SEMESTER-V

Category I

(BSc Honors in Biological Science in three years)

DISCIPLINE SPECIFIC CORE COURSE – 13:

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Molecular Biology I(BS-501)	**4**	**2**		**2**	Class-XII pass with Biology & Chemistry	Should have a background in chemistry of biomolecules and enzymes

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce to the students, the basic concepts of genome, DNA structure, genes, chromatin and chromosomes.
- Provide an understanding of mechanism of DNA replication, recombination, mutations and repair.
- Teo enable students to apply this knowledge in understanding the life processes and develop an interest to pursue high quality research.

Learning outcomes

On successful completion of the course, students will be able to:

- Explain the basic information about the structure of DNA and various forms of DNA, about organization of genome in various life forms, supercoiling of DNA and its significance
- Outline and elaborate the molecular basis of processes like DNA replication, recombination and transposition and explain the significance of these processes
- Discuss about the various ways in which the DNA can be damaged leading to mutations and lesions and the different ways that DNA damage can be repaired.

SYLLABUS FOR DSC-13

Credits: 2 **Total hours: 30**

UNIT 1: Structure of DNA and genomic organization **No. of hours: 8**

Watson and Crick model of DNA, various forms of DNA, Supercoiling of DNA, linking number, Topoisomerases, Topoisomerase inhibitors and their clinical

importance, Definition of a gene, organization of genes in viruses, bacteria and eukaryotes, concept of split genes, introns, exons, satellite DNA, highly repetitive DNA.

UNIT 2: Replication of DNA **No. of hours: 10**

The chemistry of DNA synthesis, DNA polymerase, the replication fork, enzymes and proteins in DNA replication, *E coli* DNA polymerases, stages of replication: initiation, elongation, origin of replication, relationship between replication and cell division, replication in eukaryotes, end replication problem, telomerases. Comparison of replication in prokaryotes and eukaryotes.Inhibitors of DNA replication and applications in medicine.

UNIT 3: Recombination and transposition of DNA **No. of hours: 6**

Homologous recombination, enzymes in homologous recombination, site-specificrecombination, recombinases. Transposition, DNA transposition by cut and paste and replicativemechanism.

UNIT 4: Mutations and DNA Repair **No. of hours: 6**

Types of mutations, DNA damage by hydrolysis, alkylation, oxidation and radiation. Mutations caused by base analogs and intercalating agents. Ames test. Replication errors and their repair, mismatch repair system, repair of DNA damage-direct reversal of DNA damage, base excision repair, nucleotide excision repair, translesion DNA synthesis. DNA repair diseases.

PRACTICALS
CREDITS: 2 **TOTAL HOURS : 60**

1. DNA estimation by DPA
2. Separation of nitrogenous bases by paper chromatography
3. To plot the ultraviolet absorption spectrum of DNA
4. Isolation of chromosomal DNA from *E coli* cells
5. Determination of DNA concentration and purity by UV absorption.
6. Determination of the melting temperature of DNA
7. Demonstration of the mechanism of Transposition and Recombination (Dry Lab)

ESSENTIAL READINGS

1. Lehninger: Principles of Biochemistry (7th ed.) (2017) Nelson, D.L. and Cox, M.M W.H.Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10-1464126119.
2. Molecular biology of the gene: (7th ed), (2014) Watson, J. D., Baker, T. A., Bell, S. P.,Gann, A., Levine, M., & Losick, R. International). Pearson.

SUGGESTED READINGS

1. Genetics - A Conceptual Approach,) (6th ed). (2012), Pierce, B.A. W.H. Freeman & Co.(New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-
2. Lewin's Gene X (10th edition) (2018). Lewin, B., Krebs, J.E., Kilpatrick, S.T., Goldstein,E.S., Bartlett Learning publishers, LLC, ISBN: 978-0-7637-6632-0.
3. The Cell: A Molecular Approach (7th ed.) (2009). Cooper, G.M. and Hausman, R.E. ASMPress & Sunderland (Washington DC), Sinauer Associates, MA. ISBN:978-0- 87893-3030.
4. *Biochemistry* (6th ed.) (2016). Garrett, R. H., & Grisham, C. M. Brooks Cole. ISBN:9781305882409

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, Universityof Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 14

Credit distribution, Eligibility and Pre-requisites of the Course

Course title& Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Transmission and Molecular Genetics (BS-DSC-502)	**4**	**2**		**2**	Class XII pass with Biology and chemistry.	

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide the students with an understanding of both classical and modern

concepts in genetics.

- To familiarize them with the principles and mechanisms of the inheritance of traits and genes, various modes of inheritanceof traits/ phenotypes and Phenotype-genotype correlation.
- To understand the areas of transmission genetics, different mapping techniques, chromosomal aberrations andmolecular and developmental genetics.
- To corelate practical exercises with the theory and facilitate skill-oriented learning outcomes

Learning outcomes

Upon completion of the course, the students will be able to:

- Understand the concept of genotype and phenotype, describe the basic principles of Mendelian genetics and appreciate the various factors that confer genotypic and phenotypicvariability.
- Understand the inter relationship between environment (Nurture) versus inheritance(Nature) in determining the conversion of genotype to phenotype.
- Be able to use the concepts of bacterial and viral genetics to understand resistance patternsand to create linkage and genetic maps
- Be able to apply the principles of transmission and inheritance in real life situations.

SYLLABUS OF DSC- 14

Theory

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1: Transmission Genetics **No. of hours: 8**

Introduction to the basic principles of heredity. Mendelian Genetics and Extensions: Mendel'swork on transmission of traits, genetic variation, molecular basis of Genetic Information.

Principles of Inheritance, Chromosome theory of inheritance, Laws of probability, Incompletedominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy Penetranceand expressivity, norm of reaction and phenocopy. Polygenic inheritance; continuous and discontinuous variation.

Unit 2: Organelle heredity and Chromosomal variations **No. of hours: 6**

Chloroplast mutation/variegation in four'o'clock plant, mitochondrial mutations in Neurospora, maternal effects, infective heredity- Kappa particles in Paramecium. Chromosomal aberrations: Variations in chromosome number and structure.

Unit 3: Linkage, crossing over and mapping techniques **No. of hours: 4**

Linkage and Crossing over, cytological basis of crossing over, Molecular mechanism of crossingover. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and Coincidence

Unit 4: Molecular genetics **No. of hours: 6**

Sex determination: Genetic basis of sex determination in Humans, *Drosophila melanogaster,* sexlinked, sex influenced and sex limited traits. Mechanism of dosage compensation- X chromosome inactivation.Epigenetic mechanisms of transcriptional regulation, Genomic imprinting. Eukaryotictransposable elements- Ac-Ds system in maize and P-elements in drosophila.

Unit 5: Genetics of bacteria and virus **No. of hours: 6**

Complementation test, limitations of cis-trans test, intragenic complementation, rII locus of phage T4 and concept of cistron. Mechanism of genetic exchange - conjugation, transformation and transduction. Prokaryotic transposable elements- IS elements, Composite transposons, Tn-3 elements.

Practical

Credits: 2 **Total Hours: 60**

1. To understand the genetic interaction involved using the seed mixture given (all six ratios)
2. Study of Linkage, recombination, gene mapping using marker-based data from Drosophila.
3. Preparation of karyotype and idiogram from the metaphasic plate of *Phlox/Allium sp*
4. Effect of colchicine and demonstration of polyploidy in *Allium sp.*
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype.
7. Study of pedigree conventions and pedigree analysis
8. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
9. Smear technique to demonstrate sex chromatin in buccal epithelial cells.

Essential readings:

1. Griffiths, A. J. F., Wessler, S. R, Carroll, S. B., Doebley, J. (2010). An Introduction to Genetic Analysis (10thed.). W.H. Freeman & Company (New York). ISBN:10: 1- 4292-2943-8
2. Pierce, B.A. (2012). Genetics - A Conceptual Approach (4thed.). W.H. Freeman & Co. (New York). ISBN:13: 978-1-4292-7606-1 / ISBN: 10:1-4292-7606-1
3. Snustad, D. P., Simmons, M. J. (2015). Principles of Genetics (7th ed.). ISBN: 978-1-119-14228-7.
4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, 10th edition. San Francisco, California: Benjamin Cummings.

Additional Readings:

a. Raven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Co. Additional Resources
b. Hartl, D.L., Ruvolo, M. (2012). Genetics: Analysis of Genes and Genomes, 8th edition.New Delhi, Delhi: Jones and Bartlett Learning.

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DISCIPLINE SPECIFIC CORE COURSE –15 :

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Growth and Reproduction (BS-DSC-503)	**4**	**2**		**2**	Class XII pass with Biology and chemistry	**Understanding of animal and plant physiology**

Learning Objectives

The Learning Objectives of this course are as follows:

- To allow students to explore the development of plants and animals from juvenile to mature phase.
- To enthuse students to explore the myriad ways in which plants produce fruits and seeds, and encourage them to pursue further studies in plant reproductive biology and its genetic regulation.
- To explore the fundamentals of reproduction anddevelopment in animals particularly vertebrates, from fertilization to organogenesis, primarily for understanding of tissue differentiation and molecular mechanisms fundamental to developmentof animals.

Learning outcomes

By the end of the course, the student will be able to:

- Students will understand the development of plants from juvenile to senescent stage with the associated genetic, cellular, anatomical and morphological changes.
- Students will appreciate the role of pollinators and get hands-on experience of observing patterns on pollen grains, pollen germination, embryo and endosperm dissection, and collecting seeds with different dispersal mechanisms.
- Students will understand the reproductive system in animals and human beings so as to relate with the control of population and environmental threats in the current scenario.
- Students will be able to explain how errors in development can lead to congenital defects.
- Students will visualize and appreciate concepts learnt in theory and apply experimental approaches to understand these developmental events in the laboratory

SYLLABUS OF DSC-15

Theory

Credits: 2 **Total Hours: 30**

Unit 1: Introduction to Growth and Reproduction **No. of hours: 5**

Vegetative and Reproductive phases of growth in plants, senescence and abscission. Functional anatomy of male and female reproductive systems in humans.

Unit 2: Fertilization **No. of hours: 10**

Sexual reproduction in angiosperms: Structure and organisation of flower, organization of typical tetrasporangiate anther and eight nucleate embryo sac (Polygonum type), pre-fertilization events in plants, microgametogenesis and megagametogenesis, anther dehiscence, pollination, pollen- pistil interaction, pollen germination, double fertilization.

Gametogenesis- Spermatogenesis and Oogenesis with reference to human, Estrus and menstrual cycle, Types of eggs in animals, capacitation, fertilization and development of an embryo from zygote, Causes of Infertility.

Unit 3: Embryogenesis in Plants and Animals **No. of hours: 10**

Post fertilization events in plants: Types of embryogenesis (with special emphasis on dicot embryogenesis), endosperm development, types of endosperm, seed formation, seed dispersal: mechanisms and agents. Embryogenesis; Types of cleavages, Morphogenetic movements, Gastrulation in humans; Extra Embryonic membranes, Mechanism of Implantation, Placentation: Endocrine functions and types based on chorionic villi distribution and histology. feto-placental unit

Unit 4: Differentiation **No. of hours: 5**

Post-embryonic meristem in plants with special reference to *Arabidopsis* embryogenesis. Role ofmeristem in differentiation, shoot and root apical meristems, lateral meristem (vascular and cork cambium), floral meristem, ABC model of flowering. senescence and abscission

Formation of organs Organogenisis during development, critical windows of development in humans during pregnancy. Teratogens and Ageing.

PRACTICALS

CREDITS: 2 **TOTAL HOURS: 60**

1. Luteinizing Hormone (LH) Levels and HCG based test.
2. Vaginal smear preparation to examine estrous cycle.
3. Preparation and histological study of mammalian testis and ovary or Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sectionsof ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina; Study different types of mammalian placenta on the basis of histology andmorphology.

4. Case studies on teratogens.
5. Study different stages of micro and mega-gametogenesis in angiosperms-throughpermanent slides.
6. To study percent pollen germination using different media.
7. To study embryo development in flowering plant /slides.
8. To dissect out endosperm and embryo from angiosperm seeds.
9. Study of apical and lateral meristem by permanent slides.
10. Survey of dispersal mechanisms of seeds/ pollination agents
11. To study Polyembryony/ Types of Embyo sacs through permanent slides/ photographs/temporary prepartions/chart
12. Project report on visit to animal house facility/ IVF lab.

Essential Readings:

1. Bhatnagar, S. P., Dantu, P. K., & Bhojwani, S. S. (2018). The Embryology of Angiosperms, 6th Edition.Vikas
2. Raghavan, V. (2000).Developmental Biology of Flowering Plants.New York: Springer.
3. Tortora, G. J., & Derrickson, B. (2017). *Principles of anatomy & physiology.* Fifteenth edition; Wiley Loose-Leaf Print Companion. Hoboken, New Jersey: John Wiley & Sons, Inc.
4. Regulation of Implantation and Establishment of Pregnancy in Mammals, Editors: Rodney D Geisert, Fuller W. Bazer, ISBN 978-3-319-15856-3, Springer International Publishing, 2015.
5. Gilbert, S. F., & Barresi, M. J. F. (2016).

Developmental biology.

Additional readings:

1. Kalthoff, K. O. (2000). Analysis of Biological Development (2 edition). Boston: McGraw-Hill Science/Engineering/Math.
2. William. J. Larsen.(2001). Human Embryology (3 edition). New York: Churchill Livingstone.

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