Course title: Conceptual Foundations of Molecular Biology

Course code: BBP158	**No. of credits:** 2	**L-T-P:** 21-7-0	**Learning hours:** 28

Pre-requisite course code and title (if any): None

Department: Department of Biotechnology

Course coordinator(s): Dr. Ramakrishnan Sitaraman	**Course instructor(s):** Dr. Ramakrishnan Sitaraman

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Course type: Core	**Course offered in:** Semester 1

Course description: The objective of this foundational course is to familiarize students of varied academic backgrounds with the interdisciplinary knowledge that underlies molecular biology. The approach will not only ensure the transmission of this knowledge, but also emphasize the scientific method, creative thought processes, fortuitous discoveries and elegant experimental approaches that led to classic insights and discoveries in this field. Original articles outlining seminal insights in the field will be discussed in detail. Finally, the value of this information will be highlighted by a detailed description of instances of gene regulation, as well as the contribution of molecular biology to the determination of evolutionary relationships in the living world.

Course objectives:

1. To provide students of varied backgrounds the history of ideas in, and the theoretical bases of molecular biology.
2. To highlight the interdisciplinary nature of major advances in molecular biology.
3. To present an overview of gene regulation.

Course contents

S.No	Topic	L	T	P
Module1	**The Development of Molecular Biology**			
1	Historical background The scientific method, vital force theory, classic experiments related to vital force theory and spontaneous generation	4	0	0
2	Physico-chemical approach to biology The influence of *What is life* by Schrodinger on molecular biology	2	1	0
3	The nature and replication of the genetic material The discovery of transformation, DNA structure, semi-conservative replication of DNA	4	0	0
4	The flow of genetic information The central dogma and its continuing relevance, sequence hypothesis, adaptor hypothesis, operon concept, transcription, translation, the genetic code	4	3	0
5	The physical nature and universality of Mendel's 'genes' Benzer's experiments on phage T4, the Luria-Delbruck fluctuation test.	3	0	0
Module2	**The Impact of Molecular Biology**			
6	Gene expression and control Examples of positive and negative control of gene expression, considerations in the global regulation of gene expression	2	3	0
7	Beyond dichotomies – evolution and molecular phylogeny Formulation of the three-domain system of classification by Woese and Fox	2	0	0
	Total	**21**	**7**	**0**

Evaluation criteria:

1. 2 minor tests 30% (each)
2. 1 major test (end semester) 40%

Learning outcomes:

1. Recognition of crucial advances in molecular biology based on model systems.
2. Knowledge of different modes and levels of the regulation of gene regulation.

Pedagogical Approach:

Classroom lectures and tutorials, with a major emphasis on the detailed discussion of original research articles from scientific journals in class.

Skill Set:

1. Design of molecular biology/genetic engineering experiments.
2. Critical analysis of molecular biology/genetic engineering experimental design and results.
3. Formulation of experimental strategies for molecular genetic studies of simple model organisms.

Employability:

1. Academic and industrial research involving molecular biology approaches.
2. IPR firms.

Materials:

Required text

Suggested readings

1. E. Schrödinger, E. What Is Life? : The Physical Aspect of the Living Cell with Mind and Matter and Autobiographical Sketches (Cambridge University Press, Canto series, Cambridge, 11th reprint, 2004).
2. J. D. Watson., *et al.* Molecular Biology of the Gene. (Benjamin Cummins, Cold Spring Harbor, ed. 6, 2008).
3. J. D. Watson, F. H. C. Crick. *Nature*, 3, 737-738 (1953).
4. M. Messelson, F. W. Stahl. *Proc. Natl. Acad. Sci. USA*, 44, 671-682 (1958).
5. F. H. C. Crick. *Nature*, 227,561-563 (1970).
6. F. H. C. Crick *et al. Nature*, 192, 1227-1232 (1961).
7. S. Benzer. *Proc. Natl. Acad. Sci. USA*, 45, 1607-1620 (1959).
8. S. Benzer. *Proc. Natl. Acad. Sci. USA*, 47, 403-415 (1961).
9. S. Brenner. *Proc. Natl. Acad. Sci. USA*, 43, 687-693 (1957).
10. S. Brenner *et al. Nature*, 190, 576-581 (1961).
11. G. W. Beadle, E. L. Tatum. *Proc. Natl. Acad. Sci. USA*, 27, 499-506 (1941).
12. O. T. Avery *et al. J. Exp. Biol.*, 79, 137-158 (1944).
13. S. E. Luria, M. Delbrück. *Genetics*, 28, 491-511 (1943).
14. B. Magasanik. *Proc. Natl. Acad. Sci. USA*, 97, 14044-14045 (2000).
15. C. R. Woese, G. E. Fox. *Proc. Natl. Acad. Sci. USA*, 74, 5088-5090 (1977).

Case studies

Websites

Journals

Other readings

Additional information (if any):

Student responsibilities:

1. Class attendance.
2. Study of course materials as specified by the instructor.

Course reviewers:

1. Dr. Rup Lal, Professor, Delhi University
2. Dr. Anjan Banerjee, Associate Professor, IISER, Pune