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, Biotechnology and Botany
Subject: Genetics (Optional)
(BSc. Life Sciences)
W.e.f 2021-22 onwards
BSC GENETICS II YEAR

SEMESTER III PAPER III

DSC-IC BIOSTATISTICS AND BIOINFORMATICS

Code: GT332

Credits :4

No. of Hrs: 60 hrs

Skill development for employability in the field of Biostatistics and Bioinformatics.

Objectives:

Cob 1: To analyse the measures of central tendency, dispersion and principles of probability.

Cob 2: To apply statistical tests for testing of hypothesis and analysis of variance.

Cob 3: To implement bioinformatics tools and resources using biological databases.

Cob 4: To compare the various methods of sequence alignment.

Unit 1: Descriptive Biostatistics and Probability **15 hrs**

1.1. Introduction to biostatistics, kinds of data and variables- based on nature (numerical - discrete and continuous; categorical- ordinal and nominal) - based on source (primary and secondary data): sample size, sampling methods and sampling errors. (3)

1.2. Data tabulation and representation methods: Graphical methods- stem and leaf plot. line diagram, bar graphs, histogram, frequency polygon, frequency curves. Diagrammatic method- pie diagram. (2)

1.3. Measures of Central tendency: mean, median, mode; merits and demerits. (2)

1.4. Measures of Dispersion-range. variance, standard deviation, standard error and coefficient of variation: merits and demerits. (2)

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1.5. Concepts of probability: random experiment, events, probability of an event, probability rules (Addition and Multiplication rules), permutations and combinations, random variables (Discrete and Continuous). (3)

1.6. Probability Distributions: Binomial & Poisson distributions for discrete variables. Normal distribution for continuous variables. (3)

Unit 2: Applications of Biostatistics **15 hrs**

2.1. Hypothesis testing Steps in testing for statistical hypothesis, null and alternate hypothesis. level of significance: type-1 and type-2 errors(2)

2.2. Test of significance for small samples- Student's t-test (one sample and two samples).(2)

2.3. Test of significance for large samples- z-test of means and proportions. (2)

2.4. Chi-square test and its applications- goodness of fit, independence.(2)

2.5. Analysis of Variance (ANOVA) - one way analysis.(3)

2.6. Correlation- Definition. Simple and Linear analysis, Karl Pearson's correlation coefficient.(4)

Unit 3: Introduction to bioinformatics and biological databases **15 hrs**

3.1. Bioinformatics definition, history, scope and applications.(2)

3.2. Bioinformatics tools and resources- internet basics. Role of internet: free online tools downloading free softwares and installation.(3)

3.3. Bioinformatic web portals- NCBI, EBI and EXPASy(2)

3.4. Biological databases: Classification of databases- primary (GenBank), secondary (PIR) and tertiary or composite (KEGG) databases.(2)

3.5. DNA sequence databases (ENA & DDBJ).(3)

3.6. Protein sequence databases (Swissprot & PROSITE).(3)

Unit 4: Sequence Alignment **15 hrs**

4.1. Basics of sequence alignment - match, mismatch, gaps, gap penalties, scoring alignment.(3)

4.2. Types of sequence alignment - pairwise and multiple alignment, local and global alignment.(2)

4.3. Dot matrix comparison of sequences (2)

4.4. Scoring matrices - PAM and BLOSUM (3)

4.5. Pairwise sequence similarity search by BLAST and FASTA. (2)

4.6. Concepts of phylogenetic tree- character based (maximum likelihood & maximum parsimony method). (3)

By the end of the course, students will be able to

CO1: Apply the measures of central tendency, dispersion and principles of probability.

CO2: Implement statistical tests for testing of hypothesis and analysis of variance.

CO3: Interpret the tools of bioinformatics and resources for biological databases.

CO4: Investigate various methods of sequence alignment.

DSC-IC BIOSTATISTICS AND BIOINFORMATICS

PRACTICALS

W.e.f 2021-22 onwards

Code: GT332P

Credits:1

No. of Hours: 30hrs(2hrs/week)

Skill development to use the basic tools of Biostatistics and Bioinformatics.

Cob: To solve numericals in biostatistics and implement the tools of bioinformatics using biological databases.

1. Calculation of mean, median, mode, standard deviation, variance, standard error, coefficient of variation for a variable.
2. Construction of bar diagram, pie diagram, line diagram, histogram and box plot for data.
3. Problems on hypothesis testing using Z test, t-test and Chi-square test.
4. Problems of probability and probability distributions.
5. Exploring web portals-NCBI. EBI & ExPASY.
6. Literature search through PubMed and PubMed Central.
7. Sequence retrieval from GenBank, ENA and Swissprot.
8. Pairwise homology search by BLAST and FASTA.

CO: By the end of this course, students will be able to use various statistical tools and compare tools of bioinformatics.

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RECOMMENDED BOOKS

1. Khan & Khanum (2004), Fundamentals of Biostatistics, II Revised Edition. Ukaaz Publication

2. Bailey, N.T.J, Statistical methods in Biology, Cambridge Univ. Press

3. Fundamentals of Biostatistics, P Hanumantha Rao and K.Janardhan

4. Danial, W. W. Biostatistics, Wiley

5. Introduction to Bioinformatics by Aurther M lesk

6. Developing Bioinformatics Computer Skills By: Cynthia

7. Bioinformatics second edition By David M mount

8. Essential Bioinformatics by Jin Xiong

9. Bioinformatics Computing By Bryan Bergeron

10. Bioinformatics: Concepts, Skills & Applications by R.S. Rastogi

11. Queen. J. P.. Quinn, G. P., & Keough. M. J. (2002). Experimental design and data analysis for biologists Cambridge University Press.

12. Mahajan. B. K. (2002). Methods in biostatistics Jaypee Brothers Publishers.

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Semester –IV CBCS
W.e.f 2021-22 onwards
BSC GENETICS II YEAR

SEMESTER IV PAPER IV

DSC-ID POPULATION GENETICS & EVOLUTION

Code: GT432

Credits : 4

No. of Hours: 60

Basic Knowledge and skills for research in the field of Life Sciences, prepares students for a career in Evolutionary Biology.

Objectives:

Cob 1: To analyse the structure of populations and genetic equilibrium.

Cob 2: To explain mutation, migration and selection.

Cob 3: To evaluate the consequences of inbreeding in populations.

Cob 4: To demonstrate genome evolution at the molecular level.

Unit 1: Principles of Population genetics **15 Hrs**

1.1. Population structure, Random mating population, Concepts of a population (gene pool, deme and panmictic unit). (2)

1.2. Genetic and phenotypic variation in a population, allele frequencies and genotype frequencies at a locus. (2)

1.3. Hardy-Weinberg Law- assumptions and implications, establishment of Hardy Weinberg equilibrium for single gene locus.(3)

1.4. Extension of Hardy-Weinberg Law for multiple alleles.(2)

1.5. Establishment of Hardy-Weinberg Law for X-linked genes. (3)

1.6. Linkage disequilibrium haplotypes. coefficient of linkage disequilibrium, coupling gametes and repulsion gametes. (3)

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Unit 2: Selection, Mutation & Migration 15 Hrs

2.1. Selection- fitness, patterns of natural selection, general selection equation, equilibrium under selection.(3)

2.2. Selection favouring heterozygotes: stable equilibrium, balanced polymorphism (sickle cell anaemia, heterozygote advantage). (3)

2.3. Selection against heterozygotes: unstable equilibrium (Rh incompatibility) complete elimination of recessive genes.(2)

2.4. Mutation influence of mutation on allele frequencies, balance between forward and backward mutation.(3)

2.5. Genetic load - mutational and segregational.(2)

2.6. Gene flow- Migration - Wahlund effect.(2)

Unit 3: Inbreeding, Genetic Drift and Quantitative inheritance 15 Hrs

3.1. Inbreeding-non-random mating, Identity by descent, selfing. (2)

3.2. Construction of pedigrees- Raw & forked pedigrees - inbreeding coefficient.(3)

3.3. Effect of inbreeding on genotype frequencies and inbreeding depression(2)

3.4. Genetic Drift - Bottleneck effect. Founder effect.(2)

3.5. Effective population size, consequences of a decreasing population size.(3)

3.6. Quantitative vs qualitative traits- genetic and environmental values measures of variances. (3)

Unit 4:Genetic Variation and Molecular Evolution 15 Hrs

4.1. The origin of genomes- Acquisition of new genes by gene duplication and from other species.(2)

4.2. Origin of non-coding DNA, transposable elements and introns.(3)

4.3.Molecular phylogenetics- DNA sequence and protein sequence phylogenetics.(3)

4.4. Molecular Evolution-neutral theory.(2)

4.5. Establishment of evolutionary relationship - molecular clock.(2)

4.6. Construction of molecular phylogenetic trees- UPGMA, NJ methods.(3)

By the end of the course, students will be able to

CO1: To demonstrate the concept of genetic equilibrium and recognise HWE.

CO2: To differentiate the effects of mutation, migration and selection.

CO3: Interpret the effects of inbreeding in populations through inbreeding coefficient.

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CO4: To judge evolutionary relationships between/among organisms.

Semester –IV CBCS

BSC GENETICS II YEAR

SEMESTER IV PAPER IV

DSC-ID POPULATION GENETICS & EVOLUTION

PRACTICALS

W.e.f 2021-22 onwards

Code : GT432P

Credits: 1

No. of hrs: 30 hrs (2hrs/week)

Skill development in mathematical analysis and reasoning for a career in research.

Cob : To solve numericals on HWE and construct pedigrees to deduce inbreeding coefficient.

1. Calculating allele and genotypic frequencies.

2. Testing of gene frequencies for Hardy-Weinberg equilibrium – monogenic.

3. Testing of gene frequencies for Hardy-Weinberg equilibrium -multiple alleles and sex linked linked loci.

4. Testing for deviation of HW equilibrium using chi-square test.

5. Estimation of mutation rates.

6. Calculation of gene frequencies under different types of selection.

7. Construction of pedigrees-raw and forked pedigrees.

8. Estimation of inbreeding coefficient using pedigrees.

CO: By the end of this course, students will be able to apply the concepts of HWE, Chi square test and inbreeding coefficient.

RECOMMENDED BOOKS

1. Hedrick P. W. -Jones & Bartlett. Genetics of Population
2. Hartl D. L. And Clark A. G., Principle of Population Genetics, Sinauer Associates
3. Falconer. D (1995) Introduction to Quantitative Genetics, 4th edition London
4. Stickberger, M. W (1990) Evolution, Jones and Bartlett, Boston
5. Population Genetics- C C Lee

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Department of Genetics and Biotechnology

Skill Enhancement Course- Credits 2

Effective from 2023-'24 onwards

Title: Medicinal Plants-SE332

Skill Development: Students learn the powder analysis, histo chemical & specific chemical analysis of crude drugs like turmeric, ginger, cloves, cinnamon, and senna. They learn the basic concepts of Pharmacognosy.

Course Objective: To develop skill in analysis of crude drugs and examine the importance of medicinal plants in alternative systems of medicine like Ayurveda and Siddha.

Cob 1:To distinguish Rhizome, Bark, Leaf, Flower, Fruit drugs and analyse their medicinal properties by powder analysis.

Cob 2: To enhance identification skills by Herbarium preparation.

UNIT I: **(15 hours)**

1. History and Scope of Medicinal Botany with reference to Ayurveda and Siddha. (3)

2. Sources, Classification, Collection, Contamination and Preservation of Drugs. (5)

3. Medicinal Importance and identification of the following at the organoleptic level (5)

3.1 Rhizome drugs: Ginger and Curcuma

3.2 Bark drugs: Cinchona and Cinnamon

3.3 Leaf drugs: Senna and Datura

3.4 Flower drugs: Hibiscus

3.5 Fruit drugs: Strychnos, Emblica.

4. Medicinal principles and powder analysis of the following (2)

i) Cinnamomum ii) Cloves and iii) Curcuma

UNIT II- Practicals. **(15 hours)**

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1. Identification of the following crude drugs. (4)

i. Ginger ii. Curcuma iii. Cinnamomum iv. Datura v. Hibiscus vi. Strychnos

2. Powder analysis of the following drugs: (4)

i. Ginger ii. Curcuma iii. Cinnamomum iv. Senna v. Cloves

3. Histochemical and specific chemical test of the following drugs: (4)

i. Curcuma ii. Senna and iii. Cloves

4. Herbarium preparation of Medicinal Plants. (3)

Course Outcome: Students recognise the importance of medicinal plants and appreciate the significance of Medicinal Botany with reference to Siddha and Ayurveda systems of medicine.

CO 1: They collect and identify locally available medicinal plants in the form of a herbarium.

CO 2:They differentiate crude drugs by the technique of powder and histochemical analysis.

References:

1. C K Kokate, A P Purohit and S B Gokhale. 1990. *Pharmacognosy*. NiraliPrakashan
2. Chadha, K.L. and Gupta, R. 1995. *Advance in Horticulture*: Vol. II: *Medicinal and Aromatic Plants*. Malhotra Pub. House, New Delhi
3. Kameswara Rao, C.2000. *Database of medicinal plants.* KSCST, Bangalore
4. Nair, C.K.N. and Mohanan, N. *Medicinal Plants of India*. Nag Publishers, Delhi
5. Reddy, T.Y. and Reddy, G.H.S. 2005. *Principles of Agronomy*. Kalyani Publishers, New Delhi.
6. Dr S Vedavathy, Y Mrudula and A Sudhakar. 1997. *Tribal Medicine of Chittoor District, AP, India.* Published by Herbal Folklore Research Centre, Tirupati.
7. A S SAmmanna Sastry and A V Subbalakshmi. 1997. *A text book of Medical Botany.* Sri Vikas Publications.
8. Sivarajan, V.V. and Indira Balachandran. 1988. *Ayurvedic Drugs and Their Plant Sources*. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

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Skill Enhancement Course- Credits 2

Effective from 2023-'24 onwards

Title:Genetic Counselling- SE432

Skill Development: Students learn risk assessment using principles of probability and Bayes theorem, they get hands-on training at the Institute of Genetics & Hospital for Genetic Diseases in Cell Biology (Cytogenetics), Clinical Genetics, Clinical Biochemistry, Molecular Biology and Environmental Toxicology laboratories.

Course Objectives: To evaluate the process of Genetic Counselling and its importance in prevention of genetic defects/disorders

Cob 1: To recognize the importance of prenatal diagnosis and molecular genetic techniques in the detection of genetic disorders.

Cob 2: To examine various strategies for the management/treatment of genetic disorders.

UNIT I: **15 Hours**

1. Basic aspects of Genetic Counselling: Types of genetic disorders and the need for Genetic Counselling (3)

2. Steps in Genetic Counselling (2)

3. Carrier detection (for recessive disorders) and risk prediction of genetic disorders. (Simple Probability and Bayesian calculation methods). (3)

4. Prenatal diagnosis and screening for congenital birth defects. (2)

5. Applications of molecular genetic techniques in detection of genetic disorders. (3)
6. Strategies for treatment of genetic disorders. (2)

UNIT II

Practical training program (Internship) at the Institute of Genetics and Hospital for Genetic Diseases, Begumpet, Hyderabad for a period of 4 weeks.

Course Outcome: Students distinguish the different aspects and steps involved in genetic counselling and value its importance in reducing the burden of genetic disease in populations.

Cob 1: They compare different methods of carrier detection and prenatal diagnosis.

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Cob 2:Hands-on practical training program at the Institute of Genetics and Hospital for Genetic Diseases, Hyderabad, helps students to improve their practical skills in Molecular Biology, Biochemistry and Cytogenetics.

References:

1. Emery's Elements of Medical Genetics, 2012, Elsevier, 14th edition.

2. Nussbaum, Genetics in Medicine, 2004, Elsevier, 2nd edition.

3. Harper, Practical Genetic Counselling, 2004, Arnold Publishers, 6th edition.

4. Emery and Rimoin, Principles and Practice of Medical Genetics (3 volumes), 2006, Churchill Livingston, 5th edition.

5. Mange and Mange, Basic Human Genetics, Sinauer Associates, Inc., 1999, 2nd edition.

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