



Programme – Ph.D. (Biosciences and Biotechnology)

Course Title: Research Methodology

Course Code: Credit Units: 04

| L | T | P/S | SW/F W | TOTAL CREDIT UNITS |
|---|---|-----|-----------|--------------------------|
| 4 | 0 | 0 | 0 | 4 |

Course Objectives: The course develops skills based on scientific learning, biochemical, analytical and computational techniques that embrace the fundamental as well as applied knowledge to probe intricate patterns in latest biological research.

Prerequisite: Graduate in Biosciences, Life Sciences

Student Learning Outcomes: On the completion of the course

- The student will be able to resume the core vital concepts presented in biosciences and biotechnology and make rational perception about research in biological sciences and allied fields.
- Evaluate and interpret current literature and research explorations in the relevant biological research.
- Correlate and employ channelized biological and molecular concepts learned through research methodology evaluations.

Course Contents/Syllabus:

| | Weightage (%) |
|---|---------------|
| Module I | 9 |
| Descriptors/Topics – Research Methodology Basics (Steps in research – Identification, Selection and formulation of research problem – Research questions – Research design. Formulation of Hypothesis – Review of Literature); Plan; Research Project: Formulation of research plan; Publication: Writing a scientific article : Type of Articles (review, letters etc); choosing a Journal for publication; General - Ethics in scientific research; Assessing the impact of research contribution | |
| Module II | 9 |
| Descriptors/Topics: Biochemical calculations Solutions: expression and inter-conversion of concentrations of solutions, Buffers: preparation of buffers, buffer capacity, Henderson-Hasselbalch equation. Proteins: Determination of protein molecular weight from the gel filtration | |

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| and SDS-PAGE electrophoresis. Nucleic acid: determination of nucleic acid composition, copy number, molecular weight, length and helical twist in double helix. Enzymes: determination of kinetic parameters v , V_{max} and K_m , specific activity (international unit IU). Enzyme purification: recovery and purification fold. Spectrophotometer: calculation of molar absorption coefficient and its use for determining protein concentration. Radioisotopes: determination of specific activity for preparing radioactive solution. | |
| Module III | 9 |
| Descriptors/Topics: Instrumentation and separation techniques Basics: Meaning & importance; Precision, accuracy, sensitivity, specificity, Calibration; Spectroscopy: Vis-UV, IR, Atomic absorption; Microscopy: resolution, magnifying power, objective lens character. Types of microscope- light, fluorescence, dark field, inverted, confocal; Electrophoresis: PAGE, AGE, PFGE, 2D, immunoprecipitation. Centrifugation: laboratory, high speed and ultracentrifuge. Chromatography: Gas, liquid, ion, affinity. Description of basic principle, operation and applications | |
| Module IV | 7 |
| Descriptors/Topics: Microbial Techniques Microbial growth and measurement. Techniques, Sterilization Techniques, Isolation of microbes from soil, water and air, purification Techniques, Identification Techniques: Morphological, Gram's staining, biochemical tests and 16s rDNA identification, antibiotic sensitivity assay, MIC determination techniques | |
| Module V | |
| Descriptors/Topics: Plant Tissue Culture Historical perspective, Totipotency and regeneration; Applications of PTC; stress tolerance, disease free plants, conservation. | 5 |
| Module VI | |
| Descriptors/Topics: Animal Tissue Culture Gene transfer methods; Industrial Applications. Transgenesis and animal bioreactor. | 5 |
| Module VII | |
| Descriptors/Topics: Molecular Biological and Recombinant DNA Techniques CsCl and sucrose density gradient centrifugation; Restriction enzymes and types of termini generated; DNA polymerases and other modifying enzymes; Southern, northern and Western blotting techniques; labeling probes, 3' and 5' end labeling. Gel retardation and <i>in vitro</i> footprinting, generation of nested deletion, PCR, Site directed mutagenesis. Cloning Vectors : plasmid and vectors; cDNA and genomic libraries; identification of recombinant clones. | 10 |
| Module VIII | |
| Descriptors/Topics: Proteomics Post – genomic evolution of proteomics and functional proteomics. Technologies in proteomics -2D gel electrophoresis and Fundamentals of mass spectrometry, Reversed-phase HPLC and Microcapillary LC, protein and peptide separation technique. Qualitative and quantitative proteome analysis (Shot-gun proteomics for proteome profile (whole proteome and sub-proteome analysis); Expression proteome analysis (<i>in-vitro</i> and <i>in-vivo</i> proteome analysis); Protein identification and analysis tools (Post-protein database search tools); Proteomic analysis of protein-protein, protein-DNA interactions; Proteomic analysis of post-translational modifications; Proteomic data interpretation; Overall proteomics experimental workflows | 10 |

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| Module IX | |
| Descriptors/Topics: Biostatistics Quantitative and qualitative methods of data analysis; Hypothesis Testing - Parametric tests (Z-test, t-test, F-test) and Non-parametric Tests (Chi-Square Test, ANNOVA), Tests of significance based on normal distributions; association of attributes | 36 |
| | |

Pedagogy for Course Delivery:

Lectures – 58
Class test – 2
Total – 60 hours

Assessment/ Examination Scheme:

| | | |
|-----------------------|---------------------------------|-----------------------------|
| Theory L/T (%) | Lab/Practical/Studio (%) | End Term Examination |
| 100 | - | 100 |

Theory Assessment (L&T):

| | | | | | |
|--|-------------------|-------------------|-------------|-------------------|-----------------------------|
| Continuous Assessment/Internal Assessment | | | | | End Term Examination |
| Components (Drop down) | Class test | Assignment | Viva | Attendance | |
| | | | | | 70 |
| Weightage (%) | 15 | 5 | 5 | 5 | |

Lab/ Practical/ Studio Assessment: NA

Text & References:

- o **Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590**
- o **Molecular Biology - David P. Clark and Nanette J. Pazdernik, Second Edition, Elsevier Academic Press. ISBN-13: 978-0123785947**
- o **Principles of Gene Manipulation and Genomics- Primrose S & Twyman R, 7th Edition, Blackwell, 2006. ISBN-10: 1405135441**
- o **Kuby Immunology – Judy Owen, Jenni Punt and Sharon Stranford, Seventh Edition, Freeman Publication. ISBN-13: 978-1429219198**
- o **An Introduction to Genetic Engineering – Desmond S. T. Nicholl, 3rd edition, Cambridge University Press, 2008. ISBN : 9781139471787**
- o **Prescott's Microbiology – Joanne Willey, Linda Sherwood and Chris Woolverton, Edition: 8th ISBN-13: 978-0077350130**
- o **Bioinformatics – Sequence and Genome Analysis – David W. Mount –Cold Spring Harbor Laboratory Press, U.S.; 2nd Revised edition, 2004. ISBN-10: 9746520709**
- o **Gene VIII, Benjamin Lewin 2005, Oxford University Press ISBN: 9780131439818**

- o **Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing, 2007. ISBN-10: 0815341059**
- o **Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing. ISBN 978-0-321-76243-6**
- o **Gene Cloning and DNA analysis: An Introduction, 2010, T. A. Brown, Wiley- Blackwell ISBN: 9781405181730**
- o **Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009. ISBN-10: 0471210048**