SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Programme duration: 2 years (Semester I-IV)

Total credits: 24 x 4 = 96;

Total marks: 600 x 4 = 2400

Semester – I

Course Code	Course Name	L-T-P	Course Type	Credits	Total Marks
MMBC101	Microbial Metabolism	2-0-0	Core Course	2	50
MMBC102	Microbial Cell Biology	2-0-0	Core Course	2	50
MMBC192	Microbial Cell Biology Lab	0-0-4	Core Course	2	50
MMBC103	Molecular Biology	2-0-0	Core Course	2	50
MMBC193	Molecular Biology Lab.	0-0-4	Core Course	2	50
MMBC104	Biophysical Methods & Instrumentation	2-0-0	Core Course	2	50
MMBC194	Biophysical Methods & Instrumentation Lab	0-0-4	Core Course	2	50
MMBC105	Enzymes & Reaction Kinetics	2-0-0	Core Course	2	50
MMBC195	Enzymes & Reaction Kinetics Lab	0-0-4	Supportive Course	2	50
MMBS101	Quality Assurance (QA) and Quality Control (QC)	2-0-0	Supportive Course	2	50
MMBS181	Seminar-I	0-0-8	Skill Dev	4	100
	Total			**24**	**600**

SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Semester – II

Course Code	Course Name	L-T-P	Course Type	Credits	Total Marks
MMBC201	Recombinant DNA Technology	2-0-0	Core Course	2	50
MMBC291	Recombinant DNA Technology Lab	0-0-4	Core Course	2	50
MMBC202	Ecology and Environmental Studies	2-0-0	Core Course	2	50
MMBC292	Ecology and Environmental Studies Lab	0-0-4	Core Course	2	50
MMBC203	Genetics (Prokaryotes & Eukaryotes)	2-0-0	Core Course	2	50
MMBC293	Genetics (Prokaryotes & Eukaryotes) Lab	0-0-4	Core Course	2	50
MMBC204	Biostatistics	2-0-0	Core Course	2	50
MMBC205	Biostatistics Lab	0-0-4	Core Course	2	50
MMBS201	Clinical Data Management (CDM)	2-0-0	Supportive Course	2	50
MMBS202	Active Pharmaceutical Ingredient (API) Production	2-0-0	Supportive Course	2	50
MMBS281	Seminar-II	0-0-8	Skill Dev	4	100
	Total			**24**	**600**

SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Semester – III

Course Code	Course Name	L-T-P	Course Type	Credits	Total Marks
MMBC301	Fermentation and Bioprocess Engineering	2-0-0	Core Course	2	50
MMBC302	Proteomics and Genomics	2-0-0	Core Course	2	50
MMBC392	Proteomics and Genomics Lab	0-0-4	Core Course	2	50
MMBC303	Drug Discovery & Development	2-0-0	Core Course	2	50
MMBE301	A. Application of AI/ML in Biology and Biopharma B. Microbial Biotechnology	4-0-0	Elective Course	4	100
MMBE302	A. Microbial Proteomics B. Environmental Microbiology	4-0-0	Elective Course	4	100
MMBS381	Summer Project	0-0-8	Supportive Course	4	100
MMBS382	Seminar-III	0-0-4	Skill Dev	4	100
	Total			**24**	**600**

SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Semester – IV

Course Code	Course Name	L-T-P	Course Type	Credits	Total Marks
MMBC401	Virology	4-0-0	Core Course	4	100
MMBC402	Immunology	4-0-0	Core Course	4	100
MMBC492	Immunology Lab	0-0-4	Core Course	2	50
MMBC403	Medical Biotechnology and Gene Therapy	2-0-0	Core Course	2	50
MMBS401	Computer Aptitude and Bioinformatics	2-0-0	Core Course	2	50
MMBS491	Computer Aptitude and Bioinformatics Lab	0-0-4	Supportive Course	2	50
MMBS402	Medical Scribing & Medical Coding	2-0-0	Supportive Course	2	50
MMBS481	Summer Project	0-0-4	Supportive Course	2	50
MMBS482	Seminar-IV & Grand Viva	0-0-8	Supportive Course	4	100
	Total			**24**	**600**

Topics for Project/Dissertation for SEM-III & IV

1. Mushroom Hybrid Production & Cultivation Technology
2. Biofuel Production
3. Water Recycling and Irrigation
4. Microbial Technology
5. Bioprocess Technology
6. Enzymology
7. Metabolic Engineering
8. Plant Biotechnology
9. Molecular Breeding
10. Molecular Genetics
11. Economically Important Microbes and Applications
12. Industrial & Food Biotechnology
13. Animal Biotechnology
14. Nanobiotechnology
15. Cancer Genetics
16. Plant Diversity and Medicinal Applications
17. Plant Tissue Culture & Nursery Management
18. Bioengineering
19. Industrial Microbiology
20. Waste Management
21. Microbial Diversity
22. Entrepreneurship Development

Important features: Mandatory

SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Internal assessment and evaluation of each course will be made as per the University Standard.

Detail Syllabus of Semester – I

Course Name: Microbial Metabolism
Course Code: MMBC101
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [12H]

Bacterial photosynthesis (different types of photosynthetic bacteria, photopigments, paths of carbon and electron in bacterial photosynthesis); metabolism of energy reserve compounds (polyglycans, poly- and □-hydroxybutyrate); metabolic energetics: basic differences in anaerobic and respiratory kinds of energy metabolism; electron transport system; basic mechanisms of ATP synthesis; energy conservation in chemolithotrophic bacteria (Nitrobacter, Nitrosomonas, Thiobacilli including Thiobacillus ferrooxidans, methanogens, hydrogen oxidizing bacteria);

Module-II [8H]

Respiratory metabolism-Embden-Meyerhoff pathway, Entner-Doudroff pathway, phosphoketolase pathway, glyoxalate pathway, Krebs‟ cycle, oxidative and substrate level phosphorylation, reverse TCA cycle, gluconeogenesis- Pasteur effect; energy metabolism and microbial growth; growth yield coefficients, theoretical growth yield;

Module-III [4H]

Fermentation of carbohydrates-homo and heterolactic ferementations- mixed acid, propionic acid, butyric acid, acetone-butanol etc. fermentations, substrate level phosphorylation in anaerobic energy metabolism; transport processes.

Course Outcome

The course on Microbial Metabolism is designed in such a way that the students would get ample opportunity to study various metabolic pathways in microorganisms. Moreover, the topics would be significant enough for in depth understanding into various biochemical reactions involved for microbial metabolic activities which are pertinent to the industrially important product generation.

Course Name: Microbial Cell Biology
Course Code: MMBC102
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [4H]

Cell as a basic unit of living systems; precellular evolution of cell; the evolution of cell from prokaryotes to eukaryotes and from single cells to multicellular organisms; Structure of the cell;

Module-II [10H]

Bacterial Cell wall: structures, diversities and biosynthesis, different cell wall hydrolyzing enzymes; bacterial endospores: structure, formation and germination; Uncommon bacterial genera: Rickettsia, Chlamydia, Mycoplasma, sheathed bacteria, stalked and budding bacteria, gliding bacteria including Myxobacteria. Cellular structure and function; flagella, pili, capsules; specialized features of higher bacteria like budding, gliding bacteria etc.; fruiting body formation

in myxobacteria.

Module-III [6H]
Internal organization of the cell; Cell membrane structure; membrane constituents; phospholopids, glycolipids, cholesterol, membrane proteins, receptors and phospholipases; bilayer structure, asymmetry, fluid mosaic model of random diffusion of membrane components, domains in membrane- natural and artificial membranes.

Module-IV [4H]
General strategies of cell division: bacteria and yeast, molecular genetics of cell cycle regulation; Cell signaling; Chemotaxis, Quorum sensing; Regulation of biofilm formation.

Course Name: Microbial Cell Biology Lab
Course Code: MMBC192
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Microscopic observation of bacterial cell.
2. Microscopic observation of fungal cell.
3. Bacterial cell viability and counting.

Course Outcome:
Microbial Cell Biology would cover the study of pathogenic microorganisms as tools for cellbiology research. It also provides knowledge in the direction of cell-biology methods to understand microbial pathogenesis. Experiments on Microbial Cell Biology train students to expertise in subcellular fractionation of different cellular organelles. This course will also help students learn about staining techniques and organelle localization.

Course Name: Molecular Biology
Course Code: MMBC103
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [10H]
DNA replication in prokaryotes and eukaryotes: General features and enzymology; detailed mechanisms of initiation, elongation and termination; experiments underlying each step and role of individual factors; telomerases: mechanism of replication, maintenance of integrity and role in cancer;

Module-II [14H]
Transcription: RNA polymerase subunits, different sigma factors- related to stress, viral infections etc., initiation, elongation and termination (rho- dependent and independent) of RNA synthesis; antitermination, attenuation and other influences of translational apparatus on the process of transcription; various protein motifs involved in DNAprotein interactions during transcription; translation: in prokaryotes and eukaryotes, processing of mRNA for translation and involvement of different translational factors at different stages of the process.

Course Name: Molecular Biology Lab
Course Code: MMBC193

Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. DNA isolation and PCR
2. mRNA isolation – RT PCR
3. DNA-protein interaction

Course Outcome
The Molecular Biology course would provide ample knowledge regarding the composition, structure and interactions of cellular molecules – such as nucleic acids and proteins – that carry out the biological processes essential for the cell's functions and maintenance- *the central dogma.*

Course Name: Biophysical Methods & Instrumentation
Course Code: MMBC104
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [12H]
Thermodynamics: extensive and intensive variables; mathematical description of a system with two or more variables, exact and partial differential; first law of thermodynamics, isothermal process, entropy and second law of thermodynamics, reversible and irreversible process, free energy and chemical potential; Gibb‟s free energy; potentiometric determination of pK‟s of amino acids. Free energy of charged macro-ions; Debye-Huckel theory; Hydration, solvation number.

Module-II [12H]
Instrumentation: Principles of light absorption, extinction coefficient, ultraviolet, visible and infrared absorption spectrophotometer and their working principles; molecular vibrations, normal modes and group vibrations- hydrogen bonding effect on vibrational spectra; resonance Raman spectroscopy and its biological applications; Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD) and their application in the study of macromolecules; fluorescence and phosphorescence. Introduction to Mass Spectrometry, MALDI-TOF, ESI.

Course Name: Biophysical Methods & Instrumentation Lab
Course Code: MMBC194
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. General laboratory practices and handling of instruments;
2. Training on centrifugation, microscopy and spectroscopy.

Course Outcome
During this study knowledge will be gained in the direction of biophysical methods which measure the binding or interactions among and between proteins and small molecules. Besides, students will get the hands-on training on various instruments to be handled for the research purpose.

Course Name: Enzymes & Reaction Kinetics

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Course Code: MMBC105
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [16H]
Definition of enzymes; active site, substrate, coenzyme, cofactor and different kinds of enzyme inhibitors; enzyme kinetics, two substrate kinetics, three substrate kinetics, deviation from linear kinetics; ligand binding studies; rapid kinetics; association and dissociation constants; use of isotopes in enzyme kinetics mechanism analysis; effect of pH, temperature and isotopically labeled substrates on enzyme activity; allosteric model of enzyme regulation; substrate induced conformational change in enzyme;

Module-II [8H]
Techniques for purifying and characterizing proteins and enzymes; idea of all analytical techniques like electrophoresis, liquid chromatography, crystallography, column chromatography for enzyme protein analysis.

Course Name: Enzymes & Reaction Kinetics Lab.
Course Code: MMBC195
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Estimation of proteins,
2. Enzyme kinetics,
3. Effects of pH and temperature on enzyme,
4. Use of inhibitors for active site determination,
5. Chromatographic techniques,
6. Purification of enzymes,
7. Chemical estimation of vitamins, minerals like calcium, iron etc,
8. Separation of biomolecules by electrophoresis,
9. Determination of molecular weight by gel filtration.

Course Outcome:
Enzymes & Reaction Kineticscourse would cover various aspects of enzymology. This study is relevant in the direction of enzyme activity, ligand binding assay and also in the field of enzyme purification.

Course Name: Quality Assurance (QA) & Quality Control (QC)
Course Code: MMBS101
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Unit 1: Introduction to QA and QC (1 Credit)
- Definitions, Scope, and Importance of QA and QC in Biotech and Pharma
- Key Concepts: Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP), and ISO Standards
- QA/QC Systems: Objectives, Components, and Workflow
- Risk Assessment and Management in Quality Processes

Unit 2: Regulatory Guidelines and Compliance (1 Credit)
- Overview of Regulatory Authorities: USFDA, EMA, CDSCO, WHO
- Regulatory Guidelines: ICH Q8, Q9, Q10, and Q11
- Documentation Practices: Standard Operating Procedures (SOPs), Batch Records, and Validation Protocols
- Audits and Inspections: Types, Preparation, and Handling Non-Compliance

Unit 3: Quality Control Techniques and Tools (1 Credit)
- Analytical Methods for QC: Chromatography (HPLC, GC), Spectroscopy (UV-Vis, FTIR), and Mass Spectrometry
- Microbial and Sterility Testing in Biotech Products
- Validation Techniques: Process, Analytical, and Cleaning Validation
- Statistical Tools for Quality Control: Six Sigma, Control Charts, and Process Capability Analysis

Unit 4: Applications and Case Studies (1 Credit)
- QA/QC in Biopharmaceuticals: Monoclonal Antibodies, Vaccines, and Biosimilars
- QA/QC in Food and Nutraceuticals: Standards and Testing
- Case Studies: Real-World Examples of Quality Failures and Lessons Learned
- Emerging Trends in QA/QC: AI in Quality Monitoring, Real-Time Release Testing (RTRT)

Learning Outcomes
Upon completing this course, students will:
1. Understand the fundamental principles of QA and QC in biotechnology and pharma.
2. Be familiar with global regulatory standards and their application in quality management.
3. Gain hands-on knowledge of QA/QC techniques and tools used in testing and validation.
4. Apply QA/QC principles to biomanufacturing processes and compliance audits.

Course Name: Seminar-I
Course Code: MMBS181
Contact: 4P
Credits: 4
Contact Hours: 48 Hours

Students will present PowerPoint presentation of any topic having good impact to improve their presentation skills.

Course Outcome
The Seminar-I is included in the syllabus as this is one kind of training for students in order to know the state of art in delivering lectures and to gain expertise in preparing digital presentations though both online and offline mode.

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Detail Syllabus of Semester – II

Course Name: Recombinant DNA Technology
Course Code: MMBC201
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [12H]
Principles and methods of recombinant DNA technology- hybridization, cloning, sequencing, polymerase chain reaction, genome projects; gene manipulations; cloning in E.coli, plasmids, bacteriophages and cosmid vectors, cloning strategies, genomic and cDNA library; expression of cloned genes in E. coli, products made in E. coli by genetic engineering; cloning in yeast: transformation in yeast, yeast vector development: Yep, YRp, YCp and YIp, 2 plasmid, yeast artificial chromosome (YAC), expression of proteins in yeast; yeast 2-hybrid system.

Module-II [12H]
Genetic engineering of plants: transformation of plants, manipulating gene expression in plants, selectable markers and reporter genes, Agrobacterium tumefaciens; Genetic elements present on the Ti plasmid, genetic engineering of the Ti plasmid, vectors used to introduce foreign DNA into plant cells- binary cloning vector, disarmed Ti plasmid, cointegrate cloning vector; comparison of methods for transfer of DNA to plants, manipulation of gene expression in plants; production of transgenic plants without reporter or marker genes.

Course Name: Recombinant DNA Technology Lab.
Course Code: MMBC291
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Isolation of bacterial genome and plasmid DNA,
2. Restriction enzyme digestion,
3. Restriction mapping and cloning,
4. Southern blotting,
5. RT-PCR

Course outcome
Recombinant DNA technology techniques will generate the in-depth knowledge in molecular cloning, DNA transfer into cell, in vitro cloning, DNA fingerprinting etc. Moreover, RT-PCR is extremely helpful in diagnostic study.

Course Name: Ecology and Environmental Studies
Course Code: MMBC202
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [4H]
Evolution of environment and Origin of life, Diversification of life and speciation; Classifying organisms: Concepts of phenetics and cladistics; Principles of ecological organization; Basics of

structural & functional ecology; Concept of Population genetics; Basic approach to evolutionary biology and behavioral ecology; Evolutionary principles and stable strategies; types of selections.

Module-II [4H]
Biodiversity- levels of biodiversity, alpha, beta and gamma diversity, Values and ethics of biodiversity; Global patterns of biodiversity, hotspots of biodiversity and megadiversity country; Biogeographic zones in India; factors influencing local and regional biodiversity, Biodiversity documentation.

Module-III [6H]
Threat to species diversity, Extinction vortex, Causes of extinction; Population viability analysis; Red Data Book, Biodiversity conservation approaches: Local, National and International, In situ and ex situ conservation, Concept of protected area network, Selecting protected areas, criteria for measuring conservation value of areas, Sanctuary, National Park and Biosphere reserves; Design and management of protected areas; Threats to wildlife conservation and wildlife trade; Tools for wildlife research, Wildlife threat, Use of Radiotelemetry and Remote sensing in wildlife research

Module-IV [1H]
Perception on Bioresource; Legal binding of biological materials- concept of Biopatents

Module-V [3H]
Environmental biotechnology: Understanding biotechnology, Concept and outlines of various applications- GM crops and GMO: Environmental implications; Biodegradation, Phytoremediation: types and applications Bio-fuel production, Bio fertilizer, Biopesticides; Integrated Pest Management,

Module-VI [4H]
Microorganisms and environmental pollutants: Overall process of biodegradation, Environmental biomonitoring and indicator microorganisms, biodegradation of organic pollutants, anaerobic biodegradation, in-situ and ex-situ bioremediation, case studies of microbial remediation, lagoon and Vadose zone bioremediation, surface bioremediation of soils and sludge, Applied bioremediation and industrial applications, developing bioremediation technologies, Concept of Fermentation technology and Bioreactor, microorganisms and metal pollutants, metal – microbial interaction and metal remediation; Microbial transformation of pesticides.

Module-VII [2H]
Waste treatment – modern wastewater treatment, traditional methods, wetlands and aqua-culture systems, Surface Bioremediation of soil and sludge.

Course Name: Ecology and Environmental Studies Lab
Course Code: MMBC292
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Isolation of heavy metal resistant bacteria,
2. Metabolic fingerprinting of microbes by BIOLOG,
3. Isolation of cellulolytic bacteria from soil sample,
4. Preparation of total DNA from soil and water,

5. Amplification of 16S rDNA and DGGE electrophoresis.

Course outcome
The course would enlighten students in understanding the diversity of life forms at various ecosystem levels. Students will also learn about the various types of environmental pollution and the application of biotechnology in environmental clean-up. Additionally, the study would provide knowledge about the microorganisms in remediating relevant pollutants in the environment.

Course Name: Biostatistics
Course Code: MMBC203
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [8H]
Probability and statistics; population, variables, collection, tabulation and graphical representation of data, frequency distribution, central tendency and skewness, binomial,

Module-II [8H]
Poisson and Gaussian distributions, additive and multiplicative laws of probability, concept and correlation; regression;

Module-III [8H]
Methods of least squares; chi-square tests, random number generation- testing and use; probability density and cumulative distribution function; systematic and random sampling.

Course Name: Biostatistics Lab.
Course Code: MMBC293
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Data tabulation and frequency distribution.
2. Probability testing.
3. Analysis of correlation, regression.
4. Chi-square test.
5. Sampling method.

Course Outcome
Biostatistics course would provide basic knowledge in the direction of analyzing large number of data(s). In context of biological science, this study will shed light into numerous applications of biostatistics and statistical relevance of outcomes.

Course Name: Clinical Data Management (CDM)
Course Code: MMBS201
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Unit 1: Introduction to Clinical Data Management (1 Credit)

- Definition and Importance of CDM
- Overview of Clinical Trials and CDM in the Drug Development Lifecycle
- Key Stakeholders: Sponsors, CROs, and Regulatory Authorities
- Standard Operating Procedures (SOPs) and Good Clinical Data Management Practices (GCDMP)

Unit 2: Regulatory Guidelines and Ethical Considerations (1 Credit)
- International Guidelines: ICH-GCP, US FDA, EMA, and Indian CDSCO
- Data Privacy and Protection: HIPAA, GDPR, and Indian IT Act
- Ethical Issues in Data Collection and Management
- Audits and Inspections in Clinical Data Management

Unit 3: CDM Process and Tools (1 Credit)
- Data Collection and Case Report Forms (CRFs): Design and Standards
- Data Entry and Validation: Processes and Best Practices
- Overview of CDM Systems and Software (e.g., Oracle Clinical, Medidata RAVE, EDC tools)
- Data Cleaning, Query Management, and Database Lock

Unit 4: Advanced Topics and Applications (1 Credit)
- Integration of CDM with Biostatistics and Data Analysis
- Handling Adverse Event Data and Serious Adverse Events (SAEs)
- Real-World Data (RWD) and Real-World Evidence (RWE)
- Emerging Trends: Artificial Intelligence and Machine Learning in CDM

Learning Outcomes: Upon completion of the course, students will be able to:
1. Design and implement a clinical data management plan for clinical trials.
2. Demonstrate proficiency in using CDM tools and software.
3. Ensure compliance with ethical and regulatory standards for data management.
4. Analyze clinical data and generate comprehensive reports for regulatory submissions.
5. Understand emerging technologies in CDM and their applications in clinical research.

Course Name: Active Pharmaceutical Ingredient (API) Production
Course Code: MMBS202
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Unit 1: Introduction to APIs and Manufacturing Processes (1 Credit)
- Definition and Classification of APIs: Small Molecules, Biologics, and Peptides
- Overview of API Manufacturing Workflows: Raw Material Procurement, Synthesis, and Purification
- Key Techniques: Chemical Synthesis, Biocatalysis, and Fermentation
- Role of APIs in Drug Development and Therapeutics

Unit 2: Process Development and Optimization (1 Credit)
- Principles of Process Design: Reaction Kinetics, Reactor Design, and Yield Optimization
- Scale-Up Considerations: Lab-Scale to Pilot-Scale and Commercial Production
- API Purification Techniques: Crystallization, Filtration, and Drying
- Process Analytical Technology (PAT) and Continuous Manufacturing

Unit 3: Quality Assurance, Regulatory Compliance, and Safety (1 Credit)

- Good Manufacturing Practices (GMP) in API Production
- Regulatory Requirements: USFDA, EMA, WHO, and ICH Guidelines
- Quality Assurance and Quality Control in API Manufacturing
- Safety and Environmental Considerations in API Production

Unit 4: Emerging Trends and Case Studies (1 Credit)

- Green Chemistry in API Manufacturing: Sustainable Processes and Waste Reduction
- AI and Machine Learning in API Process Optimization
- Biopharmaceutical APIs: Production of Monoclonal Antibodies, Vaccines, and Biosimilars
- Case Studies: Success Stories and Challenges in API Manufacturing

Learning Outcomes: Upon completing this course, students will:
1.Acquire knowledge of the science and engineering behind API production.
2.Understand process design, optimization, and scale-up in API manufacturing.
3.Demonstrate an understanding of quality assurance, compliance, and safety in API production.
4.Apply emerging technologies to optimize and innovate API production processes.

Course Name: Seminar-II
Course Code: MMBS281
Contact: 4P
Credits: 4
Contact Hours: 48 Hours

Students will present PowerPoint presentation of any topic having good impact to improve their presentation skills.

Course Outcome
The Seminar-II is included in the syllabus as a one kind of training program where students, in order to know the state of art in the delivering lectures and to gain the expertise in preparing the digital presentations though both online and offline mode of studies.

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Detail Syllabus of Semester – III

Course Name: Fermentation and Bioprocess Engineering
Course Code: MMBC301
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [8H]
Introduction to Bioprocess Engineering, Bioreactors, and Membrane Bio reactors, Isolation, preservation, and Maintenance of Industrialn Microorganisms, Kinetics of microbial growth and death, Media and medial sterilization for industrial Fermentation. Air quality Management and air sterilization. Types of Fermentation processes: Analysis of batch, Fed-batch and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.); Fermentation kinetic and monitoring; Measurements and control of bioprocess parameters.

Module-II [8H]
Downstream processing: Introduction, removal of microbial cells and solid matter, foam preparation, precipitation, filtration, centrifugation, cell disruptions, liquid liquid extraction, chromatography, Membrane process, Drying and Crystaliztion, Effluent treatment: D.O.C. and C.O.D. treatment and disposal of effluents. Whole cell immobilization and their industrial applications: Immobilized enzymes, enzymes in aqueous and nonaqueous media, Bioconversion and biotransformation.

Module-III [8H]
Industrial production of chemicals: alcohol (ethanol), Acids (citric, acetic, and gluconic), solvents (glycerol, acetone, and butanol) antibiotics (ampicillin, streptomycin and tetracyclin), microlodes, anticancer antibiotics, aminoacids (lysine, glutamic acids), single cell protein, single cell lipids. Use of microbes in mineral beneficiation and oil recovery. Introduction to food technology: Elementary idea of canning and packing– fat based edible products, sterilization and pasteurization of food products, fat-based nutraceuticals technology of typical food/food products (bread, cheese, idli, agroproducts (oilseeds), food preservation, food colors, flavors, and antioxidants. Introduction to Bioprocesses technology: Hydrogenation, oxidation, esterification.

Course Outcome
Fermentation and bioprocess engineering explore the production of pharmaceutical products, foods and chemicals. Also, the biocatalyst production would be introduced such as an enzyme, microorganisms, plant cell, or animal cell in bioreactor.

Course Name: Proteomics and Genomics
Course Code: MMBC302
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [4H]
Mass spectroscopy, basic principle, MALDI-TOF, ESI; 2-D Gel electrophoresis, Nuclear magnetic resonance spectroscopy (NMR), basic principles, chemical shift, spin-spin interaction, NOE, 2D-NMR, NOESY, COSEY.

Module-II [6H]
X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg‟s law, special properties of protein crystals, model building, refinement and Rfactor.

Module-III [10H]
Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, chromosome microdisection, molecular markers in genome analysis; RAPD and AFLP analysis, molecular markers linked to disease resistant genes, application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, varietal etc. Genome sequencing: genome sizes, organelle genomes, genoimc libraries, strategies for genome sequencing, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes.

Module-IV [4H]
Pharmacogenetics, genetics of globin triplet repeat disorders, cancer genetics; immunogenetics; mapping of human genome; somatic cell genetics; DNA polymorphism in mapping; structure and function; biochemical genetics; polygenic inheritance, Microarray.

Course Name: Proteomics and Genomics Lab
Course Code: MMBC392
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. DNA sequencing,
2. PCR based site directed mutagenesis,
3. Protein electrophoresis-1D + 2D

Course outcome
Proteomics investigates how proteins affect and are affected by cell processes. In addition, this course will also deal with the genome of individual organisms.

Course Name: Drug Discovery & Development
Course Code: MMBC303
Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [10H]
Target identification and molecular modelling: Identification of target or drug leads associated with a particular disease by a number of different techniques including combinations of molecular modeling, combinatorial libraries and high-throughput screening (HTS); Conceptualizing the automation of the HTS process and the importance of bioinformatics and data processing in identification of lead compounds; Rational drug design, based on understanding the three-dimensional structures and physicochemical properties of drugs and receptors; Modelling drug/ receptor interactions with the emphasis on molecular mechanisms, molecular dynamics simulations and homology modelling; Conformational sampling,

macromolecular folding, structural bioinformatics, receptor-based and ligand-based design and docking methods, in silico screening of libraries, semi-empirical and ab-initio methods, QSAR methods, molecular diversity, design of combinatorial libraries of drug-like molecules, macromolecular and chemical databases.

Module-II [8H]
Lead optimization: Identification of relevant groups on a molecule that interact with a receptor and are responsible for biological activity; Understanding structure activity relationship; Structure modification to increase potency and therapeutic index; Concept of quantitative drug design using Quantitative structure–activity relationship models (QSAR models) based on the fact that the biological properties of a compound are a function of its physicochemical parameters such as solubility, lipophilicity, electronic effects, ionization, stereochemistry, etc.; Bioanalytical assay development in support of in vitro and in vivo studies (LC/MS/MS, GC/MS and ELISA).

Module-III [8H]
Preclinical development: Principles of drug absorption, drug metabolism and distribution - intestinal absorption, metabolic stability, drug-drug interactions, plasma protein binding assays, metabolite profile studies, Principles of toxicology, Experimental design for preclinical and clinical PK/PD/TK studies, Selection of animal model; Regulatory guidelines for preclinical PK/ PD/TK studies; Scope of GLP, SOP for conduct of clinical & non clinical testing, control on animal house, report preparation and documentation Integration of non-clinical and preclinical data to aid design of clinical studies.

Module-IV [6H]
Drug manufacturing: Requirements of GMP implementation, Documentation of GMP practices, CoA, Regulatory certification of GMP, Quality control and Quality assurance, concept and philosophy of TQM, ICH and ISO 9000; ICH guidelines for Manufacturing, Understanding Impurity Qualification Data, Stability Studies.

Module-V [6H]
Clinical trial design: Objectives of Phase I, II, III and IV clinical studies, Clinical study design, enrollment, sites and documentation, Clinical safety studies: Adverse events and adverse drug reactions, Clinical PK, pharmacology, drug-drug interaction studies, Statistical analysis and documentation.

Module-VI [10H]
Fundamentals of regulatory affairs and bioethics: Global Regulatory Affairs and different steps involved, Regulatory Objectives, Regulatory Agencies; FDA guidelines on IND and NDA submissions, Studies required for IND and NDA submissions for oncology, HIV, cardiovascular indications, On-label vs. off-label drug use GCP and Requirements of GCP Compliance, Ethical issues and Compliance to current ethical guidelines, Ethical Committees and their set up, Animal Ethical issues and compliance.

Learning outcome:
1. Students will learn about various aspects of drug discovery and development.
2. Students will study various clinical trial designs and clinical safety designs.

Course Name: Application of AI / ML in Biology and Biopharma
Course Code: MMBE301A
Contact: 2L
Credits: 2

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Contact Hours: 24 Hours

Unit 1: Fundamentals of AI/ML in Biology (1 Credit)
•Introduction to AI and ML: Definitions, Types (Supervised, Unsupervised, Reinforcement Learning)
•Key Concepts: Neural Networks, Deep Learning, and Natural Language Processing (NLP)
•Biological Data Types: Genomic, Transcriptomic, Proteomic, and Clinical Data
•Overview of AI/ML Tools: Python Libraries (Scikit-learn, TensorFlow, PyTorch), R Programming

Unit 2: AI/ML in Drug Discovery and Development (1 Credit)
•Applications in Drug Target Identification and Validation
•AI in Virtual Screening, Molecular Docking, and ADMET Prediction
•Accelerating Drug Discovery Pipelines with Generative AI Models
•Case Studies: AI-Driven Drug Development (e.g., AlphaFold, BenevolentAI)

Unit 3: AI/ML in Biopharma Process Optimization (1 Credit)
•Process Monitoring and Optimization in Bioreactors
•Predictive Models for Yield Optimization and Quality Control
•AI in Supply Chain and Manufacturing Processes
•Integration of AI in Biopharma 4.0 Frameworks

Unit 4: Emerging Trends and Ethical Considerations (1 Credit)
•AI in Personalized Medicine and Precision Therapeutics
•Role of AI/ML in Synthetic Biology and Genetic Engineering
•Challenges in Data Privacy, Bias, and Interpretability in AI/ML Models
•Regulatory and Ethical Guidelines for AI Applications in Biopharma

Learning Outcomes
Upon completion of this course, students will:
1.Understand the principles of AI/ML and their applications in biology and biopharma.
2.Develop skills to analyze biological data using AI/ML techniques.
3.Apply AI/ML models to real-world problems in drug discovery and biopharma process optimization.
4.Critically evaluate ethical and regulatory considerations in AI/ML applications.

Course Name: Microbial Biotechnology
Course Code: MMBE301B
Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [12H]
Fermentative production of industrial alcohol, uses, raw materials, microorganisms, inoculum preparation, preparation of wort, fermentation and recovery, Fermentative production of beer – Medium components, malt, malt adjuncts, hops, water, Preparation of wort, mashing, wort boiling, microorganism, inoculum preparation, fermentation, cold storage maturation, carbonation, packing and preservation. Principles of wine making – Fruit selection, picking, crushing, sulphite addition, processing, fermentation, aging and bottling.

Module-II [12H]
Fermentative production of citric acid, uses, inoculum preparation, medium preparation,

fermentation, recovery and mechanism of citric acid production, Fermentative production of vitamin B12 – Uses, structure of vit-B12, microorganisms, inoculum preparation, medium preparation, fermentation and recovery, Fermentative production of glutamic acid – Uses, microorganism, inoculum preparation, production medium, fermentation and downstream processing.

Module-III [12H]
Antibiotics – Commercial production of benzyl penicillin, uses, microorganism, inoculum preparation, production medium, fermentation, recovery and semi-synthetic penicillins, Fermentative production of tetracyclines – uses, chlortetracycline, oxy- tetracycline, tetracycline and semisynthetic tetracyclines, structures, microorganisms, inoculum preparation, production medium, fermentation and recovery methods.

Module-IV [12H]
Production and application of microbial enzymes. – Amylases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery, Steroid transformations – Substrates, typical structures, microorganisms, inoculum preparation, 11-hydroxylation, process and recovery, Principles of vaccine production and types of vaccines, Microbial biopesticides, Microbial products from genetically modified (cloned) organisms eg. Insulin.

Course Outcome
The course Microbial Biotechnology includes various aspect of microbiological metabolic product development though various processes like fermentation and its related use.

Course Name: Microbial Proteomics
Course Code: MMBE302A
Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [12H]
Protein structure – Different levels of protein structure, Protein Folding and unfolding, Active sites and effects of pH, temperature, substrate concentrations, inhibitors and activators on activity. Protein functions, Protein interaction in cell signaling neurotransmitters and membrane channel opening and closing.

Module-II [12H]
Separation techniques – 2-D gel and polyacrylamide gel electrophoresis (PAGE), Biological mass spectrometry -MALDI-MS , ESI-MS, LC-MS/MS Finger printing, Protein identification – Peptide mass fingerprinting (PMF), Electro blotting and sequencing, Determination of 3-D structures by x-ray crystallography, NMR and homology modeling.

Module-III [12H]
Microbial pathogenesis at the proteome level. Proteomics of Saccharomyces cerevisiae- cell wall & transport, differential expression in stress. Proteomics of probiotic Lactobacilli-intestinal epithelial cells interactions, Proteomic Identification of Mycobacterium tuberculosis.

Module-IV [12H]
Protein-protein, protein-DNA interactions, Yeast two hybrid system, Protein micro arrays-Protein Markers, Clinical Proteomics, Small peptides, Personalized medicine, Protein

engineering, Drug design.

Course Outcome
The course microbial proteomics gives in depth idea about the protein structures, the purification methodology of proteins and also let us know the protein-protein interaction in microbial system.

Course Name: Environmental Microbiology
Course Code: MMBE302B
Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [10H]
Contribution of pioneer worker (Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Edward Jenner) in the field of microbiology. Basic structure and function of microorganisms.

Module-II [18H]
M.Sc. in Microbiology Programme Structure 2021 (As per UGC CBCS Template) Familiarity with the science of microbiology and its significance in everyday life: Microorganisms drive the biogeochemical cycles that sustain all living things, and can be used to ameliorate environmental degradation, in food industry/ biotechnology.

Module-III [4H]
Microbial habitats and mechanism of their survival (terrestrial, aquatic, and extreme conditions).

Module-IV [10H]
Preparation of media, Isolation, and cultivation of microbes (autotrophs, heterotrophs, aerobes, anaerobes etc.), sterilization techniques (Physical and chemical methods), Pasteurization.

Module-V [4H]
Microbial contribution in i) biofuel production; ii) changes in global climate; iii) pollutant degradation.

Course outcome:
The Environmental Microbiology course includes various aspects of microorganisms found in nature. The study deals with the microbial interaction with the different factors in the environment. Moreover, it sheds light on the various aspects of environmental bioremediation.

Course Name: Summer Project
Course Code: MMBS381 Contact: 8P
Credits: 4
Contact Hours: 96 Hours

Students will submit the project proposal and synopsis to the departmental HOD or project coordinator. Initial classes will be on selection of topics, supervisor/guide, template for project proposal writing etc. Students may start actual lab/theory work in due course.

Course outcome:
Summer Project is introduced to expose students to research projects. It would be beneficial for students working in the laboratory environment, gaining expertise in research and development.

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Course Name: Seminar-III
Course Code: MMBS382
Contact: 4P
Credits: 4
Contact Hours: 48 Hours

Students will present PowerPoint presentation of any topic having good impact to improve their presentation skills.

Course outcome
The Seminar-III is included in the curriculum as a training program where students get hands- on opportunities to carry out scientific projects related to their field of study and gain the expertise in preparing the digital presentations and delivering the project outcome in seminar sessions. Grand viva is also included which is essential for the overall assessment of the students.

Detail Syllabus of Semester - IV

Course Name: Virology
Course Code: MMBC401

Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [16H]
Classification and modes of propagation, bacterial, plant and animal viruses: morphology and ultra-structure; assay of viral particle, cell culture, viral enzymes, nucleic acids, bacterio phages; lambda, T4, T7, M13, lytic cycle, lysogeny; viral replication, nucleic acid and protein synthesis, viral diseases.

Module-II [20H]
Virus host interaction: virus infection, viral diseases and pathogenesis: Herpes, adeno, hepatitis, rhabdo, oncogenic viruses etc. DNA viruses: Herpes, hepatitis B, adenovirus; RNA viruses: polio, VSV, influenza, retroviruses: structure and life cycle, transformation; baculovirues.

Module-III [12H]
Molecular biology of genetic shift and drift in influenza virus, cellular tropism of HIV; Plant viruses: TMV.

Course outcome
Virology is relevant because this domain discusses various classes of viruses and their life cycles. Also, this domain lets us know the mode of interaction of viruses in different living systems.

Course Name: Immunology
Course Code: MMBC402
Contact: 4L
Credits: 4
Contact Hours: 48 Hours

Module-I [8H]
Immunoglobins, organization and expressions of Ig genes; B cell maturation, activation and differentiation; MHC/ HLA; antigen processing and presentation;

Module-II [14H]
T-cells, T-cell receptors, T-cell maturation, activation and differentiation; cytokines; cell mediated and humoral effector responses, auto immunity, immunodeficiency diseases, transplantation immunology, cancer and immune system.

Module-III [10H]
Monoclonal and polyclonal antibodies, monoclonal antibody technique. Structure and function of antibody molecules, generation of antibody diversity, antibody engineering, antigen-antibody interactions.

Module-IV [16H]
Concept of - a) lymphoid organs, b) primary and secondary immune responses, c) antigen processing and presentation, d) major histocompatibility complex (MHC) antigens, e) Toll-like receptors, f) complement systems, g) Transplantation, h) Hypersensitivity, i) Tolerance and autoimmunity, j) Immunosuppression, and k) congenital and acquired immunodeficiencies.

Course Name: Immunology Lab.
Course Code: MMBC492

Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Immunization with a specific antigen and raising of the antibody,
2. Determination of blood group (ABORL),
3. Bacterial agglutination (raising antibody in rabbit using bacteria as antigen),
4. ODD (Ouchterlony double diffusion),
5. SRID (Mancini‟s method),
6. Immuno-electrophoresis.
7. Lymphocyte preparation from peripheral blood and separation of macrophages.
8. Antibody producing CFU form mouse spleen.

Course outcome
Immunology is a branch of Bio-Medicine that covers the study of immune systems. This also includes important aspects that enable us to know about the various components of the immune systems and their interactions which are implemented in various diagnostic purposes.

Course Name: Medical Biotechnology and Gene Therapy
Course Code: MMBC403
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [4H]
Disease diagnosis-probe, PCR, LCR immunological assay. Detection of genetic, Neurogenetic disorders involving Metabolic and Movement disorders. Treatment- products from recombinant and non-recombinant organisms, Interferons, Antisense therapy, cell penetrating peptides.

Module-II [10H]
Gene therapy, Types of gene therapy, somatic virus germline gene therapy, mechanism of gene therapy, Immunotherapy, Detection of mutations in neoplastic diseases MCC, SSCP, DGGE, PTTC. Focusing on emerging infections, viral classifications, transmissions and preventions, viral pathogenesis, mechanisms of viral induced cancer and viral evolution, developmental biology of virally induced birth defects, factors in pathogenesis and transmission of prions. Cell mediated and Gene therapy as a novel form of drug delivery, vectors, cell types. Responses to viral infections; slow and persistent infections, anti-viral agents, interferons, equipment and materials for animal cell culture technology. Primary and established cell line cultures.

Module-III [4H]
Introduction to the balanced salt solution and the simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Serum and protein free defined media and their applications. Measurements of viability and cytotoxicity. Biology and characterization of the culture cells, measuring parameters of growth.

Module-IV [6H]
Basic techniques of mammalian cell culture in vitro; desegregation of tissue and primary culture, maintenance of cell culture, cell separation. Scaling up of animal cell culture. Cell synchronization. Cell cloning and micromanipulation. Cell transformation. Application of animal cell culture. Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines, somatic cell genetics, organ and histolytic cultures.

SWAMI VIVEKANANDA UNIVERSITY
Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121
School of Life Sciences
M.Sc. in Microbiology
Programme Structure 2025
(As per UGC CBCS Template)

Course Outcome
The course Medical Biotechnology and Gene Therapy deals with genetic manipulations, cloning of genes and also applications of gene therapy in living system.

Course Name: Computational Aptitude and Bioinformatics
Course Code: MMBS401
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module-I [6H]
Basic idea to work on Linux platform – basic concept of OS. Simple shell commands.

Module-II [6H]
Concept of homology, paralogy, orthology, analogy and xenology. Comparison of sequences of biological macromolecules – Pairwise alignment: local and global alignment; Concept of indel, affine gap penalty; Database search algorithm, significance of hits, KarlinAltschul equation; Multiple sequence alignment, concept of consensus, interpretation with regular expression, concept of protein profile and PSSM, algorithm of PSI-BLAST. PHI-BLAST and other forms of BLAST.

Module-III [6H]
Concept of tree, reading and interpreting phylogenetic trees, distance-based and character-based methods for the construction of phylogenetic trees, judging strength of clades (with BS or PP values) in a tree.

Module-IV [6H]
Kyte-Doolittle plot and Hopp-Woods plot- prediction of localization of a protein, prediction of TMD. Secondary, tertiary and quaternary structure prediction –concept of propensity in Chou-Fasman method; Homology modeling, threading and ab initio method; Docking – rigid and flexible, protein-protein and protein-ligand.

Module-V: Introduction to Computational Thinking (1 Credit)
•Basics of Computational Thinking: Logical Reasoning and Problem-Solving
•Algorithm Design: Steps in Problem Formulation and Solution Design
•Understanding Flowcharts and Pseudocode for Logical Representation
•Applications of Computational Thinking in Biotechnology

Module-VI: Programming Fundamentals (1 Credit)
•Introduction to Programming Languages: Python and R
•Basic Syntax, Variables, Data Types, and Operators
•Control Structures: Loops (for, while) and Conditional Statements (if-else)
•Functions, Modules, and Libraries for Efficient Coding

Module-VII: Algorithms and Data Structures (1 Credit)
•Fundamental Algorithms: Sorting, Searching, and Recursion
•Data Structures: Arrays, Lists, Dictionaries, and Stacks
•Algorithm Optimization: Time and Space Complexity
•Case Studies: Biological Sequence Alignment and Phylogenetic Tree Construction

Module-VIII: Applications in Biotechnology (1 Credit)
•Data Analysis and Visualization using Python and R
•Applications in Genomics and Proteomics: Sequence Analysis and Protein Modeling
•Introduction to Machine Learning: Basics of Supervised and Unsupervised Learning
•Tools for Computational Biology: Biopython, BioPerl, and R Bioconductor

Course Name: Computational Aptitude and Bioinformatics Lab.
Course Code: MMBS491
Contact: 4P
Credits: 2
Contact Hours: 48 Hours

1. Pairwise alignment- local and global alignment using Smith-Waterman and Needleman-Wunsch algorithm respectively. Comparison of the results with reference to percentage identity, percentage gaps etc.
2. Comparison of the different BLOSUM matrices
3. Cross dot plot to identify regions of similarity/identity and self-dot plot to identify repeats
4. Two BLAST searches - one using a house keeping protein and another using a rare protein.
5. Comparison of the results with reference to elements of the search list
6. Study of the CATH and SCOP database to write a report followed by classification of a given protein
7. Hydropathy plot of a globular and a membrane protein followed by a comparison of the two plots
8. Identification of consensus sequence through multiple sequence alignment
9. Using the multiple sequence alignment for the construction of phylogenetic tree
10. Tertiary structure prediction using homology modelling and threading

Course outcome
The Computer Application and Bioinformatics course is designed in a way that would help students know about the various tools that are pertinent to get information related to the biological systems. The various online servers, together with numerous software are also implemented to explore numerous information of biological systems.

Course Name: Medical Scribing and Medical Coding
Course Code: MMBS402
Contact: 2L
Credits: 2
Contact Hours: 24 Hours

Module 1: Fundamentals of Medical Scribing (1 Credit)
- •Introduction to Medical Scribing: Role and Responsibilities
- •Anatomy and Physiology Overview for Medical Scribes
- •Medical Terminology and Abbreviations
- •Electronic Health Records (EHRs): Systems and Workflow
- •Real-Time Medical Documentation: Patient History, Symptoms, and Treatments

Module 2: Principles of Medical Coding (1 Credit)
- •Overview of Medical Coding: Purpose and Applications
- •ICD-10-CM and ICD-11 Coding: Structure and Guidelines

- CPT and HCPCS: Procedure and Services Coding
- Coding for Different Specialties: Cardiology, Orthopedics, Oncology, etc.
- Error Minimization and Quality Assurance in Coding

Module 3: Technology and Software in Medical Scribing and Coding (1 Credit)

- Introduction to Medical Scribing Tools and Transcription Software
- Coding Software Platforms: 3M CodeFinder, EncoderPro, etc.
- Integration of Artificial Intelligence and Automation in Scribing and Coding
- Data Security and Confidentiality in Medical Records
- Case Studies: Implementing Technology in Real-Life Scenarios

Module 4: Ethical, Legal, and Regulatory Aspects (1 Credit)

- Health Insurance Portability and Accountability Act (HIPAA) Compliance
- Documentation Standards and Legal Considerations in Medical Records
- Billing and Reimbursement Processes in Healthcare
- Ethical Issues in Medical Scribing and Coding
- Global Coding Standards: Regional Variations and Challenges

Learning Outcomes

By the end of this course, students will:

1. Develop the ability to document medical encounters accurately and efficiently.
2. Gain competency in using ICD, CPT, and HCPCS coding systems for various medical procedures and diagnoses.
3. Demonstrate proficiency in medical coding software and EHR systems.
4. Understand the ethical and regulatory requirements for handling medical data.
5. Be prepared for careers in medical scribing, coding, and related roles in healthcare and biotech industries.

Course Name: Summer Project
Course Code: MMBS481
Contact: 8P
Credits: 4
Contact Hours: 96 Hours

Students will completely utilize the credit hours in lab work to finish their summer project.

Course outcome:

Summer Project is introduced to expose students to research projects. It would be beneficial for students working in the laboratory environment, gaining expertise in research and development.

Course Name: Seminar-IV & Grand Viva
Course Code: MMBS482
Contact: 4P
Credits: 4
Contact Hours: 48 Hours

Students will present PowerPoint presentation of their project details and followed by viva voce.

Course outcome

The Seminar-IV is included in the curriculum as a training program where students get hands-on opportunities to carry out scientific projects related to their field of study and gain the expertise in preparing the digital presentations and delivering the project outcome in seminar sessions .

SWAMI VIVEKANANDA UNIVERSITY

Telinipara, Barasat-Barrackpore Road, Bara Kanthalia, WB - 700121

School of Life Sciences

M.Sc. in Microbiology

Programme Structure 2025

(As per UGC CBCS Template)

Grand viva is also included which is essential for the overall assessment of the students.