

M.S.Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054



**RAMAIAH
UNIVERSITY**
OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme: M.Sc. in Molecular and Cellular Biology

Programme Code: 092

Programme Outcome (PO)

Programme Specific Outcome (PSO)

Program Educational Objectives (PEO)

Course Outcomes (CO)


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Faculty of Life and Allied Health Sciences (FLAHS)

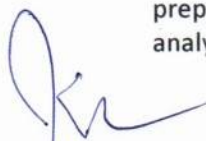
Programme Name: M.Sc. in Molecular and Cellular Biology

Programme Outcomes (POs)

- PO 1. Technical Knowledge:** Demonstrate in-depth knowledge of the scientific fundamentals and the modern technical knowledge needed to support molecular biology research activities.
- PO 2. Design/Development solution:** Identify, analyse and understand the problems related to life sciences and find valid conclusions with basic knowledge acquired in the fields.
- PO 3. Multidisciplinary approach:** Correlate how different sub-systems co-operate with each other in current research and development in the respective fields.
- PO 4. Entrepreneurship skills:** Analyze manufacturing constituents and complete systems for relevant products and to enable enterprising skills for competing globally.
- PO 5. Societal Responsibility:** Innovate and develop sustainable solutions and understand their effect on society and environment.
- PO 6. Leadership and Ethics:** Apply professional Ethics, Leadership and consensus building skills relevant to the aspects of business enterprise in the respective fields.
- PO 7. Lifelong learning:** Adopt changes and advancements in science and engage in independent learning.
- PO 8. Communication:** Communicate the information effectively in scientific writing and oral presentation.

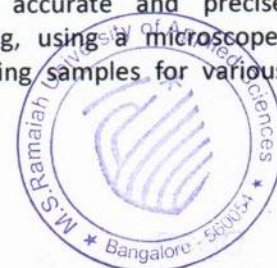
Programme Specific Outcomes (PSO)

- PSO 1:** Understand the foundational concepts of molecular biology, and how these impact life science research and development in the diverse fields that span healthcare and agriculture.
- PSO 2:** Design, perform, and analyze results of experiments using basic molecular biology methodologies and recombinant DNA techniques, including agarose and polyacrylamide gel electrophoresis, restriction enzyme digestion, bacterial transformations, plasmid DNA protein expression, PCR, and tissue culture.
- PSO 3:** Demonstrate proficiency in basic laboratory skills common to clinical and non-clinical research laboratories, including aseptic technique, making accurate and precise measurements using balances and macro- and micro-pipetting, using a microscope, preparing solutions, operating current instrumentation, preparing samples for various analyses, and maintaining a proper scientific laboratory notebook.


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PSO 4: Apply the fundamentals of molecular biology theories, methodologies, and techniques by critically analyzing, interpreting, and presenting a recent and relevant scientific research paper that has been published in a refereed scientific journal

Programme Educational Objectives (PEO):

The objectives of the programme are to enable the students to:

- PEO 1:** To acquire basic knowledge and expertise necessary for professional practice in Molecular Biology for higher studies and research.
- PEO 2:** To attain and practice technical skills to identify, analyze and solve complex problems and issues related to cell and molecular biology.
- PEO 3:** To possess a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for life-long learning.

Course Outcomes (COs)

Course Title & Code: Fundamentals of Cell Biology (BTD501A)

After undergoing this course students will be able to:

- CO-1.** Explain the bimolecular composition, organization and function of different organelles like cell membrane systems, nucleus, mitochondria, peroxisomes, ER, chloroplast, Golgi complex
- CO-2.** Enumerate the differences between the integral and peripheral proteins of membrane, active and passive transport across membrane, intercellular and intracellular signaling in apoptosis
- CO-3.** Delineate the involvements of cytoskeleton in cellular motility, mitochondria in energy production, hormones in maintaining homeostasis, signal receptors in growth and development
- CO-4.** Explain the internal and external factors that influence the cell cycle control system and relate them with cancer
- CO 5.** Illustrate various signaling pathways and its components involved in maintaining cellular homeostasis by controlling cellular proliferation, growth, cell death, and cellular motility
- CO 6.** Explain the methods of studying cell structure, function and activity

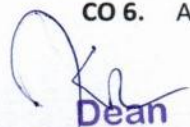
Course Outcomes (COs)

Course Title & Code: Principles of Molecular Genetics (BTD502A)

After undergoing this course students will be able to:

- CO-1.** CO 1. Illustrate the structure and organization of the genetic material
- CO-2.** Classify the mobile genetic elements
- CO-3.** Summarize the various alterations in the genetic composition that lead to disease
- CO-4.** Compare mechanisms involved in the genetic recombination and sex determination
- CO 5.** Outline the various techniques applied in the study of molecular genetics
- CO 6.** Apply the concepts of genetic recombination for gene mapping




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Course Outcomes (COs)

Course Title & Code: Biological Chemistry (BTD503A)

After undergoing this course students will be able to:

- CO-1. Demonstrate a broad knowledge of the fundamental introductory concepts of Chemistry and Biology
- CO-2. Describe the structures and functions of amino acids and proteins, and to characterize these at the molecular level
- CO-3. Explain the chemistry and functions of enzymes in order to address its catalytic activity, the process of regulation and inhibition
- CO-4. Describe the structures and functions of carbohydrates and lipids, and its metabolic importance in biological system
- CO 5. Enumerate the structure and chemistry of DNA and RNA, and its functional significance and metabolic importance in living organism
- CO 6. Demonstrate proficiency in developing relevant biochemical questions and answer those questions with critical analysis and interpretation.

Course Outcomes (COs)

Course Title & Code: Concepts of Microbiology (BTD504A)

After undergoing this course students will be able to:

- CO-1. Identify the differences between traditional and molecular approaches to taxonomy
- CO-2. Describe the cell morphology of gram positive, gram negative, archea and mycoplasmas
- CO-3. Demonstrate the phases of microbial growth curve and determine the relation to generation time
- CO-4. Differentiate the general characteristics , structure and reproduction of eukaryotic microorganisms
- CO 5. Compare and contrast the commons methods used for culture in the clinical laboratory for viruses that infect humans
- CO 6. Explain the methods of strain improvement for the production of economically important microbial products

Course Outcomes (COs)

Course Title & Code: Practical I: Cell Biology & Molecular Genetics (CBL501A)

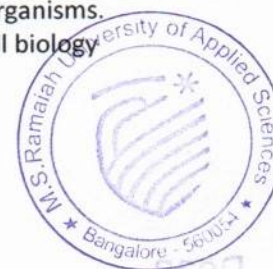
After undergoing this course students will be able to:

- CO-1. Describe and carry out basic cell culture and microscopy
- CO-2. Evaluate cellular processes that occur in and between cells
- CO-3. Describe and explain processes for the characteristics of living organisms.
- CO-4. Explain cell-based methods used to expand understanding of cell biology
- CO 5. Experiment with model organisms (Drosophila) in genetics
- CO 6. Demonstrate significant genetic concepts via experimentation


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Course Outcomes (COs)

Course Title & Code: Practical II: Microbiology & Biochemistry (CBL502A)

After undergoing this course students will be able to:

- CO-1. Perform an estimation of the concentration of bio-molecules from an unknown sample
- CO-2. Isolate and characterize the colony morphology of bacterial strains by staining and biochemical tests
- CO-3. Isolate enzyme from different sources, and estimate its specific activities
- CO-4. Production and estimation of byproducts from various bacterial strains
- CO 5. Evaluate the quality of water by BOD and MPN test
- CO 6. Perform enzyme kinetic studies to characterize its molecular behavior

Course Outcomes (COs)

Course Title & Code: Biostatistics (BTD505A)

After undergoing this course students will be able to:

- CO-1. Explain the importance of data collection and its role in determining scope of inference
- CO-2. Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation
- CO-3. Explain the use, and interpret results of, the principal methods of statistical inference and design
- CO-4. Explain the results of statistical analyses accurately and effectively
- CO 5. Enumerate an appropriate use of statistical software
- CO 6. Demonstrate the use of mathematical and statistical theory underlying the application of biostatistical methods; use and interpret results from specialized computer software for the management and statistical analysis of research data

Course Outcomes (COs)

Course Title & Code: Molecular Biology I (CBC501A)

After undergoing this course students will be able to:

- CO-1. Illustrate the replication of genetic material
- CO-2. Compare processes involved in recombination and repair of the genome
- CO-3. Identify the regulatory differences in transcription of prokaryotes and eukaryotes
- CO-4. Explain the processes involved in the post-transcriptional processing of RNA and regulation of transcription
- CO 5. Summarize the mechanisms involved in the synthesis and regulation of proteins
- CO 6. Outline the mechanisms involved in the regulation of genome expression


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Course Outcomes (COs)

Course Title & Code: Infection and Immunity (CBC502A)

After undergoing this course students will be able to:

- CO-1. Describe the molecular and cellular mechanisms that underpin the pathogenesis and control of infections, and the interaction of pathogens with the immune system.
- CO-2. Explain the pathogenesis of microbial and viral infections and apply this knowledge to any specific infectious disease
- CO-3. Illustrate how cells interact with other cells in the body, as well as with pathogens
- CO-4. Elaborate on an advanced level human immunity and the development of immune responses that are important in the prevention and development of disease
- CO 5. Elucidate immunological events occurring in response to various infectious agents
- CO 6. Explain the basis behind vaccinology and vaccine development and other immunotherapy

Course Outcomes (COs)

Course Title & Code: Bioinformatics (BTD506A)

After undergoing this course students will be able to:

- CO-1. Explain the use of bioinformatics in addressing a range of biological questions
- CO-2. Justify how bioinformatics methods can be used to relate sequence, structure and function
- CO-3. Enumerate the technologies for modern high-throughput DNA sequencing and their applications
- CO-4. Describe principles and algorithms of pairwise and multiple alignments, and sequence database searching
- CO 5. Explain how evolutionary relationships can be inferred from sequences (phylogenetics)
- CO 6. Explain the 3-D structure of protein, and its interaction with different ligands to draw structure- function relationship

Course Outcomes (COs)

Course Title & Code: Genomics and Proteomics (CBC503A)

After undergoing this course students will be able to:

- CO-1. Explain the genome organization in Eukaryotes.
- CO-2. Explain the various techniques of gene manipulation for research applications
- CO-3. Evaluation and application of gene manipulation techniques.
- CO-4. Compare the different methods of estimating and separating protein
- CO 5. Illustrate Protein manipulation techniques and its application in research
- CO 6. Explain clinical significance of Gene and protein manipulation techniques


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Course Outcomes (COs)

Course Title & Code: Practical III: Molecular Biology I & Immunology (CBL503A)

After undergoing this course students will be able to:

- CO-1. Isolate and characterize DNA for concentration, molecular weight, and restriction mapping
- CO-2. Expertise in AGE and SDS-PAGE techniques for quantification of DNA
- CO-3. Acquire hands-on experience on molecular biology techniques
- CO-4. Perform cell culture and counting of immune cells and comment
- CO 5. Perform assays to assess the interaction and quantification of antigen and antibody
- CO 6. Perform experiments used to purify immunoglobulins from serum sample

Course Outcomes (COs)

Course Title & Code: Practical IV: Genomics, Proteomics and Bioinformatics (CBL504A)

After undergoing this course students will be able to:

- CO-1. Analyze public database to study gene sequence through several online program
- CO-2. Demonstrate a Phylogenetic relationship between homologous, and non-homologous gene
- CO-3. Explain the sequence (nucleotide and amino acid) similarity and diversity through BLAST analysis
- CO-4. Develop a 3-D model of protein from primary structure and its energy minimization, and validation
- CO 5. Analyze a protein ligand interaction to study its structure-function relationship through molecular docking
- CO 6. Design a PCR primer and test an online PCR to check the validity of the primer

Course Outcomes (COs)

Course Title & Code: Research Methodology (BTD507A)

After undergoing this course students will be able to:

- CO-1. Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research
- CO-2. Demonstrate the application and utility of the Systematic approach and out of the box thinking concepts for research to be effective
- CO-3. Demonstrate the procedures outlined for a systematic Literature Review
- CO-4. Analyze and prepare well-structured research proposal and research paper invoking clearly outlined principles



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Course Outcomes (COs)

Course Title & Code: Molecular Biology II (CBC504A)

After undergoing this course students will be able to:

- CO-1. Understand the basic principles and methodologies of recombinant DNA technology
- CO-2. Explain Gene amplification, screening and Expression systems.
- CO-3. Enumerate the strategies of cloning in E. Coli and yeast with reference to applications.
- CO-4. Analyze methodologies of the Human Genome project and its implication on present day Human genomics
- CO 5. Illustrate various gene manipulation techniques in plants , their uses, implications and future
- CO 6. Applications of Recombinant genome technology in human welfare and future directions.

Course Outcomes (COs)

Course Title & Code: Practical V: Molecular Biology II (CBL505A)

After undergoing this course students will be able to:

- CO-1. Isolate and characterize RNA and Plasmids for molecular weight, restriction and ligation
- CO-2. Expertize in PCR and RAPD techniques for quantification of DNA
- CO-3. Acquire hands-on experience on gene cloning, protein expression and detection.
- CO-4. Perform the techniques of Southern and Western blotting
- CO 5. Acquire hands-on experience on AGE, PAGE and formaldehyde gel electrophoresis
- CO 6. Analyze DNA sequence data

Course Outcomes (COs)

Course Title & Code: Entrepreneurship Skill Development (CBM501A)

After undergoing this course students will be able to:

- CO-1. Outline the basic concepts in entrepreneurship, identification of opportunities, business evaluation and analysis.
- CO-2. Conduct a market-analysis, a distribution- and sales analysis, as well as a marketing plan
- CO-3. Illustrate the differences in issues and challenges in science-based industries related to entrepreneurship and innovation
- CO-4. Identify the own personal entrepreneurial potential, ability, and competences
- CO 5. Create and execute marketing, biotechnology development and strategic plans that integrate technological development with evolving international customer requirements
- CO 6. Compose and write a business plan offering a convincing presentation of a biotech venture. The element of the business plan should reflect skillful application of theories and tools from the course



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Course Outcomes (COs)

Course Title & Code: Group Project (CBP501A)

After undergoing this course students will be able to:

- CO-1. Work in a team and undertake a project in the area of Genomics, NGS, Clinical data analysis, Critical analysis of papers by using analytical research approach
- CO-2. Apply Biotechnology principles and techniques for executing the project
- CO-3. Apply appropriate research methodology while formulating a project
- CO-4. Define Specifications, Synthesize, Analyse, Develop and Evaluate a project
- CO 5. Develop a report which explains the project and make a presentation and document the work

Course Outcomes (COs)

Course Title & Code: Stem Cell and Regenerative Medicine (CBE501A)

After undergoing this course students will be able to:

- CO-1. Identify characteristic features of Stem cells, their origin, maintenance and regulation.
- CO-2. Explain the properties of stem cells and their therapeutic implication.
- CO-3. Illustrate the clinical uses of stem cells as an alternative treatment modality.
- CO-4. Explain the pros and cons of stem cell treatment in cancer therapeutics
- CO 5. Exemplifying the methods of bio-amplification of stem cells for therapeutic use
- CO 6. Focus on building perspective on the future of stem cell therapy and regenerative medicine.

Course Outcomes (COs)

Course Title & Code: Synthetic Biology (CBE502A)

After undergoing this course students will be able to:

- CO-1. Explain how naturally occurring organisms regulate the expression of their genes
- CO-2. Describe how the regulation of the genes and properties of gene products can be altered with synthetic biology methods
- CO-3. Justify how synthetic biology alters the properties of the cell or the organism
- CO-4. Develop a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated, and to critically analyse the results and generate testable hypotheses from these experiments
- CO 5. Develop a critically analytical skill, present and defend scientific literature in synthetic biology, including practical applications such as metabolic engineering
- CO 6. Develop a scientific approach to entirely synthesize Escherichia coli with a recoded genome



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Course Outcomes (COs)

Course Title & Code: Molecular Biology of Disease and Diagnostics (CBE503A)

After undergoing this course students will be able to:

- CO-1. Explain the different classes of diseases namely infectious, metabolic, genetic and physiological diseases
- CO-2. Enumerate on the molecular biology and immunology of disease
- CO-3. Classify the Immunological, Molecular and Biochemical techniques of diagnosis of diseases
- CO-4. Compare the nucleic acid, protein, genetic and cytogenetic based diagnostic techniques for diseases
- CO 5. Illustrate the genetic basis of cancer, current and prospective diagnostic and ameliorative approaches
- CO 6. Outline the principles of Gene therapy, its applications, prospects and Challenges

Course Outcomes (COs)

Course Title & Code: Bio-separation Technique (CBE504A)

After undergoing this course students will be able to:

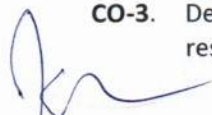
- CO-1. Understand from the scratch of techniques to bring out the bio-products from the cell wall; to remove the insoluble particles; to confirm the product availability
- CO-2. Understand more knowledge about the precipitation, types of extraction, methods and applications
- CO-3. Explain the types of liquid chromatography; gas chromatography, their principle, working mechanism, applications. The way to bring out the products to market with all final crystallization and making into powder
- CO-4. Enumerate the fundamental concepts & theories of separation techniques in HPLC, and to identify the strength & limitations of each type of HPLC technique
- CO 5. Delineate the fundamental application of ion exchange chromatography, and the use of different matrix to purify biomolecules
- CO 6. Evaluate the strengths and limitations of the most important chromatographic separation and detection methods in relation to the properties of the sample and of the analysis task

Course Outcomes (COs)

Course Title & Code: Biosafety Regulation, Bioethics and IPR (CBE505A)

After undergoing this course students will be able to:

- CO-1. Explain different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents.
- CO-2. Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations.
- CO-3. Describe ethical aspects related to biological, biomedical, health care and biotechnology research.


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Course Outcomes (COs)

Course Title & Code: Upstream Processing (CBE506A)

After undergoing this course students will be able to:

- CO-1. Describe the principles that underlie major unit operations used in upstream processing of biotechnological and biopharmaceuticals.
- CO-2. Demonstrate the methods of cell culture under various conditions, strain improvement methods
- CO-3. Apply engineering principles to address issues in bioprocesses
- CO-4. Analyze molecular biology elements used to construct recombinant cell lines and identify potential genetic instability in bioprocesses
- CO 5. Explain how environmental conditions influence cell growth and means to achieve optimal cell growth in large scale
- CO 6. Design or Select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria

Course Outcomes (COs)

Course Title & Code: Bio-analytical Technique (CBE507A)

After undergoing this course students will be able to:

- CO-1. Discuss the principles involved in undertaking standard sample preparation procedures, and recognize the critical importance of rigorous instrumental calibration procedures and the use of standards and reference materials
- CO-2. Describe the process of cell disruption followed by separation of intracellular organelles
- CO-3. Explain the character of intracellular components under microscopic observation
- CO-4. Explain the molecular behavior of purified molecules through chromatographic analysis and its characterization through spectroscopic, radio-labelled, and immunochemical
- CO 5. Critically appraise the techniques and methods adopted by scientific researchers

Course Outcomes (COs)

Course Title & Code: Plant Secondary Metabolites (CBE508A)

After undergoing this course students will be able to:

- CO-1. Classify important plant secondary metabolites
- CO-2. Explain the significance of plant secondary metabolites in plant functions
- CO-3. Compare the health promoting bioactivities of food derived compounds
- CO-4. Relate the bioactivities of plant secondary metabolites to development of effective therapeutics
- CO 5. Demonstrate the biotechnological approaches for the production of secondary metabolites
- CO 6. Choose the techniques used for purification and characterization of natural compounds


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Course Outcomes (COs)

Course Title & Code: AI in Health Care (CBE509A)

After undergoing this course students will be able to:

- CO-1. Demonstrate the understanding and knowledge regarding to the needs of AI in healthcare
- CO-2. Describe the possibilities of applications of AI to healthcare
- CO-3. Describe the ethical issues related to AI in health care sector
- CO-4. Explore methods to overcome the challenges of AI in the healthcare domain; and ways in which AI will support and assist towards better healthcare

Course Outcomes (COs)

Course Title & Code: Molecular Carcinogenesis (CBE510A)

After undergoing this course students will be able to:

- CO-1. Classify cancer types and the causal agents
- CO-2. Relate particular chromosomal aberrations that underlie specific cancer types
- CO-3. Summarize the types of genetic mutations that are key to causing cancer
- CO-4. Explain the processes involved in the initiation and progression of cancer
- CO 5. Outline the current developments in cancer diagnostics and therapy
- CO 6. Distinguish molecular pathways which form suitable targets for therapeutic applications

Course Outcomes (COs)

Course Title & Code: Dissertation and Publication (CBP502A)

After undergoing this course students will be able to:

- CO-1. Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
- CO-2. Prepare and present a research proposal
- CO-3. Conduct research to achieve research objectives
- CO-4. Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- CO 5. Create research document and write research papers for publications
- CO 6. Defend the research findings in front of scholarly audience



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