COMMON POOL OF GENERIC ELECTIVES

GENERIC ELECTIVE (BOT-GE-20)

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
		Lecture	Tutorial	Practical/ Practice		
Genomics, Proteomics and Metabolomics **BOT-GE-20**	4	2	0	2	Class XII Pass with Science	**Nil**

Learning Objectives:

22. Build the concepts of genomics, proteomics and metabolomics.
23. Understand the role of model organisms in genomics studies
24. Familiarization of tools used in genomics and proteomics.

Learning Outcomes: At the end of this course, students will be able to:

7. understand the implications of genomic, transcriptomic, proteomic and metabolomic studies in an organism.
8. assimilate logic and reasoning behind choice of model organisms for genomics study.

Unit 1: Introduction to genomics **02 Hours**

Recapitulating basics of prokaryotic and eukaryotic genomes; basic concept of structural and functional genomics.

Unit 2: Model organisms in genomics **02 Hours**

Features of important model organisms used in genomics study (*Escherichia coli*, *Saccharomyces cerevisiae*, *Caenorhabditis elegans*, *Arabidopsis thaliana*)

Unit 3: Sequencing strategies **04 Hours**

Sequencing: basic principle-Sanger's method; classical approaches for sequencing large genomes (whole genome shot gun method viz. WGS, clone by clone sequencing); Next generation sequencing (NGS) ; Concept of third generation sequencing

Unit 4: Genome sequencing Projects **04 Hours**

Human genome project (brief history and significance); *Arabidopsis* genome project; rice genome project; applications of genomics in agriculture and human health

Unit 5: Transcriptomics **03 Hours**

Concept: EST sequencing; Gene expression studies by Microarrays and RNAseq.

Unit 6: Introduction to proteins and proteomics **06 Hours**

Proteins as structural and functional unit of life; basics concept of protein structure (primary, secondary, tertiary, and quaternary), peptide bonds; brief introduction of major post-translational modifications (phosphorylation, glycosylation); introduction to enzymes; introduction to proteomics and its applications.

Unit 7: Tools for proteome analysis **05 Hours**

Separation and isolation of proteins from plant tissue; purification of proteins by chromatographic techniques (column chromatography, ion exchange and affinity chromatography); separation of total cellular proteins by electrophoresis: SDS-PAGE, western blotting and ELISA.

Unit 8: Metabolomics **04 Hours**

Concept of metabolomics; classes of metabolites (primary and secondary metabolites in plants); Experimental methods and instruments used in metabolomics- HPLC, GC; applications of metabolomics.

Practicals **60 hours**

- Genomic DNA extraction from cauliflower heads
- Select 10 different organisms (5 prokaryotic and 5 eukaryotic) whose genomes have been completely sequenced and categorize them based on taxonomy, find their genome size and locate the database where their genome sequence is hosted.
- Demonstration of gene expression studies through photographs: microarrays and RNA seq.
- Demonstration of Sanger's DNA sequencing principle.
- Interpretation and reading of DNA sequence chromatograms.
- Experiment to demonstrate activity of Amylase.
- Estimation of protein concentration through Lowry's methods/Bradford assay.
- Demonstration of separation of proteins using SDS-PAGE (demonstration).
- Study of proteins by Western blotting technique (digital resources/demonstration).
- Demonstration of ELISA through kit.

Suggested readings:

15. Brown, T. A. (2020). Gene Cloning & DNA Analysis: An Introduction. 8thedn. UK: Wiley Blackwell.
16. Glick, B.R., Patten C. (2022). Molecular Biotechnology: Principles and Applications. 6thedn. Washington, U.S.: ASM Press.
17. Griffiths, A.J.F., Doebley, J., Peichel, C, Wassarman D. (2020). Introduction to Genetic Analysis, 12th edition. New York, NY: W.H. Freeman and Co.
18. Liebler, D.C. (2002). Introduction to Proteomics: Tools for New Biology, Humana Press.
19. Primrose, S. B. Twyman, R.M. (2006). Principles of Gene Manipulation and Genomics. 7thedn. Victoria, Australia: Blackwell Publishing.
20. Twyman R. (2013) Principles of Proteomics, Taylor & Francis Books.
21. Watson J.D. (2017) Molecular Biology of the Gene. Pearson publishers.

22. Westermeier, R., Naven, T., Hopker, H.R. (2008). Proteomics in Practice: A guide to successful experimental design, 2nd edition, Wiley Blackwell.
23. Wood, P.L., (2021) Metabolomics. Springer Protocols.

Additional resources:

- Banks, K (2022) Introduction to Proteomics. Larsen & Keller Education
- Campbell, A.M. and Heyer, L.J (2006). Discovering Genomics, Proteomics and Bioinformatics, Pearson publishers.
- Bhattacharya, S.K. (2019) Metabolomics: Methods & Protocols. Springer Protocols/Humana Press

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