



Subject Code: 02BT0503

Subject Name: Genetics and Genetic Engineering (Core)

M. Sc. Semester - III

Objective: To provide comprehensive knowledge of laws of genetics, various tools and techniques used in genetic engineering and their relevant application in industry and healthcare.

Credits Earned: 4 Credits

Course Outcomes: After completion of this course, student will be able to

1. Classify and explain various approaches used for genetic engineering.
2. Justify the applications of genetic engineering in environment, industry and healthcare.
3. Design cloning various strategies utilizing tools of genetic engineering.
4. Differentiate between various patterns of heredity transfer and their implication in genetics

Pre-requisite of course: Biochemistry and Cell Biology.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE(I)	Viva (V)	Practicals/ TW	
4	0	0	4	50	30	20	0	0	100



Contents:

Unit	Topics	Contact Hours
1	Overview of Genetics Model systems in Genetic Analysis: Bacteriophage, <i>E. coli</i> , <i>Neurospora crassa</i> , yeast, <i>Arabidopsis</i> , maize, <i>Drosophila</i> , <i>C. elegans</i> , Zebra fish. Laws of inheritance: Concept of dominance, segregation, independent assortment; Concept of alleles, types of dominance, lethal alleles, multiple alleles, Epistasis. Linkage: Concepts, recombination, gene mapping in prokaryotes and eukaryotes. Sex-linked inheritance: Conceptual basis, sex influenced traits, mechanism of sex determination and Cytoplasmic inheritance.	10
2	Tools of Genetic Engineering Impact of genetic engineering in modern society; general requirements for performing a genetic engineering experiment; Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, hagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Vectors for gene expression; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc. Mammalian expression and replicating vectors; <i>Baculovirus</i> and <i>Pichia</i> vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors, shuttle vectors. Restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase;	20
3	Essential Techniques in Genetic Engineering Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; reverse-transcription PCR, real time PCR, touchdown PCR, hot start PCR, colony PCR, asymmetric PCR, direct cloning of PCR products. PCR based site specific mutagenesis. Cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; hybridization techniques: northern, southern, south-western and far-western and colony hybridization, fluorescence in situ hybridization.	15
4	Gene Manipulation and Genome Editing Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; cDNA and genomic libraries; Microarray technology. Study of protein-DNA interactions: electrophoretic mobility shift assay; DNase footprinting; methyl interference assay, chromatin immunoprecipitation; protein-protein interactions using yeast two-hybrid system; phage display. Gene replacement; gene targeting; creation of transgenic and knock-out mice; disease model; introduction to genome editing by CRISPR-CAS.	15
	Total Hours	60



References:

1. Stryer, L. (2015). Biochemistry. (8th ed.) New York: Freeman.
2. Lehninger, A. L. (2012). Principles of Biochemistry (6th ed.). New York, NY: Worth.
3. Voet, D., & Voet, J. G. (2016). Biochemistry (5th ed.). Hoboken, NJ: J. Wiley & Sons.
4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008).
5. Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
6. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
7. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI. Burlington, MA: Jones & Bartlett Learning.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

Instructional Method:

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the class-room in the form of attendance, assignments, verbal interactions etc.
- c. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.