| Semester V | | | | | | |
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| **S. No** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** |
| 1 | BB405T | Molecular Biology | 2 | 1 | 0 | 6 |
| 2 | BB502T | Genomics and proteomics | 3 | 0 | 0 | 3 |
| 3 | BB501T | Biostatistics | 3 | 0 | 0 | 3 |
| 4 | - | Biology Lab II | 0 | 0 | 6 | 6 |
| 5 | - | Institute Elective – II | 3 | 0 | 0 | 6 |
| 6 | - | Program Electives | | | | 6 |
| | | Total Credits | | | 30 | |

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| 1 | **Title of the course** (L-T-P-C) | **Molecular Biology (2-1-0-6)** |
| 2 | **Pre-requisite courses(s)** | None |
| 3 | **Course content** | 1. **Nucleic acid:** building blocks, nucleotide analogs as drugs<br>2. **DNA structure**- base pairing and stabilizing forces, different forms of DNA. minor and major grooves, supercoiling, organization into chromosomes, nucleosomes, heterochromatin, euchromatin, genes and organization, unique genes, operons, gene families, repetitive DNA, genome organization, transposons.<br>3. **Replication:** basic processes in bacteria and eukaryotes, telomeres and telomerase<br>4. **DNA damage and repair:**<br>5. Basic steps in gene expression and regulation, transcriptional and post-transcriptional regulation of gene expression<br>6. **Bacterial translation:**<br>7. **Eukaryotic translation:**<br>9. **Epigenetics:** DNA methylation in prokaryotes and eukaryotes, epigenetic gene regulation by DNA methylation in plants and mammals. Methods to detect epigenetic modifications.<br>10. **Protein-nucleic acid interactions** - nucleic acid recognition by proteins binding motifs - techniques to study protein-nucleic acid interactions.<br>11. **Non-coding RNA:** Biogenesis and its function. |
| 4 | **Texts/References** | **1.** Molecular Biology of the cell by Bruce Alberts et al. 6th edition.<br>**2.** Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick. 12$^{th}$ edition (2017)<br>**3.** DNA Repair and Mutagenesis (2nd Edition) Friedberg and others.<br>**4.** Mehta, A. and Haber J. E. (2014) sources of DNA double strand breaks and Models of Recombination DNA repair Cold Spring Harb Perspect Biol 6: a016428.<br>**5.** Anand, R.P, Lovett, S.T. and Haber J.E. (2013) Break Induced DNA Replication. Cold Spring Harb Perspect Biol 5: a010397 |

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| 1 | **Title of the course** (L-T-P-C) | **Genomics and proteomics** **(3-0-0-3)** |
| 2 | **Pre-requisite courses(s)** | None |
| 3 | **Course content** | **Introduction to Genomics and Proteomics:** Organization and structure of genomes. Introduction to Proteomics.<br>**Gene Identification and Expression:** Genome annotation, routes of gene identification, ORF, gene ontology, comparative genomics, determining gene function by sequence comparison and through conserved protein structure, Global expression profiling, applications of genome analysis and genomics.<br>**Analysis of Proteomes I: Analysis of proteomes** – 2D gel electrophoresis, Image analysis of 2-DE gels.<br>**Analysis of Proteomes II**: Mass spectrometry-based methods for protein identification. 2-DE gel electrophoresis coupled with mass spectrometry,<br>**Micro array and RNA-seq techniques**<br>**Applications of Genomics and Proteomics Analysis:** Analysis of Genomes – Human, Mouse, Plasmodium falciparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications. |
| 4 | **Texts/References** | **1.** Concepts and Techniques in Genomics and Proteomics by N Saraswathy P Ramalingam, first edition, 2011 (Woodhead Publishing).<br>**2.** Introduction to Genomics by Arthur M. Lesk. 3rd edition (Oxford university press).<br>**3**. Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick. 12th edition (2017)<br>**4.** Human Genetics and Genomics by Bruce R. Korf. 4th edition ( Blackwell publication).<br>**5.** Introduction to Proteomics: Principles and Applications by Nawin C Mishra, Gunter Blobel 1st edition (Wiley publication). |

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| 1 | **Title of the course** (L-T-P-C) | **Biostatistics**<br>**(3-0-0-3)** |
| 2 | **Pre-requisite courses(s)** | None |
| 3 | **Course content** | • **Introduction to statistics for biologists:** importance of statistics, hypothesis testing, overview of statistical tests, variables.<br>• **Summarizing and visualizing data:** types of data, summarizing data, displaying data, descriptive statistics, tools for graphical display.<br>• **Probability & distributions:** basic probability, laws of probability, types of distributions, statistics of distributions, probability distributions.<br>• **Methods of sampling:** populations and samples, sampling & non-sampling errors, various methods of sampling, experimental design.<br>• **Hypothesis testing**: need for statistical testing, acceptable errors, P-values.<br>• **Parametric & non-parametric tests:** concept of parametric & non-parametric statistics, tests for differences.<br>• **ANOVA:** one-way ANOVA, Two-way ANOVA, Three-way ANOVA, Multiway ANOVA, Nested ANOVA, ANCOVA.<br>• **Correlation & regression:** scatter plot, correlation coefficient, partial correlation coefficient, linear regression, non-linearity, non-linearity.<br>• **Survival analysis:** censoring, survival times, summarizing and presentation.<br>• **R for biostatistics:** introduction, performing common statistical tests in R, visualizing data in R, exporting data and analysis. |
| 4 | **Texts/References** | 1. Michael C. Whitlock and Dolph Schluter, The Analysis of Biological Data, Roberts And Company Publishers, 2015.<br>2. Steve McKillup, Statistics Explained: An Introductory Guide for Life Scientists, Cambridge University Press, 2006.<br>3. Calvin Dytham, Choosing and Using Statistics: A Biologist's Guide, Wiley-Blackwell, c2011 |

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| 1 | **Title of the course** (L-T-P-C) | **Biology Lab II (0-0-3-3)** |
| 2 | **Pre-requisite courses(s)** | None |
| 3 | **Course content** | 1. Methods of describing, observing, counting and estimating the abundance, diversity and behaviour of living organisms.<br>2. Light Microscopy, sample preparation and examination, identification of microorganisms,<br>3. Staining techniques (Gram's, acid fast),<br>4. Bacterial plating, tests for antibiotic resistance,<br>5. Microbial growth kinetics, bacterial motility assay<br>6. Transformation, |
| 4 | **Texts/References** | NA |