

M.Sc in Biotechnology Syllabus (C.B.C.S)

Effective from July 2012

Course Curriculum:

Semester: I, II, III and IV

Name of Programme : M.Sc. Biotechnology

Time Duration : 02 years

Semester : 04(Four)

SEMESTER-I

Sr.No	Code	Name of the course	Credit	Hrs/Week	Marks		
					Int.	Ext.	Total
01	BTA 101CMB	Cell and Molecular Biology	04	03	30	70	100
02	BTA102 BCE	Biochemistry and Enzymology	04	03	30	70	100
03	BTA 103 IAT	Instrumentation and Analytical Techniques	04	03	30	70	100
04	BTA 104 BRM	Biostatistics and Research Methodology	04	03	30	70	100
05	BTB 105 LCS	Language and Communication Skills-I	04	03	30	70	100
06	BTA 106 PRA	Practical Module -I	08	15	--	100	100
Total:			28	30	150	450	600

Biotechnology

SEMESTER-I

BTA 101 CMB Cell and Molecular Biology

Unit No.	Description	hours
01	History and developments in Cell Biology, Ultra structure and functions of Prokaryotic and Eukaryotic cells and their organelles	10
02	Structure and Organization of Chromatin, Giant Chromosomes, Cell Division (Prokaryotic and Eukaryotic), Cell Cycle: Mechanism and Regulation	06
03	Intracellular compartments: Protein sorting, secretory and endocytic pathway	06
04	Cell differentiation, Cell-cell interaction, Cell communication	04
05	Dosage compensation, Sex determination, Sex linked inheritance	07
06	Mendel's discoveries; Chromosomal theory of Heredity; Gene linkage and crossing over; Chromosome mapping; Concept and architecture of gene; genetic code	03
07	Organization of genome in prokaryotes and eukaryotes	02
08	DNA replication in prokaryotes and eukaryotes.	04
09	Gene transcription in prokaryotes and eukaryotes; post transcriptional modification and Translation in prokaryotes and eukaryotes; post transnational modification; Protein Processing	08
10	Gene Regulation in prokaryotes and eukaryotes; Operon concept; DNA methylation; Characteristics of Cancer, Molecular biology of cancer; oncogenes; chemical carcinogenesis; Genetic and metabolic disorders; Genetic load and genetic counseling and Apoptosis	10
	Total hours	60

References:

1. **Monroe. W. Strickberger**, Genetics
2. **Benjamin Lewin**, Genes VIII to X
3. **R.M. Twyman** Advances in Molecular Biology
4. **Larry Snyder and Wendy Champness**. Molecular Genetics of Bacteria
5. **Stanly.R. Maloy, John E.Cronan, Jr. David Freifelder** Microbial genetics
6. **George.M. Malacinski** Essentials of Molecular Biology
7. **James.D.Watson**, Molecular Biology of the Gene
8. **Benjamin Lewin**, Essentials Genes
9. **Lehninger** Principles of Biochemistry
10. **B.D. Singh** Genetics
11. **De Robertis and De Robertis**, Cell and Molecular Biology,
12. **Alberts** Molecular Biology of Cell
13. **Cupper**, The cell
14. **R.M. Atlas**, Principles of Microbiology
15. **Prescott** Microbiology
16. **David white**, The Physiology and Biochemistry of Prokaryotes
17. **Gerald Karp**, Cell and Molecular Biology

BTA102 BCE Biochemistry and Enzymology

Unit No.	Description	hours
1.	Basic chemistry of Biology, Principles of thermodynamics and bioenergetics	04
2.	Carbohydrates: Classification of carbohydrates; Metabolism of carbohydrates (EMP, ED, TCA PPP, ETC), Inter conversion and Regulations, glycogen metabolism, Gluconeogenesis, glyoxylate cycle and oxidative phosphorylation and Disorders of carbohydrate metabolism.	08
3.	Proteins : Classification Amino acids: Biosynthesis and catabolism of amino acids, protein turn over and disorders	06
4.	Lipids : Characteristics and types of Lipid; lipid metabolism, metabolism of fatty acids and other lipids and disorders	06
5.	Nucleic Acids: Classification of Nucleic acids, Metabolism of purines and pyrimidines and disorders	06
6.	Enzymology : An Introduction to Enzymes, classification and nomenclature, activation energy, specific activity and specificity, cofactors and coenzymes, mechanism of enzyme action, bi-substrate reactions and Isoenzymes	06
7.	Enzyme Kinetics: factors affecting enzyme activity, MM equation, Enzyme inhibition-types with examples, Regulatory Enzymes; Multienzyme system-examples	06
8.	Allosteric Enzymes: sequential and symmetrical models and physiological significances	04
9.	Enzyme purification, immobilization and industrial applications	06
10.	Signal transduction: Characteristics and types of receptors, examples, cascades and signaling pathway	08
	Total hours	60

References:

1. **Lehninger**, Principles of Biochemistry
2. **Stryer**, Biochemistry
3. **Voet and Voet**, Biochemistry
4. **David White**, The Physiology and Biochemistry of Prokaryotes
5. **Nicholes Price and Levis Stevens**, Fundamentals of Enzymology
6. **Trevor Palmer**, Understanding Enzymes
7. **Lodish**, Cell Molecular Biology
8. **Hans Bisswanger**, Enzyme Kinetics: Principles and Methods

BTA 103 IAT Instrumentation and Analytical Techniques

Unit No.	Description	hours
1.	Electrochemistry : pH and buffers, potentiometric and conductometric titration	03
2.	Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, atomic force microscopy, confocal microscopy	07
3.	Chromatography: gel-filtration, ion-exchange and affinity chromatography; Thin layer and gas chromatography; High pressure liquid (HPLC) chromatography, FPLC	08
4.	Centrifugation: Basic principle and application; Differential, density and Ultra centrifugation	04
5.	Spectroscopy method : X ray diffraction, fluorescence, UV, ORD/CD, visible, IR, NMR and ESR spectroscopy	09
6.	Atomic absorption and plasma emission spectroscopy; MALDI-TOF	07
7.	Principle and technique of Nucleic acid hybridization and cot curve; sequencing of proteins and nucleic acids; Southern , Northern and South-western blotting technique; Polymerase chain reaction; Methods for measuring nucleic acid and protein interactions	07
8.	Electrophoresis: Principle and application of Native, SDS, Agarose, 2D gel electrophoresis	04
9.	Principle and applications of tracer technique in biology; Radiation dosimetry; Radioactive isotopes and half life of isotopes; Effect of radiation on biological system; Auto radiography; Cerenkov radiation; liquid scintillation spectrometry	06
10.	Biosensors: Principle and applications	05
	Total hours	60

References:

1. **Sharma B K**, Instrumental method of chemical analysis
2. **D.A. Skoog**, Instrumental methods of analysis
3. **Plumner**, An introduction to practical Biochemistry
4. **Chatwal and Anand**, Instrumentation
5. **Boyer**, Modern experimental Biology
6. **Wilson & Walker**- Practical Biochemistry
7. **Upadhyay & Nath**- Biophysical Chemistry

BTA 104 BRM Biostatistics and Research Methodology

Unit No.	Description	hours
01	Bio statistics: Definition and scope, collection and classification. Principle and practice of statistics in Bioscience, tabulation of data; its graphical and diagrammatic presentation	07
02	Measures of central tendency, Statistics of dispersion; standard Deviation and variance; Probability distributions: binomial, Poisson and normal distribution	07
03	Statistical significance: Hypothesis testing, Standard error, level of significance, confidence limit ,Student's t-test, F test and Chi square test	06
04	Simple linear regression and correlation analysis	04
05	Non parametric tests: Rank test, F-Max test, Mann-Whitney (U) test, and Sign test	04
06	Characteristic and types of scientific research	04
07	Research and Experimental design	07
08	Method of Data collection and Data analysis	07
09	Scientific Writing: Research proposal, Research Paper, Review paper, Thesis, Conference report, Book review and Project report; Reference writing, scientific abbreviations	08
10	Preparation and presentations of scientific paper and poster	06
	Total hours	60

References:

1. **Zar**, Biostatistical Analysis
2. **S.P.Gupta**, Statistical Methods
3. **Day R.A.** How to write ad publish a scientific papers
4. **Kothari C.R.** Research Methodology
5. **Dawson, Catherine, 2002**, Research methodology.
6. **Arora et al.**Comprehensive Statistical Methods
7. **G. Nageshwar Rao** Statistics for Agriculture Sciences
8. **R. Rangaswamy** A textbook of Agricultural Statistics
9. **Daniel** Biostatistics: A foundation for analysis in the health sciences
10. **B. K. Mahajan** Methods in Biostatistics
11. **Veer Bala Rastogi** Fundamentals of Biostatistics
12. **Zar** Biostatistical Analysis
13. **Evans** Statistical Methods in Bioinformatics
14. **S. P. Gupata** Statistical methods
15. **G.D.Garson**, Guide to write scientific papers

BTB 105 LCS Language and Communication Skills-I

Unit No	Description	Hours
	Professionals & Communication skills	
1.	Nature of Professional Communication – An Insight, Principals, Stages and Modes of Communication ,Methods of Communication.	5
	Flow and Levels of Communication in an Organization	
2.	7 C's of Effective Communication,Essentials of Communication for Professionals, Barriers to Communication with Remedies to overcome.	5
	Basic Language Components	
3.	Parts of Speech, Verb forms (Active & Passive)	5
	Types of Sentences (Function and Structure based)	
4.	Auxiliary Verbs – Primary and Modal, Causal Contructions,Concord.	5
	Listening skills	
5.	Introduction, Types and Modes of Listening, Active versus Passive Listening, Implications of Effective Listening and Reflective Response.	5
	Reading Skill	
6.	Introduction to Reading Skill, Purpose of Reading, Techniques for effective Reading Comprehension, Active versus Passive Reading.	5
	Speaking Skill	
7.	Introduction to Speaking Skill, Components of Effective Speaking,Paralanguage-Tone,Stress,Pause,Pitch and Intonation, Techniques for Improving Speaking Skill.	10
	Constituents of Effective Writing	
8.	Introductio,Significance of Written communication for Professionals, how to improve writing skill with word Selection	5
	Sentence Construction	
9.	Sentence Structure, Paragraph Development, Characteristics of Effective Written Communication	5
	Business Letter Writing	
10.	Introduction to Business Correspondence, Essential of Effective Business Correspondence,Form and Structure of Business Letters, Drafting of Business Letter:Inquiry,Inviting quotation,Reply,Purchase Order, Complaint And Adjustment	10
	Total Hours	60

Text & Reference Books:

- 1.**Ashraf Rizvi M.***Effective Technical Communication*. Tata McGraw – Hill Publishing Company Limited : New Delhi:2005
- 2.**Raman,Meenakshi & Sharma Sangeeta.***Technical Communication Principles and Practise*. OUP, New Delhi:2008.
- 3.**Ramchandran K.K at al.***Business Communication*. McMillan India Pvt.Ltd, New Delhi:2007.
- 4.**Mohan Krishna & Raman, Meenakshi.***Effective English Communication*. Tata McGraw –Hill Publishing Company Limited: New Delhi:2000
- 5.**Doctor Aspi & Doctor Rhoda.** *Principles and Practice of Business Communication*.Sheth Publishers Pvt Ltd:2001

BTA 106 PRA Practical Module -I
Description

Unit No.	Description
01	Standard operating procedure and validation of Autoclave
02	Standard operating procedure and validation of pH meter
03	Standard operating procedure and validation of UV visible spectrophotometer
04	Standard operating procedure and validation of laminar air flow
05	Standard operating procedure and validation of Balance and Microscope
06	Gram's and Acid fast staining
07	Mitosis
08	Isolation of chloroplast
09	Quantitative analysis of carbohydrates(Cole's, DNS, Anthrone)
10	Estimation of Proteins (Folin, Bradford)
11	Quantitative analysis of Amino acids
12	Estimation of inorganic phosphorus
13	Estimation of inorganic nitrogen
14	Bioassays of antibiotics
15	Effect of Substrate concentration, pH, Temperature and Time on enzyme activity.
16	Determination of Km and V max for Enzyme
17	Enzyme inhibition study
18	Isolation of Chromosomal DNA and Plasmid DNA.
19	Agarose gel electrophoresis
20	SDS PAGE analysis for Protein
21	Separation of amino acid by paper chromatography
22	Separation of sugars by thin layer chromatography
23	Computation of Mean, Median and Mode
24	Computation of standard deviation and Co-efficient of variation
25	Calculation of confidence limit for the population mean
26	To perform student's 't' test (Paired and unpaired)
27	To perform ANOVA
28	To perform regression and correlation analysis
29	To perform Chi square goodness of fit
30	To perform non parametric tests
31	Application statistical software (SPSS/ minitab/ metlab)

Name of Programme : M.Sc.Biotechnology

Time Duration : 02 years

Semester : 04(Four)

SEMESTER-II

Sr.No	Code	Name of the course	Credit	Hrs/Week	Marks		
					Int.	Ext.	Total
01	BTA 201 RDT	Recombinant DNA Technology	04	03	30	70	100
02	BTA 202 BTM	Biodiversity and Taxonomy of Microorganisms	04	03	30	70	100
03	BTA 203 BFT	Bioprocess and Fermentation Technology	04	03	30	70	100
04	BTA 204 CAB	Computer Applications and Bioinformatics	04	03	30	70	100
05	BTB 205 LCS	Language and Communication Skills-II	04	03	30	70	100
06	BTA 206 PRA	Practical Module -II	08	15	--	100	100
Total:			28	30	150	450	600

Biotechnology

SEMESTER-II

BTA 201 RDT Recombinant DNA Technology

Unit No.	Description	hours
01	Basic concepts of r DNA technology: Restriction enzymes, cutting and joining of DNA molecules, Gene isolation techniques	04
02	Cloning vectors: Plasmids, Cosmids, phages and other advanced vectors	07
03	Cloning strategies, gene libraries and c DNA cloning, Expression in <i>E. coli</i> of cloned DNA molecule; Gene manipulation for stability, secretion detection and maximizing the expression of cloned gene.	08
04	Recombinant screening and selection	06
05	Cloning in bacteria other than <i>E. coli</i>	05
06	Cloning in <i>Saccharomyces cerevisiae</i> and other microbial eukaryotes	06
07	Basic techniques: RFLP, PCR and RAPD, DNA fingerprinting, gene expression study with micro array and changing genes: Site directed mutagenesis and protein engineering and Nucleotide Sequencing.	06
08	Recombinant DNA technology for Health: Nucleic acid sequences as diagnostic tools, new drugs and new therapies for genetics diseases, combating infectious disease, protein engineering, metabolic engineering, microbial production of therapeutic agents, Vaccines.	07
09	Recombinant DNA technology for industry and environment: Synthesis of Commercial products by recombinant microorganisms, Bioremediation and biomass utilization, genetic engineering of commercial strain of microorganism	06
10	Regulation of recombinant DNA technology: Regulation of Recombinant DNA technology and deliberate release of genetically engineered organisms, Biotechnology Regulatory Affairs, Patents and IPR for Biotech Industry.	05
	Total hours	60

1. **Waston**, *Recombinant DNA*
2. **Old & Primrose**, *Principles of gene manipulation:*
3. **T.A. Brown** *Gene Cloning*
4. **Glick**, *Molecular Biotechnology*
5. **Pathak**, *Recombinant DNA Technology*
6. **Maniatis** *Molecular Cloning: A Laboratory Manual*

BTA 202 BTM Biodiversity and Taxonomy of Microorganisms

Unit No.	Description	Hours
01	Biodiversity: Origin, speciation, extinction and ecological role of biodiversity; Types of biodiversity: alpha, beta and gamma diversity, Major levels, Losses and coarse action of biodiversity.	06
02	Microbial evolution and phylogeny: Microbial taxonomy and classification; Taxonomic Hierarchies; Classical approach to microbial classification; Numerical taxonomy; Molecular taxonomy.	05
03	Phylogeny of microbial diversity: Phylogenetic groups of Bacteria, Archaea and Eukaryotes.	06
04	Techniques for microbial identification: Morphological, Biochemical, serological and Molecular methods, Fatty acid profiling, metabolic fingerprinting (Biolog), DGGE and TGGE.	05
05	Differential characteristics of Enterobacteriaceae, <i>Pseudomonas</i> , <i>Azotobacter</i> , <i>Rickettsias</i> , <i>Mycoplasma</i> .	07
06	Mycology: Taxonomic criteria of fungal classification; Distinguishing and significant characteristics of Mastigomycotina, Ascomycotina, Basidiomycotina, Zygomycotina and Deuteromycotina; Fungal growth and differentiation, Industrial applications of fungi	07
07	Virology: Structure, classification, cultivation and economic importance of plant viruses. Bacteriophage: Viroids, Prions.	05
08	<i>Actinomycetes</i> : Classification, Cell structure and composition; Eco-physiology; Salient features and economic importance.	06
09	Protozoa: Structure, classification, reproductive strategies and economic importance.	06
10	Algae : structure, classification, reproductive strategies and economic importance; Industrial applications of Algae, lichens	07
Total hours		60

References:

1. **R.M. Atlas**, Principles of Microbiology
2. **Prescott**, Microbiology
3. **Dubey**, Introduction to Fungi
4. **Alexoplous**, Introductory mycology
5. **Flint**, Virology
6. **Biswas**, Viruses
7. **Luria** Virology
8. **Michael** et al, Brock biology of Microorganisms.
9. **Channarayappa**-Molecular Biotechnology, Principles & Practices
10. **Das, Dutta and Ganguli**- College Botany
11. **Mehrotra and Aneja**, An introduction to Mycology
12. **J.W. Deacon**, Modern Mycology
13. **Ray and Ray**, Biodiversity and Biotechnology
14. **P.K. Mohapatra**, Text book of Environmental Biotechnology

BTA 203 BFT Bioprocess and Fermentation Technology

Unit No.	Description	Hours
01	Sources of industrial microbes: Isolation, selection & screening of industrially important microbes. Strain improvement programme; Preservation of industrially important strains.	6
02	Substrates for fermentation process. Sterilization of bioreactor, air and fermentation media	6
03	Aeration and agitation: Theory of oxygen transfer; factors affecting K_La and Oxygen transfer rate; Methods for determination of aeration efficiency; Balance between Oxygen supply and demand; Rheology of fluid.	5
04	Recovery and purification of products: Removal of Microbial cells; Foam separation; Precipitation; Filtration; Centrifugation; Disintegration of cell (Physical and chemical method); Liquid- Liquid extraction; Solvent recovery; Aqueous two phase extraction adsorption; Super critical fluid extraction; Chromatography; membrane processes; Evaporation; Drying; Crystallization; Whole broth processing.	7
05	Growth and multiplication of microbe; measurement of microbial growth; Batch culture, continuous culture, steady state, fed batch culture kinetics; Kinetics characteristics of microbial process	5
06	Microbial enzymes: (Proteases, Lipases, Carbohydratases) and Microbial biomass (SCO, Mushroom) production, and their uses.	6
07	Fermentative production of Citric acid, Glutamic acid and Industrial alcohol.	7
08	Dairy & Food products: Milk processing and milk product, Sea food processing & fermented sea food products, Alcoholic beverages, Vinegar, Vitamin B2, Vitamin B12, Microbial food preservatives and other traditional fermented food products	7
09	Microbial production of therapeutic agents: Interferons, Enzymes, Monoclonal antibodies, Vaccines, Antibiotics (penicillin, tetracycline, non polyene and semi synthetic) etc.	7
10	Microbial production of polymers: Bioplastics, Xanthan and Dextran	4
Total hours		60

References:

1. **E.M. T. El-Mansi and C.F. A. Bryce.** Fermentation microbiology and biotechnology
2. **Alexander N. Glazer and Hiroshi Nikado,** Microbial Biotechnology: fundamentals of applied microbiology, W. H. Freeman and company
3. **Biotol.** Product recovery in Bioprocess technology Biotol series.
4. **Biotol:** Operational models for bioreactor Biotol series
5. **Arnold L. Demain and Julian E. Davies,** Manual of Industrial and Biotechnology, ASM press
6. **EH. J. Pepler and D perlman (2004)** Microbial technology: fermentation technology, Academic press.
7. **Michael Waites,** Industrial Microbiology: An Introduction, Blackwell publication
8. **Michal,** Bioprocess Engineering Basic Concept, Prentice Hall of India
9. **Rehm, H.J, Reed, G., Puhler, A and Stadler, P. (1997).** A multivolume Comprehensive Treaties: Biotechnology, VCH Wienheim, Germany.
10. **Prescott & Dunn,** Industrial Microbiology
11. **Whittaker and Stanbury.** Principles of fermentation technology
12. **H.A. Modi** Vol-1 and Vol.-2 Fermentation technology
13. **Bernard and Glick,** Molecular Biotechnology, Principles and Applications of Recombinant DNA, 4th ed.

BTA 204 CAB Computer Applications and Bioinformatics

Unit No.	Description	hours
01	Introduction to bioinformatics, Applications of bioinformatics, Phylogenetic Analysis	04
02	Computer fundamentals & computer programming: History, development and types of computers , Computer logics and languages, awareness softwares (MS-office), Flowchart, Algorithms, Data types, Operators, Decision making	06
03	Database Concepts, Nucleotide database, Protein database, Biological research on the web	06
04	Pair wise Sequence Alignment, Multiple alignment, Tools for similarity search and sequence alignment	06
05	Profiles and Hidden Markov models	06
06	Gene identification and prediction, Comparative genome analysis, Gene expression and microarrays	08
07	Protein classification and structure visualization, protein structure prediction	05
08	Introduction to proteomics, Protein- protein interaction, Tools and techniques in proteomics	07
09	Introduction to systems biology, Analysis of Pathways, Metabolic network properties and control analysis, Simulation of cellular activities	06
10	Introduction to drug discoveries, Drug discovery-technology and strategies, Computer aided drug design	06
Total hours		60

References

1. **David Mount**, Bioinformatics: sequence and genome analysis, Cold Springer Harbour press.
2. **Jonattan Pevsner**, Bioinformatics and Functional genomics, Wiley liss.
3. **Lesk**, Introduction to Bioinformatics, Oxford publication.
4. **Oren, Jones and Thorntor**, Bioinformatics, Gene Proteins and Computers, Advance text, Bios publication.
5. **R.M. Twyman**, Principles of Proteomics
6. **Rastogi**, Bioinformatics
7. **Westhead and Twyman**, Instant notes on Bioinformatics, Viva Publication.
8. **D. Higgins and W. Taylor (Eds)**, Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi (2000).
9. **R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison**, Biological Sequence Analysis, Cambridge Univ. Press, Cambridge, UK (1998).
10. **A. Baxevanis and B.F. Ouellette**, Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ (1998).
11. **Michael S. Waterman**, Introduction to computational Biology, Chapman & Hall, (1995).
12. **C. Gibas and P. Jambeck**, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly, 2001.
13. **Koonin, Eugene V**, Sequence-Evolution-Function: Computational Approaches in Compatative Genomics
14. **Dov Stekel**, DNA Microarrays
15. **Gu, Jenny**, Stuctural Bioinformatics

Objectives of the Course

1.To impart basic skills of communication in English through intensive practice to the First semester PG students of Science so as to enable them function confidently and effectively in their everyday professional career.

2.To improve the students' fluency in English and to enable them to listen to English spoken at normal conversational speed, to read and comprehend the English texts of varied nature, to write (draft) various technical documents and to speak (converse) in their professional career.

3.To enhance the confidence level of students so as to make them able to communicate in various professional situations effectively.

BTB 205 LCS Language and Communication Skills-II		
	Presentation Skills:	Hours
01	Introduction to Presentation: Definition, Nature, and Importance of Oral Presentation Planning and Preparation of Presentation: Six Great Helpers in Preparing Presentation - Defining Purpose of Presentation, Analysing Audience and Locale, Organising Content, Preparing Outline, Use of Visual Aids in Presentation, Rehearsing and Presentation, Attention Grabbers in the Delivery of Presentation, Steps of Preparing Presentation	10
02	Public Speaking Skill Introduction to Public Speaking, Definition and Nature, Purposes of Public Speaking, Differences between Presentation and Public Speaking	06
03	Group Discussion Definition, Nature and Importance, Difference between Group Discussion and Debate, Characteristics of Successful Group Discussion, Group Discussion Strategies, Techniques for Individual Contribution, Group Interaction Strategies, Group Discussion as a Part of Selection Process, Tips for Success in Group Discussion. Mock Group Discussion in classroom	06
04	Debate Nature of Debate, Definition, Nature and Importance, Pre Requisites of Successful Debate, Strategies for Debate, Debate as a Part of Selection Process. Practice through mock Debate in classroom.	06
05	Interviewing Skills Definition of Interview, Objectives and Process of Interview, Types of Interviews, Characteristics of Job Interview, Strategies for Successful Job Interview, Pre-Interview Preparation Techniques, Types of Interview questions, Answering Strategies, Frequently Asked Interview Questions, Alternative Interview Formats.	06
06	Report, Notice-Agenda & Minutes of Meeting Report Writing: Purpose of a report, Types of Reports, Structure and Style of Reports, Committee Reports, Individual reports Notice, Agenda and Minutes of Meeting: Requisites of Meeting, Types of Meetings, Drafting of Notice, Agenda and Minutes of Meeting	06

07	Job Application & Resume Writing	05
	Significance of Resume and Job Application, Structure Job Application, Tips for Effective Job Application, Drafting of Job Application with Resume	
08	Official Correspondence	05
	Correspondence with different authorities like government departments, civic authorities, office bearers of financial institutions, insurance agencies etc.	
09	Proposal Writing	05
	Nature and Significance of Proposal, Types of Proposals, Structure of Formal Proposals, Parts of a Formal Proposal, Writing Tips, Drafting of Formal Proposals	
10	Technical Articles	05
	Nature and Significance Technical Articles, Types of Technical Articles, Journal Articles and Conference Papers, Review and Research Articles, Elements of Technical Articles, Writing Strategies, Drafting of Technical Articles	
	Total hours	60

References:

1. **Ashraf Rizvi M.** *Effective Technical Communication*. Tata McGraw – Hill Publishing Company Limited; New Delhi; 2005.
2. **Raman, Meenakshi & Sharma Sangeeta.** *Technical Communication Principles and Practice*. OUP, New Delhi; 2008.
3. **Ramchandran K.K. at al.** *Business Communication*. McMillan India Pvt. Ltd, New Delhi; 2007.
4. **Mohan Krishna & Raman, Meenakshi.** *Effective English Communication*. Tata McGraw – Hill Publishing Company Limited; New Delhi; 2000.
5. **Doctor Aspi & Doctor Rhoda.** *Principles and Practice of Business Communication*. Sheth Publishers Pvt Ltd; 2001.

BTA 206 PRA :Practical Module-II

Unit No.	Description
01	Ultraviolet irradiation survival curve
02	Isolation of auxotrophic mutants
03	Isolation Respiratory deficient mutants
04	Isolation of streptomycin mutant by gradient plate technique
05	Enzyme Induction
06	Isolation and identification of bacteria belonging to Enterobacteriaceae
07	Isolation and identification of industrially important fungi.
08	Isolation of bacteriophage of <i>E.coli</i> from sewage
09	Study of Protozoan permanent slide
10	Study of algal permanent slide
11	Use of Microsoft Word, Excel and powerpoint
12	Use of Internet
13	Growth curve of <i>E. coli</i> determination of growth rate and generation time
14	Effect of pH, temperature, salt and glucose on growth
15	Screening of organic acid producing microorganisms
16	Screening of organic Enzyme (amylase/ protease/lipase) producing microorganism.
17	Screening of antibiotic producing microorganisms
18	Study of aqueous two phase system
19	Estimation of aeration efficiency
20	Fermentative production of Glutamic acid
21	Fermentative production of Vitamin B ₂
22	Fermentative production of Ethanol
23	Fermentative production of Gluconic acid
24	Fermentative production of Penicillin
25	Fermentative production of Amylase
26	Immobilization of amylase
27	Microbiological examination of food; Packaged Food and Milk
28	Isolation of DNA from Blood and fungi
29	Gene Cloning
30	Restriction Fragment Length Polymorphism (RFLP)
31	Amplification of DNA by Polymerase Chain Reaction (PCR) (Demonstration)
32	Western Blotting (Demonstration)
33	Internet Gene Bank Search
34	BLAST analysis
35	FASTA analysis
36	Finding an ORF
37	Analysis of DNA and protein structure by Rasmol
38	Use of Bioedit

Name of Programme : M.Sc. Biotechnology

Time Duration : 02 years

Semester : 04(Four)

SEMESTER-III

Sr.No	Code	Name of the course	Credit	Hrs/Week	Marks		
					Int.	Ext.	Total
01	BTA 301 EBT	Environmental Biotechnology	04	03	30	70	100
02	BTA 302 PAB	Plant and Animal Biotechnology	04	03	30	70	100
03	BTA 303 PBT	Pharmaceutical Biotechnology	04	03	30	70	100
04	BTA 304 MBT	Medical Biotechnology	04	03	30	70	100
05	BTB305 CBS	Current topics in Biological Sciences	04	03	30	70	100
06	BTA 306 PRA	Practical Module -III	08	15	--	100	100
Total:			28	30	150	450	600

SEMESTER-III

BTA 301 EBT Environmental Biotechnology

Unit No.	Description	Hours
01	Introduction to environment and its component; Principles of ecology, Concept of ecosystem; abiotic and biotic components; Environmental pollution: air, water, marine, land, and solid wastes. Environmental Sample collection and processing and Indicator microorganisms.	07
02	Biotechnology of Waste Management: Principles biological waste treatment; removal of nitrogen, inorganic phosphorous; Fixed film technologies: Trickling filters, rotation biological contactors, activated bio-filters, fluidized bed reactors; Suspended growth technologies: activated sludge process; oxidation ditches, aerated lagoons; Stabilization ponds, sludge treatment and disposal; Anaerobic treatments; Solid waste management	07
03	Biofertilizers: NM (Integrated Nutrient Management in Plants)N ₂ fixing Microorganisms, Phosphate solubilizing microorganisms, Micorbial inoculant development and application of field.	06
04	Bio-control of pathogens: Siderophores, antibiotics enzymes, ice Nucleation and antifreeze Proteins, Bio-insecticides: <i>Bacillus thuringiensis</i> , <i>Baculoviruses</i> and <i>Trichoderma</i> as biocontrol agent.	07
05	Biofuels: Gasohol, Bioconversion of agriculture waste, Hydrogen, electricity.	05
06	Biosurfactant: production and applications.	03
07	Biodegradation: Principle and mechanisms,Biodegradation, of xenobiotic compounds (lignin, hydrocarbons, detergents, dyes and pesticides).	07
08	Bioremediation: Principle and techniques; in situ and ex situ solid phase treatment, immobilized cells, Biosorption, bioaccumulation and Co-metabolism, Bioremediation of oil spills, hazardous wastes and Metals.	07
09	Applications of Microbiology in food industry: Introduction to food additives, sweetners, Emulsifiers and stabilizers. Role of flavours and fragrance in food industry,Food preservatives, Acidulants and antioxidants.	06
10	Bioleaching: Principles and applications; Biopulping and bioleaching	05
	Total hours	60

References:

1. **Bernard R. Glick and Jack J. Pasternak**, Molecular biotechnology : Principles and application of Recombinant DNA, ASM press.
2. **Bruce E. Rittmann and Perry L. Mccarty**, Environmental Biotechnology: Principles and application, McGraw-Hill International
3. **Christson** Manual of Environmental Microbiology, ASM press
4. **Eugenia J. Olguin, Gloria Sanchez and Elizabeth Hernandez**, Environmental Biotechnology and Cleaner Bioprocess, Taylor and Francis
5. **Martine Alexander**, Biodegradation and Bioremediation
6. **Peter Morris (Editor), RikiTherivel**, Methods of Environmental Impact Assessment
7. **P.D.Sharma**,Ecology and Environment
8. **P.S.Verma**, Principles of Ecology
9. **Atlas and Bartha**, Microbial Ecology
10. **E.P.Odmm**, Fundamentals of Ecology

BTA 302 PAB Plant and Animal Biotechnology

Unit No.	Description	hours
01	Conventional Plant breeding Techniques; Use of induced mutation in Plant Breeding, Molecular marker aided breeding, Marker assisted selection	(07)
02	Basic concept of cell culture, Concept of optimal media; Callus culture, Plant tissue culture including initiation, maintenance and response analysis; Meristem culture; Organ culture (e.g., Ovary, Ovaule, Embryo, Endosperm, Anther culture, Haploid Production).	(07)
03	Plant transformation technology – Basis of tumor formation; Hairy root; features of Ti and Ri plasmids; Mechanisms of DNA transfer , Role of virulence genes; Use of Ti and Ri as vectors; Binary vectores; use of 35 S and other promoters; Genetic Markers: Use of reporter genes; Reporter gene with introns;Use of scaffold attachment regions Methods of nuclear transformation ; Viral vectors and their applications; Multiple gene transfers;vector-less or direct DNA transfer; Particle bombardment, electroporation, microinjection; Transformation of monocots; transgene stability and gene silencing.	(08)
04	Application of plant transformation for productivity and performance; Delay of fruit ripening; Development of stress resistance in plants;(Biotic and Abiotic stress), Transgenic plants: methods and application; In vitro secondary metabolites production : Pigments, perfumes, flavours, insecticides, Molecular farming: Production of antibodies, polymers, vaccines and Bioplastics	(07)
05	Synthetic/artificial seed technology; Cryopreservation and ex situ conservation of germplasm, Somatic embryogenesis.	(03)
06	Basics of animal cell culture, laboratory lay out, media and instrumentation, animal cell culture techniques and its applications, Growth factor promoting proliferation of animal cells.	(05)
07	Mammalian cell culture in vitro, micro-carrier culture, cell synchronization and cell transformation, types of cultures; cell lines, their origin and characteristics, cryopreservation	(05)
08	Special secondary metabolites/products (insulin, growth hormone, interferon, tissue plasminogen activator, factor VIII etc.), production of vaccines and monoclonal antibodies	(05)
09	Transgenic animals: Introducing gene in to animal cells; Transferring genes into animal oocytes, eggs, embryonic and specific animal tissue; In vitro fertilization; embryo transfer; transgenic mice, transgenic cattle; transgenic sheep, Goats and pigs; transgenic birds, Bioreactors for large scale culture of cells.	(08)
10	Biotechnology of silk worms and Honey bea; Biotechnology of aquaculture	(05)
Total hours		60

1. **L A Babinnk And J P Phillips Pregamon Press Oxford** ,Animal Biotechnology(1989)
2. **K A Ward J S F Barrer K Hammond And A E Mcclintock Academic Press (1992)** Future Developments In The Genetic Improvements Of Animals
3. **J Rossant R A Pedersn (1986) Cambridge University Press ,Experimental Approaches** To Mammalian Embryonic Development
4. **OTA (1984) USA** ,Commercial Biotechnology
5. **J W Evans And A Hollaender** Genetic Engineering Of Animals Vol. 37
6. **A Puhler (1993) VCH Publishers, Weinheim** Genetic Engineering Of Animals
7. **T V R Pillat (1990) Aquaculture: Principles And Practise**
8. **M.Butler**,Animal cell culture
9. **R.Ian Freshney**,Culture of Animal Cells
10. **R.C.Dubey**, Text book of Biotechnology
11. **J. Hammond et al. Springer Verlag.** Plant Biotechnology
12. **T.J. Fu, G.Singh et al.** Plant cell and tissue culture for production of food ingredients-
13. **H.S. Chawla** Biotechnology in crop improvement
14. **R.J. Henry**, Chapman & Hall. Practical application of plant molecular biology-
15. **P.K. Gupta** ,Elements of biotechnology
16. **M.K. Razdan** An Introduction to plant tissue culture
17. **The technology (Vol. 1 & 2) – Edwin george.** Plant Propagation by tissue culture
18. **Evans et al. Mac millan.(Vol. 1 to 4)-** Handbook of Plant cell culture
19. **M.M. Yeoman** Plant cell culture technology
20. **W. Bary et al. Springer**, Plant tissue culture and its biotechnology applications-
21. **S. H. Mantell et al.** Principles of plant biotechnology : An introduction to genetic engineeringin plants

BTA 303 PBT Pharmaceutical Biotechnology

Unit No.	Description	hours
01	Biotechnology: Introduction ,role of biotechnology in pharmaceutical industry,Drug Discovery: Strategic Issue of drug target and screening procedure; rational drug designing, QSAR, preclinical and clinical Development of drug	07
02	General pharmaceutical formulations	07
03	Design and layout of sterile product manufacturing unit, Designing and safety in Microbiology laboratory	05
04	Microbial contamination and spoilage of pharmaceutical products and their sterilization.	05
05	Quality assurance and validation: Regulatory aspects of quality control, Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization), Chemical and biological indicators,	07
06	Biopharmaceutical cGMP product manufacturing process:various recombinant product process: recombinant therapctic protein,cell therapy, plasma protein, personalized medicine, antibody engineering, plant engineering	07
07	Regulatory practices in pharmaceuticals: Brief introduction to IP, BP and USP, Government regulatory practices and policies, FDA perspective; Quality validation certification from GMP, ISO, WHO	06
08	Bioentrepreneurship: Biomarket space, Biotechnology company fundamentals, funding, research development and marketing; Bio pricing strategies.	05
09	Pharmaceutical Industrial management : Principles of management; Administrative management; Production management; Material management; Personal Management; Pharmaceutical marketing; Channels of distribution; salesmanship; Marketing Research; Personal Management functions	07
10	Project Report preparation with technical and financial details	04
	Total hours	60

Referance:

1. Pharma pathway ;D.A.Sawant
2. Yali Friedman, Building Biotechnology: Starting, Managing, And Understanding Biotechnology Companies
3. pharmaceutical Industrial Management
4. Rajesh Bhatia, Rattan lal Ihhpunjani, Quality Assurance in Microbiology, CBS Publishers & Distributors, New Delhi

BTA 304 MBT Medical Biotechnology

Unit No.	Description	Hours
01	History components of immune system; Host-parasite relationship, immune responses- types of immunity	06
02	Antigens: structure, properties, types and specificity; Immunoglobulin: structure, types, properties, heterogeneity; theories of antibody formation	06
03	Complement- structure, components, properties and functions; complement pathways; Antigen- antibody reactions in vitro methods agglutination, precipitation, complement fixation, immunofluorescence, ELISA, RIA; Antigen-antibody reactions in vivo methods- skin tests, Immune complex tissue demonstrations, applications of these in diagnosis of microbial diseases	06
04	Human blood group antigen and their inheritance; ABO blood group system: Sub groups, Source of antigens, Types of antibodies; Rh blood group system- Nomenclature, Types of antigen, Mode of inheritance, Types of antibodies; Other blood group systems such as MNS, Kell, Bombay Blood group- complete knowledge of theory and genetics; Preparation and Preservation of grouping antisera; Technique of blood grouping and cross matching: Coomb's test (a) Direct and Indirect test.	06
05	Transplantation Immunity; Tumor immunity	06
06	Immunodeficiency; Hypersensitivity reactions	06
07	Stem cell technology	05
08	Oncogenes and anti-oncogenes; Applications Recombinant DNA technology in AIDS	08
09	Human Molecular genetics: Genetic Linkage and gene Mapping; Genetic Mapping of human chromosomes; Mapping of a genetic diseases locus to a chromosome location; Physical mapping of human Genome; Cloning of Human Disease Genes; Human genome project; DNA based diagnosis of diseases	06
10	Human gene therapy: Ex vivo gene therapy; in vivo gene therapy; Viral and non-viral gene delivery system; oligonucleotides as correction of genetic condition	05
	Total hours	60

References:

1. **Glick**, Molecular Biotechnology
2. **Watson**, Recombinant DNA technology
3. **Old & Primrose**, Principles of gene manipulation
4. **T.A. Brown** Gene cloning
5. **Lyolyard**, Instant notes in immunology
6. **Kuby**, Immunology
7. **Roitt**, Immunology
8. **Godkar**, Medical Laboratory technology

BTB305 CBS Current topics in Biological Sciences

Unit No.	Description	Hours
01	Basic principle and applications of Nanobiotechnology	07
02	Extremophiles: diversity of extremophiles, adaptation mechanisms and applications of extremophiles	07
03	Non cultivable microorganisms	06
04	Metagenomics: Principles and applications	05
05	Microbial Quorum sensing	06
06	Protein engineering: Principle and applications	05
07	Microbial Interaction: Interaction among microbial population, interaction between microorganisms and plants, microbial interaction with animal	06
08	National and International Environmental standards; Environmental Impact Assessment; Risk Assessment; Environment auditing and Patenting Biotechnology inventions: Patenting; Patenting in India and different country; Patenting DNA sequences; Patenting Multicellular organisms; Patenting fundamental research .	09
09	Contract research in Biotechnology	04
10	National and International status of Biotechnology and Biosafety related issues, Cartagena and Nagoya kualampur Protocol	05
	Total hours	60

References:

1. **Glick**, Molecular Biotechnology
2. **Watson**, Recombinant DNA technology
3. **Old & Primrose**, Principles of gene manipulation :
4. **Brown**, Gene cloning
5. **Koki Koki Horikoshi**, Extremophiles: Microbial Life in Extreme Environments
6. **David white**, The Physiology and Biochemistry of Prokaryotes
7. **Syndeer and Champness**. Molecular genetics of bacteria
8. **Maloy**, Microbial genetics
9. **Atlas**, Microbialecology
10. **Raina M. Maier**, Enviromental Microbiology academic press

BTA 306 PRA :Practical Module-III

Unit No.	Description
01	Microbial production of poly β hydroxybutyrate
02	Isolation of Xenobiotic (dyes, pesticides) degrading micro organisms
03	Isolation of cellulose degrading microorganism
04	Isolation of hydrocarbon degrading microorganism
05	Biosurfactant production
06	Isolation of phosphate solubilizing microorganisms
07	Water Analysis: Physicochemical analysis, BOD, COD and microbiological analysis of water
08	Microbiological analysis of air
09	Soil Analysis: Physico-chemical analysis, determination microbial biomass, determination soil enzyme activity: Amidase, Asparaginase, Amylase, Cellulase, Phosphatase ATP ase etc.
10	Production of extra-cellular polysaccharide
11	Determination of Amylase, Invertase, Peroxidase from control and stressed seeds
12	Estimation of Sugar, Protein, Amino acid from control and stressed seeds
13	Preparation of media
14	Transfer of different explants
15	Micropropagation experiments
16	Cell suspensions with reference to secondary metabolites
17	Extraction and estimation of plant pigments in young and old leaves
18	Extraction of seed proteins depending upon the solubility
19	Proline estimation of control and stressed plants
20	Separation of proteins through electrophoresis
21	Agro bacterium mediated transformation in plant
22	Animal cell culturing
23	Karyotyping
24	ABO Grouping: Slide technique; Tube technique; Reverse and forward grouping
25	Cross matching: Major and Minor
26	Coombs test : Direct coomb's; Indirect coomb's
27	Widal test,
28	Hemoglobin Estimation- Sahali's Method
29	Enzyme Linked Immuno Sorbent assay (ELISA)

Name of Programme : M.Sc.Biotechnology

Time Duration : 02 years

Semester : 04(Four)

SEMESTER-IV

Sr.No	Code	Name of the course	Credit	Hrs/Week	Marks		
					Int.	Ext.	Total
01	BTA 401 DSW	Dissertation Work	16	25	30	70	100
Total:			16	25	30	70	100