ZOOL-311A & ZOOL-311L **GENETICS** **Cr. 4(3+1)**

Course Objectives:

1. To understand the terms and basic concepts of genetics, providing a conceptual framework for future reference
2. To provide understanding about the continuity of the life from one generation to other generation is based on the mechanisms involving nucleus, chromosomes and genes etc.
3. To develop the concept that continuity not only transfers the traits of the parents but also imparts variations that render the generations sustainable in changing environment
4. To understand how traits are inherited and to use this understanding in analyses (to solve problems and complete pedigrees)
5. To understand probability concepts and use these concepts to solve problems (including basic statistical problems)
6. To understand how genetic problems may lead to disease or lethality
7. To understand the molecular basis of genetics (including such topics as Replication, Transcription, Translation, and Mutation)
8. To understand mechanism of repair and molecular genetic analysis
9. To understand the workings and importance of major genetics techniques such as PCR
10. To understand current issues regarding genetics (e.g., Cloning, use of Transgenic Organisms)
11. To understand Mendelian and non-Mendelian pattern of inheritance in human
12. To understand the workings and uses of population genetics technique

Course Learning Outcome

1. **Able** to define terms of genetics and apply concepts of modern transmission
2. **Identify** and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.
3. **Solve** transmission genetics problems, make accurate predictions about inheritance of genetic traits, and map the locations of genes.
4. **Identify** the parts, structure, and dimensions of DNA molecules, RNA molecules, and chromosomes, and be able to categorize DNA as well as describe how DNA is stored
5. **Able** to accurately draw the diagram and describe the processes of replication, transcription, translation, as well as predict the outcomes of these processes.
6. **Describe** what causes and consequences of DNA sequence changes and how cells prevent these changes, as well as make predictions about the causes and effects of changes in DNA.
7. **Describe** the processes of gene regulation and predict how a gene will be expressed under specific circumstances.
8. **Learn** and practice common genetics laboratory techniques.
9. **Describe** applications and techniques of modern genetic technology, as well as select the correct techniques to solve practical genetic problems
10. **Carry** out genetics laboratory and research techniques.
11. **Identify** the human traits and genetic diseases
12. **Describe** experimental results in written format both informally and in formal manuscript format
13. **Able** to solve problem related to population genetics

Course Contents:

1. Introduction

- Classical, molecular and population Genetics: Scope and importance of genetics, Forward and reverse genetics. The basic principles of Inheritance (Mendelism): Monohybrid and Dihybrid crosses (Definition - characteristics criss-cross inheritance).
- Multiple Alleles: blood groups and coat color in rabbits.
- Genetics of Rh factor and Erythroblastosis Foetalis.

2. Chromosomal Basis of Inheritance:

- Chromosomal Theory of Inheritance

- Interaction of genes, Epistasis, Lethality and Pleiotropism.

3. Chromosomal Aberrations

- Changes in chromosomal number, Euploidy, Aneuploidy (Klinefelters syndrome, and Turners syndrome, Down syndrome and Edwards syndrome).
- Structural changes, insertion, deletion (Cri du chat syndrome), duplication,
- Inversion and translocation

4. Pedigree Analysis:

- Normal human chromosome complement; Karyotyping.
- Sex-determination and Sex-linkage:
- Sex determination in animals and humans,
- Sex linked (Hemophilia, muscular dystrophy, color blindness), sex influenced and sex limited traits,
- Prenatal Diagnosis: Amniocentesis and choriovillus sampling - Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics

5. Chromosome mapping

- Linkage, recombination (crossing over) and
- Chromosome mapping in eukaryotes.

6. Molecular Genetics:

- Gene Concept (classical and modern),
- Genetics of Viruses and Bacteria,
- Transposons,
- Mutation and DNA repair
- Molecular Genetic Analysis,
- Regulation of Gene Expression in Prokaryotes,
- Gene Regulation in Eukaryotes,
- Genetic basis of diseases, like cancer,
- Genetic control of animal development.
- The genetic control of the Vertebrate Immune System,

7. Recombinant Technology

- The Techniques of Molecular Genetics (elements of genetic engineering),
- PCR

8. Human Genetics;

- Single and Multifactorial Disorders:
- Autosomal anomalies, Pseudoautosomal genes,
- Single gene disorders: Gene mutation and disorders; Autosomal single gene disorders (Sickle cell anemia, Brachydactyly; Inborn errors of metabolism such as Phenylketonuria, alkaptonuria).
- Complex Inheritance Patterns, Polygenic traits- Cleft lip and cleft palate,

9. Population Genetics:

- Hardy-Wienberg equilibrium,
- Systematic and Dispersive pressures, Inbreeding and heterosis

Practical:

1. Drosophila culture techniques: preparation and maintenance of culture
2. Identification of male and female fruit fly and isolation of virgin females
3. Study of polytene chromosomes from the salivary glands of Drosophila melanogaster
4. Mutation induction in Drosophila
5. Human karyotyping from photographs prepared slides: paper cut out method
6. Preparation of human metaphase chromosomes from blood lymphocytes
7. Study of mitosis in plants by using onion root tip cells
8. Study of meiosis in the testes of male grasshopper

9. Extraction of genomic DNA from whole blood (lymphocytes)
10. Separation of heterogeneous population of bio-molecules through electrophoresis
11. Study of blood group polymorphisms in local population
12. Study of qualitative traits in humans: a survey of common physical heritable (monogenic) polymorphisms
13. Human Pedigree analysis problems (Determination of inheritance pattern of different human characters (Widows Peak, ear loop, etc), risk estimation and genetic counselling
14. Study of quantitative traits in humans: finger prints as model of polygenic traits
15. Study of Barr bodies in human cell nucleus
16. Dermatoglyphics in normal and mentally retarded subjects
17. Probability problems. Tossing of coins. X2 test
18. Study of transformed bacteria on the basis of antibiotic resistance
19. PCR

Teaching-Learning Strategies

Teaching will be a combination of class lectures, class discussions, and group work. Short videos/films will be shown on occasion.

Assignments

The sessional work will be a combination of written assignments, class quizzes, presentation, and class participation/attendance.

Assessments and Examination

Sessional Work: 25 marks
Midterm Exam: 35 marks
Final Exam: 40 marks

Books Recommended:

1. Snustad, D.P., Simmons, M.J. 2003. Principles of Genetics. 3rd Ed., John Wiley and Sons Ins. New York, USA.
2. Tamarin, R.H. 2001.Principles of Genetics. 7th Ed., WCB publishers USA.
3. Lewin, B. 2013. GENE-VIII. Oxford University Press. UK.
4. Gardener, E.J., Simmons, M.J., Snustad, D.P. 1991. Principles of Genetics. John Wiley and Sons Ins. New York, USA.
5. Strickberger, M.W. 2015. Genetics. McMillan, New York. USA.(9780024181206)
6. PRINCIPALS OF GENETICS Gardner E.J., Simmons M.J. and Snistad
7. A.P. (Latest available Addition)
8. Reference Books. Concepts of Genetics By Klug, W.S and Cummings M.R.
9. Willium S. Klug, 2014. Concept of Genetics, ISBN-11: 978-0321948915
10. Lewin's Gene XI BY Jocelyn E.Krebs et al. 2013, isbn-13:978-1449659851,ISBN-10:1449659853
11. 10. Gene- XI by Lewin's,2013,ISBN:978-1449659851
12. Concepts of genetics 11th edition, William S.Klug,2014,ISBN-13:978- 0321948915