B cells, T cells and NK cells), Myeloid cells (Neutrophils, Eosinophils, basophils, mast cells, macrophages and dendritic cells) 3

1.4. Lymphoid organs- Primary lymphoid organs (Bone Marrow and thymus); secondary lymphoid organs (lymph node and spleen) 3

1.5. Antigens - Immunogens, epitopes 3

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1.6 Haptens and types of adjuvants 2

Unit 2: Humoral and MHC immune responses **15**

2.1. Basic structure of Immunoglobulin - Immunoglobulin domains- variable region and constant region domains; isotypes, allotypes, idiotypes 3

2.2. Immunoglobulin classes and its functions - IgG, IgM, IgA, IgD, IgI. 2

2.3. Polyclonal antibodies, Monoclonal antibodies - its production and applications. 2

2.4. Structure and organization of MHC class I and class II molecules. 3

2.5. MHC molecules - cellular distribution and immune responsiveness. 2

2.6. Types of grafts: Role of HLA typing in organ transplantation. 3

Unit 3: Cell mediated Immune response and Vaccines **15**

3.1. Cell mediated immunity: Structure and functions of T-cell receptors; Antigen presenting cells (APCs), ternary complex (TCR, peptide and MHC); Cytokines 3

3.2. Hypersensitivity - Types (I, II, III & IV) 2

3.3. Autoimmunity - mechanisms of autoimmunity and autoimmune diseases (thyroid and Rheumatoid arthritis) 2

3.4. Immunodeficiency disorders - primary immunodeficiency disorders (SCID), secondary immunodeficiency disorders (AIDS) 3

3.5. Vaccines - historical background and principle; passive and active immunisation, attributes of effective vaccines. 2

3.6 Types of vaccines - live attenuated and inactivated killed vaccines, subunit vaccines, DNA vaccines, edible vaccines. 2

3.7 Covid-19- Cause and Vaccine development strategies in India. 1

Unit 4: Immunological Techniques **15**

4.1. General features of ag-ab reactions - Agglutination, neutralisation, complement fixation, opsonization 3

4.2. Immunoprecipitation, immunoelectrophoresis, immunodiffusion tests 2

4.3. ELISA –Types(Sandwich, Indirect, Dot ELISA) - Principle and applications. 3

4.4. Immunofluorescence assays (direct and indirect) - Principle and Applications 3

4.5. Western blot - Principle, methodology and applications 2

4.6 Flow Cytometry - Principle, methodology and applications 2

Course Outcome: Students recognise the basic concepts of Immunology, mechanisms involved in hypersensitivity, auto immunity, immunodeficiency disorders, principles of immunology in vaccines development and importance of immunological techniques.

CO1: They distinguish innate and adaptive immunity and various components of the immune system.

CO2: They distinguish different types of immunoglobulins in terms of structure and function and relate the role of MHC/HLA in organ/tissue transplantation.

CO3: They interpret the role of the immune system in types of hypersensitivity, autoimmune disorders, immunodeficiency disorders and development of different types of vaccines.

CO4: They compare the principles and applications of different immunological techniques.

RECOMMENDED BOOKS

1. Essential Immunology by I. Roitt,Publ: Blackwell
2. Immunology by C. Reever&I. Todd,Publ: Blackwell
3. Immuno diagnostics by S.C.Rastogi, Publ: NewAge
4. Immunology by Richard A.Goldsby, Thomas J Kindt, Barbara Osborne, Janis Kuby
5, Fundamental immunology by William E. Paul
6. Basic Immunology by Bhoos Reddy G.L. and Wadher B. J.
7. Textbook of Immunology by Baruj Benacerraf
8. Immunology by Kuby. Publ:Freeman

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Paper VI A Practicals

Credits: 1
Paper Code: GT632AP
No of Hours: 45(3hr/wk)

Skill Development: Students learn the principle and working of important techniques used in immunology such as ELISA, SRID, Coomb's test and Western Blot.

Course Objective: To distinguish the principle and applications of commonly used immunological techniques.

1. ABO blood typing
2. Differential count of lymphocytes
3. Single Radial Immunodiffusion
4. ELISA
5. Agglutination
6. Haemagglutination test
7. Coomb's test
8. Western Blot

Course Outcome: Students evaluate the importance of different immunological techniques and relate to their applications.

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Department of Genetics, Biotechnology and Botany

Subject: Genetics

Semester –VI

W.e.f 2023-24 onwards

Advanced Techniques in Genome Analysis

Credits: 4
Paper Code: GT632_O
No of Hours: 60(4hr/wk)

Employability: Students can pursue research/career in companies/institutes/University departments that deal with molecular biology techniques and genetic engineering of plants and animals such as Centre for Cellular & Molecular Biology (CCMB), Institute of Genomics and Integrative Biology (IGIB), and National Institute of Plant Genome Research (NIPGR) etc.

Course Objectives: To recognise the importance of biophysical techniques, genome analysis techniques, gene transfer techniques and their applications

Cob1: To examine biophysical techniques such as electrophoresis, hybridization, PCR etc.

Cob2: To discuss advanced genome analysis techniques like NGS and DNA Microarray.

Cob3: To describe gene transfer strategies for the development of Genetically Modified Organisms.

Cob4: To value the production of transgenic plants and animals.

Unit I: Biophysical Techniques. **15**

1.1. Chromatography – Principles and applications –Separation of peptides and amino acids. 3

1.2. Gel electrophoresis – Principles and applications. 2

1.3. Separation of proteins and nucleic acids- Agarose and PAGE. 3

1.4. Polymerase chain reaction (PCR) Principle and its applications. 3

1.5. Types of PCR- Reverse Transcription PCR, Inverse PCR, Anchored and site Directed PCR. 2

1.6. Autoradiography – Principles and Applications. 2

Unit II: Advanced techniques in genome analysis. **15**

1.1. Hybridization techniques – Southern, Northern, Western blotting techniques – FISH, Principles and Applications. DNA - Microarray technology. 3

1.2.DNA sequencing – Maxam Gilbert's method, Sanger's method and automated sequencing, Next Generation Sequencing. 3

1.3. Hybridoma technology and production of Monoclonal Antibodies. 2

1.4. Chromosome Banding - G-banding, C-banding, R-banding, Q-banding, NOR banding. 2

1.5. Flow cytometry – cell sorting & isolation of individual chromosomes. 2

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Course Outcome:Students distinguish the inheritance of different traits, types of nucleic acids, mitotic & meiotic cell division, types of genetic disorders and value the applications of Genetics to agriculture, animal husbandry, human health and medicine.

CO1: They recognize Mendel's laws of inheritance and different inheritance patterns.
CO2: They compare the structure and function of different types of nucleic acids, prokaryotic and eukaryotic cells, mitotic and meiotic cell division.
CO3: They appraise the importance of transgenic plants& transgenic animals in addressing global issues like food scarcity, nutrient deficiency etc. and bioremediation to reduce environmental pollution.
CO4: They identify different types of human genetic diseases, techniques of genetic testing and treatment strategies.

RECOMMENDED BOOKS

1. The Foundations of Genetics by F.A. I. Crew, Elsevier, 2014

2 Concepts of Genetics, 7/E by Klug, Pearson Education India, 2002

3 Genetics byKarvita B. Ahluwalia, New Age International, 2009

4. Genetics by M. Yadav, Discovery Publishing House, 2003

5. Human Genetics: The Basics byRicki Lewis Taylor & Francis, -2016

6. Essentials of Human Genetics by Bhatnagar, S.M. Orient Blackswan, 1999

7. DNA Technology: The Awesome Skill by I. Edward Alcamo, Gulf Professional

Publishing, 2001

8. Recombinant DNA Technologyby KeyaChaudhuri, The Energy and Resources Institute (TERI), 2013

9. Recombinant DNA Technology edited by Sardul Singh Sandhu, I.K. International Pvt.

Ltd, 2010

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1.6. DNA Fingerprinting – RAPD technique, VNTRs. 3

Unit III: Techniques of gene transfer **15**

1.1.Physical methods – Electroporation – Microprojectile bombardment. 3
1.2.Chemical methods – Liposome fusion, Calcium precipitation of DNA. 3
1.3.Gene transfer by Plant vectors –Ti vectors, CaMV and Gemini virus. 3
1.4.Gene transfer by Animal Vector- SV 40 and BPV. 2
1.5.Engineered embryonic stem cells – method. 2
1.6.Selection of engineered embryonic stem cells -positive, negative selection, PCR method. 2

Unit IV: Genetic engineering of Plants and Animals. **15**
1.1.Transgenic plants – Need for developing transgenic plants. 1
1.2. Development of insect and herbicide resistant plants. 3
1.3. Development of stress tolerant plants. 2
1.4. Transgenic animals – Need for developing transgenic animals. 1
1.5. Nuclear transfer and cloning. 2
1.6. Developing transgenic animals – Cattle, Birds and Fish 3
1.7. Transgenic Mice – animal models for genetic diseases. 2
1.8 Gene Editing- CRISPR CAS 9 1

Outcomes: Students compare the principles and applications of various biophysical techniques, genome analysis techniques and gene transfer protocols

CO1: To value biophysical techniques such as electrophoresis, Hybridization techniques, PCR etc.
CO2: To appreciate advanced genome analysis techniques like NGS and DNA Microarray.
CO3: To differentiate gene transfer strategies for the development of Genetically Modified Organisms.
CO4:To appraise the uses of transgenic plants and animals.

Recommended Books

1. Molecular Biotechnology Principles and Applications of recombinant DNA by BR Glick and JJ Pasternak
2. Next-Generation DNA Sequencing Informatics by Stuart M. Brown
3. Biophysical Chemistry by Upadhayay and Upadhayay
4. Recombinant DNA by James D Watson

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5. Plant Biotechnology by H.S.Chawla

6. Gene Cloning by T. A. Brown

7. Principles of Gene Manipulation by Old & Primrose

Semester –VI

W.e.f 2022-'23 onwards

Advanced Techniques in Genome Analysis and Genetic Engineering (Practical))

Credits: 1
Paper Code: GT632_OP
No of hours: 45 hrs (3hr/ week)

Objectives: To implement techniques like chromatography, electrophoresis and leucocyte culture.

1.Identification of amino acids / proteins by chromatography.

2. Separation of proteins by electrophoresis.

3. Separation of nucleic acids by electrophoresis.

4.Restriction digestion analysis.

5. Leukocyte Culture

6.Karyotyping and G banding of Human chromosomes.

Outcomes: The students distinguish uses of cytogenetic techniques like Karyotyping and biophysical techniques like Agarose and Polyacrylamide gel electrophoresis.

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Department of Genetics and Biotechnology
Subject: Biotechnology
B.Sc Life Sciences
Semester–VI
CBCS
W.e.f 2023-24 onwards
PROJECT WORK

Credits: 4

Paper Code: BT632_PW
No of Hours: 60 (4hr/wk)

1. **Basic concepts of Project planning**

   a) **Selection of Project topic and defining objectives**
   b) **Planning of methods/approaches**

2. **Guidelines for Project writing**

- **Title of the project:**
- **Title page- Name of the Project, Name of the Student & the Supervisor**
- **Declaration by Student**
- **Declaration by Supervisor**
- **Introduction**
- **Objectives**
- **Review of Literature**
- **Methodology**
- **Results and Discussion**
- **Conclusion**
- **References**

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Course Objectives:

Cob 1: To develop practical and project writing skills.

Cob 2: To select a topic and execute the planned work using scientific analysis and logic.

1. **Project work will involve experimental work/data collection and it has to be completed in the stipulated time by the student.**

- Students will be asked their choice for Project work at the beginning of Semester VI and all formalities of topic and mentor selection will be completed. Project work will be offered as per the expertise and infrastructural facilities available in the department.

- Project work may be allotted to students as individual or as group project (not exceeding 4-5 students per group).

- The completed work and compiled data would be presented in the form of results and submitted in the form of a dissertation/project report.

- Final evaluation of the project work will be through a panel consisting of internal and external examiners.

- Guidelines provided for execution and evaluation of project work will be strictly adhered.

- The grading would be based on evaluation of punctuality, experimental work, record keeping, academic inputs, data presentation, interpretation etc.

Course Outcome:
At the end of the course, students will be able to
CO1: Plan and execute a project effectively in the stipulated time.
CO2: They develop analytical skills, statistical data handling skills, paper writing and oral presentation skills.

PROJECT WORK EVALUATION SCHEME

Presentation of Thesis Dissertation to External Examiner - 70 Marks
(50 Presentation + 20 Dissertation)

Continuous Evaluation by the Internal Examiner - 30 Marks

Total - 100 Marks

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