JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095
DEPARTMENT OF GENETICS
B.Sc. VI SEMESTER GENETICS PAPER VIII SYLLABUS (2021 NEP BATCH)
POPULATION AND EVOLUTIONARY GENETICS

COURSE TITLE	**POPULATION AND EVOLUTIONARY GENETICS**
COURSE CODE	**21VIGT8 (T)**
COURSE CREDITS	**04**
TOTAL CONTACT HOURS	**60 Hours**
DURATION OF ESE	**2 ½ Hours**
CONTINUOUS INTERNAL ASSESSMENT (CIA)	**40 Marks**
END SEMESTER EXAMINATION (ESE)	**60 Marks**

COURSE OBJECTIVES:

1. To define and understand statistical measures of heritability and inheritance of polygenic traits.
2. To understand evolution from the perspective of genetic and molecular basis.
3. To understand the principle of Hardy-Weinberg basis of allele distribution in a given population.
4. To initiate the students to Project work related to the subject and recorded as a dissertation

LEARNING OUTCOMES:

At the end of the course the students will be able to

1. Understand the concepts of population and quantitative genetics.
2. Analyse the quantitative traits and the pattern of inheritance.
3. Describe Hardy-Weinberg principle and its importance in population genetics.
4. Conceptualise mating patterns, inbreeding coefficient and genetic polymorphism.
5. Understand molecular evolution in protein and DNA sequences.

CO Mapping with Knowledge Levels

CO No.	Course outcomes statement	Knowledge level
1	Will get an understanding on the human structural chromosomal anomalies and the techniques used to identify them.	**K1, K2, K3, K4, K5**
2	Analyse the quantitative traits and the pattern of inheritance.	**K1, K2, K3, K4, K5**
3	Describe Hardy-Weinberg principle and its importance in population genetics	**K1, K2, K3, K4, K5, K6**
4	Conceptualise mating patterns, inbreeding coefficient and genetic polymorphism.	**K1, K2, K3, K4, K5**
5	Understand molecular evolution in protein and DNA sequences.	**K1, K2, K3, K4, K5, K6**

Knowledge Levels- K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2	✓	✓	✓	✓	✓
PO3					✓
PO4	✓	✓	✓	✓	✓
PO5					
PO6					
PO7	✓	✓	✓	✓	✓
PO8					
PO9	✓	✓	✓	✓	✓
PO10	✓	✓	✓	✓	✓

Progrmme Objectives aligned with Graduate attributes

PO1- Knowledge, PO2- Scientific thinking, PO3- Entrepreneurial skills
PO4- Analytical skills , PO5- Communication skills, PO6- Social commitment
PO7- Research and Inquiry , PO8- Conservation of Environment\
PO9- Employability, PO10- Academic orientation

Unit 1 **15 Hrs.**

- Population genetics: Definition & Meaning, Mendelian Population and scope of

population genetics. Gene and genotype frequencies, Mating patterns, Random and Non-random mating.

- Hardy Weinberg principle, Extension of H-W principle to multiple alleles and sex-linked alleles. Factors affecting Hardy Weinberg Equilibrium: (a) Mutation (b) Migration (c) Selection (Stabilizing selection, Directional selection, Disruptive selection, Balancing selection, Frequency dependent selection, Density dependent selection, Group, and kin selection), (d) Selection coefficient, and fitness, (e) Genetic drift and Founder Principle (f) Non-random mating.
- Quantitative Genetics: Quantitative inheritance (Continuous, Meristic and Threshold traits) and distribution. Causes of variation (Genetic and environmental variance). Partitioning of Polygenic variability (Genotype - environment interaction and association).
- Analysis of quantitative traits (a) Traits controlled by two loci, three loci and multiple loci (b) Heritability - broad sense and narrow sense heritability.
  Heterosis, transgressive inheritance; Inbreeding and Inbreeding coefficient.

Unit 2 **15 Hrs.**

Theories of Evolution:

- Evolutionary time scale: Eras, periods and epoch, Major events in evolutionary time scale.
- Origin of basic organic monomers and polymers, Spontaneous generation, Louis Pasteur's experiment, Oparin and Haldane's theory of origin of life, Miller-Urey Experiment.

Emergence of Evolutionary Theory: Lamarckism and Darwin's Theory of Evolution, Lamarckism and Neo-Darwinism (Modern synthetic theory) and Mutation theory.

Unit 3 **15 Hrs.**

Selection and Speciation:

- Natural Selection, types of selection - Balancing Selection, Mutation–Selection Balance, Mutation– Drift Balance.
- Concept of fitness in natural selection.
- Isolating mechanisms and Classification – (a) Geographic isolation (b) Reproductive isolation – (i) Pre-mating isolation – Climatic, Seasonal, Habitat, Ethological (ii) Post-mating isolation – gametic mortality, zygotic mortality, hybrid inviability and hybrid sterility, Hybrid breakdown

Speciation: (a) Species types and Species categories. (b) Models of speciation Based on distribution- sympatric, allopatric, stasipatric, Based on genetic drift – Genetic revolution, Genetic transilience, Founder-flush theory (c) Hybridization, introgression and speciation (d) Phyletic gradualism and punctuated equilibrium (h) Molecular aspect of speciation - speciation genes.

Unit 4 **15 Hrs.**

Molecular Basis of Evolution:

- Molecular evolution- Introduction, Molecular tools in phylogeny and applications. Principles of molecular evolution studies (nucleotide substitution in-DNA sequence, substitution within gene, substitution between different genes.
- Concept of neutral theory of molecular evolution, Origin of new gene functions, Molecular clocks.

Molecular phylogeny-Types of phylogenetic trees, Methods of reconstruction of phylogenetic relationship, Construction of phylogenetic trees using tools of Bioinformatics.

GENETICS PRACTICAL PAPER 8

COURSE TITLE	**POPULATION AND EVOLUTIONARY GENETICS**
COURSE CODE	**21VIGT8 (P)**
COURSE CREDITS	**02**
TOTAL CONTACT HOURS	**4 Hours/week**
DURATION OF ESE	**3 Hours**
CONTINUOUS INTERNAL ASSESSMENT (CIA)	**25 Marks**
END SEMESTER EXAMINATION (ESE)	**25 Marks**

Experiments

1. Study of population genetics problems- Population Genetics- Gene and Genotype Frequencies (including multiple alleles - LM blood group and ABO blood group) (Min 3 problems in each)
2. Experiments on natural selection (antibiotic resistance) , male selection, female selection, genetic drift- Population size, sampling error.
3. Quantitative genetics - Kernel colour in wheat, Ear length in maize, heritability
4. Bioinformatics basic tools- BLAST, FASTA, and RASMOL.
5. Construction of phylogenetic tree using DNA and protein sequences.
6. Construction of phylogenetic tree using Bioinformatics tools.

   Project related to Genetics such as: Cytogenetics, Molecular, Microbial, quantitative, population and evolutionary Genetics.

References

1.Principles of Genetics by D. Peter Snustad and Michael J Simmons

2.Genetics: A Conceptual Approach by Benjamin A. Pierce

3.The Science of Genetics by Alan G. Atherly, Jack R. Girton, John F. McDonal

4.Genes in the Environment- Rosie S. Hails, Wiley-Blackwell Publications, 2003.

5.Hartl. D.L. (1988): A primer of population genetics. Sinauer sunderland USA.

6. Li. W and Graur (1990): Fundamental of Molecular evolution. Sinauer associates Sunderland bd, USA.

7.Price, P.W. (1996): Biological evolution. Saunders pub. Philadelphia.

8.Russo, V.E.A., Brody, S., Cove. D. And Okkolenghi (1992): Development. The molecular genetic approach. Springer Verlag Berlin.

9.Snustad, D.P., and Simmons, M.J. (2003): Principles of Genetics, 31 Edn. John Wiley and Sons, inc. N.Y.
10.Strickberger, M.W. (1996); Evolution, 2ndEdn. Jones and Barlett Pub. London.
11.Strickberger, M.W. (1996): Genetics, 3rdEdn. Prentice Hall of India, New Delhi.
12.Tamarin, R.H. (2000): Principles of Genetics 6 Edn. W.C. Brown Publishers, London.
13.Wolpert, L.et.al. (2002): Principles of development, 2d ed. Oxford University Press, Oxford
14.Life Evolution Adaptation Ethology, Dr Sanjib Chattopadhyay (2009), First Edition, Books & Allied (p) Ltd.