M.Sc./Int. M.Sc.-Ph.D. in Biological Sciences:

Program outcomes

- Obtain domain and technical knowledge in the subject related to Biological Sciences
- Learn Essential experimental skills
- Foster Research Aptitude required for biological research
- Learn effective scientific communication
- Gain advanced learning in Contemporary areas of Biological Sciences

Program specific outcomes

- Develop strong foundation in basic and applied concepts of Cell Biology, Molecular Biology, Recombinant DNA Technology, OMICS, Human Genetics and Immunology, Biostatistics, Analytical Techniques
- Integrate theoretical knowledge with hands on training and apply understandings of theoretical concepts through engagement in experimental work
- Strengthen analytical and technical skills.
- Develop core competence and problem solving approach
- Learn different bioinformatics, computational and Statistical tools
- Recognize, understand and apply basic ethical principles in biological research.
- Develop creative problem-solving skills and analytical thinking
- Ability to identify a problem and design laboratory experiments, perform Good Laboratory Practice, Ability to inspect data, interpret observations and apply statistical tools for their analysis.
- Learn and apply fundamental concepts of Intellectual Property Rights (IPR) in biological research
- Read, understand, interpret and critically evaluate scientific literature/information/data.
- Ability to communicate (both oral and written) scientific information clearly and in a well-organized approach.
- Ability to write research proposals for procuring intra or extramural research funding.

- Learn concepts of emerging areas in Biological sciences (Stem Cell biology, Oncology, Regenerative Medicine, Nanosciences, Bioinformatics) in conjunction with computational languages and tools (R, Python, Big data analysis).

Course outcomes

After taking the course the student would pursue career in

- Academia: Doctoral research in National/International Institutions
- Sales and R&D: Research fellow, Application/Technical expert in Pharmaceutical and Biotech companies
- Industry: Quality control, Clinical data management, Molecular diagnostics
- Scientific communication/Editing

Subject Wise Expected Outcome

Sl. No	Semester	Course/module	Expected outcomes
1	I	Cell Biology	After completion of the course, students would be able to describe 1) Cellular organization 2) Cell cycle regulation 3) Cell communication 4) Techniques involved in cell biology
		Analytical Techniques in Biology	After completion of the course, students would be able to describe the principle and operation of biological instrumentation methods and techniques of 1) Centrifugation and Electrophoresis b) 2) Chromatography 3) Spectroscopy
		Molecular Biology	After completion of the course, students would be able to describe: 1) Genome organization 2) Amino acids structures and properties 3) Proteins structure and function 4) Transcription and Translation
		Research Methodology	The course will help to make students productive member of their supervisor's lab without repetitive training across lab groups.
		Biostatistics	After completion of the course, students would be able to: 1) Understand types of data, and appropriate statistical tools for their analysis. 2) Describe data using tables, graphs, or numbers 3) Understand and use probability distributions 4) Use statistics for generalizations and decision making 5) Evaluate statistical conclusions based on experimental design
		Human Evolutionary Genetics	After completion of the course, students would be able to: 1) Understand evolutionary patterns and how evolutionary relationships are estimated. 2) Understand the principles of population genetics, including selection, genetic drift, mutation, linkage, and gene flow. 3) Understand the mechanisms of speciation and diversification. 4) Understand the relevance of evolutionary biology to human society, particularly human health.
	I	Practical Paper 1	After completion of the course, students would be able to: 1) Perform cell culturing 2) Handle cell lines

			3) Characterizing cell cultures 4) Perform immunological assays that are routinely used in the field of immunology. 5) Calibrate analytical instruments 6) Operate and use UV spectrophotometer, HPLC, IR spectrophotometer 7) Analyse NMR and MS data
		Practical Paper 2	After completion of the course, students would be able to: 1) Perform transcription and mobility shift assay. 2) Understand importance of performing literature review for writing a scientific research proposal. 3) Make a poster or powerpoint presentation suitable for scientific conference
2	II	Recombinant DNA Technology	Students will get basic understanding of gene cloning techniques, expression in various expression systems.
		Bioinformatics	After completion of the course, students would be able to describe 1) bioinformatics databases, tools and soft wares 2) Information access for DNA, protein and metabolites 3) Sequence and structure analysis and predictions
		IPR and Patenting	After completion of the course, students would be able to: 1) Have fair understanding of types of Intellectual Property Rights 2) Gain knowledge about the International arrangements for protection of various IPRs, Have insight into Patent system and Indian Patents Act and Rules 3) Understand International Patent Application Procedure and Timelines 4) Will have through understanding of patentability criteria, Fair skill of conducting prior art searches, analysing search results and form preliminary opinion on patentability of invention, Draft patent applications and claims. 5) Have understanding of Patent examination process, timelines and preparing response to the examination report, 6) Prepare representation/opposition
		OMICS	After completion of the course, students would be able to: 1) Understand the field of 'Omics'. 2) Apply methods and techniques used for gene, peptide, metabolite detection in genetic and biomedical research 3) Describe and examine strategies used in the literature to find genes from expected biological and metabolic pathways

			4) Demonstrate and apply computer skills used in 'Omics' research
			5) Describe how protein folding happens from both an energetic and a structural perspective
			6) Describe how protein structure can be determined using x-ray scattering or nuclear magnetic resonance (NMR) experiments
	II	Recent Advances in Biology	After completion of the course, students would be able to: 1) Basic understanding or developmental biology 2) Explain the ways to derive and characterize different stem cells. 3) Understand the numerous application of stem cells in various fields. 4) Describe the various types of biomaterials. 5) Explain basic principles of tissue engineering. 6) Describe use of stem cells for treatment of various disorders and diseases. 7) Describe methods of synthesis, characterization and biological applications of nanoparticles.
		Research Seminar	After completion of the course, students would be able to: 1) Find latest scientific literature published in peer reviewed journal 2) Understand and critically discuss the findings in research articles 3) Communicate scientific finding effectively
		Practical Paper 1	After completion of the course, students would be able to: 1) Isolate genomic and plasmid vector 2) PCR amplify and restriction digestion of vector and insertion of DNA 3) Transform DH5α host with plasmid vector containing DNA 4) Induce expression of recombinant protein with IPTG in bacterial host 5) Purify of protein using column chromatography and analysis by SDS PAGE
	II	Practical Paper 2	After completion of the course, students would be able to: 1) Access bioinformatics databases 2) Use different bioinformatics tools 3) Analyse DNA/protein sequence and structure Maintain, subculture and characterize human pluripotent stem cells. 4) Differentiate human pluripotent stem cells followed by characterization 5) Assess the biocompatibility of biomaterial for growing human pluripotent stem cells

			6) Differentiate human pluripotent stem cells in biocompatible scaffolds/membranes followed by characterization by qRT-PCR 7) Synthesize metal oxide nanoparticles by various methods followed by their spectrophotometric analysis 8) Synthesize Lipidic/Polymeric nanoparticles
3	III	Molecular Oncology	After completion of the course, students would be able to: 1) Acquire an historical perspective on the set of related diseases that are referred to as cancer. 2) Gain an understanding of the sequence of events which can take a cell from normal to transformed. 3) Be introduced to the molecular mechanisms responsible for cancer initiation and progression. 4) 4. Gain an appreciation for the evolution of cancer detection and treatment as well as the current state of the art in these areas.
		Immunology	After completion of the course, students would be able to: 1) Describe structural and molecular mechanisms of innate and adaptive immunity 2) Know structural and molecular aspects of immune regulation including cell signaling and activation 3) Know cellular and molecular bases of autoimmunity, transplantation reactions, tumours, infectious and immunodeficiency disorders 4) 4) Know recent developments in vaccine development and techniques in clinical immunology
		Computational Tools	After completion of the course, students would be able to: 1) Do data analysis on MS Excel and have hands on knowledge of the same 2) Analyze Data using Machine Learning algorithms in R 3) Analyze biological data using R program
		Research Proposal Presentation	After completion of the course, students would be able to: 1) Understand various components of a research proposal 2) Write a research proposal
	III	Practical Paper 1	After completion of the course, students would be able to: 1) Understand and analyze genetic changes that may occur during cancer and extend the knowledge to various cancer types. 2) Perform basic immunology experiments
		Introduction to Pharmacology	After completion of the course, students would be able to:

		(Elective)	1) Understand general principles of pharmacology 2) Enlist steps involved in drug discovery and development 3) Explain the different aspects of clinical pharmacology 4) Describe types of toxins, their metabolism and toxicity testing
		Introduction to Python (Elective)	By the end of this course the student should be able to 1) Code programs in python 2) Use the acquired programming skill to utilize in biological research
		Molecular medicine (Elective)	By the end of this course the student should be able to Understand molecular causes of genetic and pathogenic diseases.
4	IV	Project	1) Obtain experimental work experience and by working in an academic or industrial set-up. 2) Improve your employability prospects.