Course contents for Molecular Biology

1. **Faculty**: FLSB
2. **Course Code**:
3. **Course Title**: Molecular Biology
4. **Number of Credits**: Three
5. **Course objectives**: All life forms contain nucleic acids that carry information. In this course, we will cover the basic principles of nucleic acids and their structure, how it replicates and the mechanisms of transcription, translation and repair. Latest concepts in gene regulation and synthetic biology will also be discussed through original paper-based resources. This will also include concepts of molecular genetics, inheritance and developmental genetics.

6. **Minimum prerequisites for taking this course, if any**: Bachelor-level Chemistry, Biochemistry or any branch of Biology.

7. **Course structure with units, if applicable**: The following topics will be covered as part of Molecular Biology course:
   a. Introduction to Molecular Biology: From molecules to multicellularity, RNA world concept, milestones (classic experiments) in molecular biology and its implications for genetic engineering
   b. Nucleic acids: Experiments leading to DNA as the genetic material, Watson-Crick's seminal 1953 paper, base stacking and sugar puckering in DNA, DNA and RNA topology, enzymes involved in supercoiling
   c. Replication: DNA helicases and initiation of replication, cell cycle linked to replication, elongation and termination in pro- and eukaryotes, replication fork arrest and rescue mechanisms
   d. Genome Organization: Euchromatin and heterochromatin, nucleosome organization, telomeres and replication of DNA across telomeric ends
   e. Mutations, Chromosomal Aberrations and Repair: Spontaneous and induced mutations, types of mutations, photoreactivation repair, excision repair mechanisms, chromosomal aberrations (deletion, inversion, duplication and translocation), DNA strand breaks, transposons and genome evolution
   f. Non-Mendelian Inheritance: Cytoplasmic inheritance, plasmids and plasmid DNA replication, organization of mitochondria and replication of mitochondrial DNA, histone code and epigenetic inheritance, sex determination, concept of X chromosome inactivation
   g. Transcription and translation: Types of RNA and their synthesis, universal genetic code and codes for non-conventional amino acids, prokaryotic transcription mechanisms, interrupted genes, RNA polymerase, eukaryotic mRNA synthesis, posttranscriptional modifications - capping and splicing events, catalytic RNA, stability of mRNA, prokaryotic and eukaryotic mechanisms of protein biosynthesis, synthetic biology and its possible implications
   h. Gene regulation: *Lac* operon as the basic model, RNA regulators in prokaryotes (*Trp* operon, riboswitch, sRNA), activators and repressors in eukaryotic gene regulation, maternal-to-zygotic transition, RNA interference, miRNA biosynthesis and regulation of gene expression

8 Suggested Readings:

a. Lewin's Genes (XI^{ed}) Jocelyn Krebs, Elliot Goldstein and Stephen Kilpatrick. Jones and Bartlett Publishers (2012)
b. Molecular Biology of the Gene (6$^{ed.}$) James Watson. Benjamin Cummings (2007)
c. Introduction to Genetic Analysis, Griffiths, (2008)
d. Molecular Cell Biology (6$^{ed.}$) Harvey Lodish et al. W H Freeman and Co (2008)
e. Principles of Genetics, Snustad, (2004)
f. Original papers and reviews as provided during the class – from journals such as Nature, Proceedings of National Academy of Sciences, Science, Journal of Biological Chemistry, Journal of Molecular Biology, Cell, etc.

9 Evaluation:

Theory:	Mid-semester Written Examination	: 40% Marks
	End-semester Written Examination	: 40% Marks
	Quiz / Assignment/Presentation (oral / poster)/other)	: 20% Marks