CBCS System

Scheme of Examination

&

Syllabus

For

Master of Science (M.Sc.)

Biotechnology

Part I & II – Semester I, II, III & IV

SESSION 2022-23

CHRISTIAN EMINENT COLLEGE, INDORE
ACADEMY OF MANAGEMENT, PROFESSIONAL EDUCATION & RESEARCH
An Autonomous Institution Established in 1996
AFFILIATED TO DEVI AHILYA VISHWAVIDYALAYA, INDORE
F-SECTOR, R.S.S. NAGAR, H.I.G. MAIN ROAD, INDORE

Scheme of Examination

M.Sc. (Biotechnology) Part I – Semester I

COURSE	CREDITS	TOTAL HOURS	LECTURE HOURS PER WEEK	MIN. GRADE POINT OUT OF 10
CORE COURSE				
MBT- T101 BIOCHEMISTRY	04	64	04	04
MBT- T102 CELL AND DEVELOPMENTAL BIOLOGY	04	64	04	04
MBT- T103 MICROBIOLOGY	04	64	04	04
MBT- T104 BIOSTATISTICS AND BIOINFORMATICS	04	64	04	04
MBT- P105 PRACTICAL COURSE	03	48	06	04
SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC)				
MBT – 106 SKEG (ANY ONE)	SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC/GC)			
SKEG-T103 COMMUNICATIVE ENGLISH	03	48	03	04
SKEG-T108 HEALTH EDUCATION				
SKEG-T116 MANAGERIAL SKILLS				
SKEG-T119 PERSONALITY DEVELOPMENT				
TOTAL	22	352	25	

Course	Max. Marks				Min. Marks		
	External Theory Examination	Internal Theory Examination	Practical Examination	TOTAL MARKS	External Theory Exam.	Internal Theory Exam.	Practical Marks
MBT- T101 BIOCHEMISTRY	70	30	-	100	28	12	-
MBT- T102 CELL AND DEVELOPMENTAL BIOLOGY	70	30	-	100	28	12	-
MBT- T103 MICROBIOLOGY	70	30	-	100	28	12	-
MBT- T104 BIOSTATISTICS AND BIOINFORMATICS	70	30	-	100	28	12	-
MBT- P105 PRACTICAL COURSE	-	-	100	100	-	-	40
MBT – T 106 SKEG (ANY ONE) SKILL ENHANCEMENT COURSE	70	30	-	100	28	12	-
TOTAL MARKS	350	150	100	600	-	-	
GRAND TOTAL	600				270		

Scheme of Examination

M.Sc. (Biotechnology) Part I – Semester II

COURSE	CREDITS	TOTAL HOURS	LECTURE HOURS PER WEEK	MIN. GRADE POINT OUT OF 10
CORE COURSE				
MBT-201 MOLECULAR BIOLOGY	04	64	04	04
MBT-202 BACTERIAL GENETICS AND GENETIC ENGINEERING	04	64	04	04
MBT-203 IMMUNOLOGY	04	64	04	04
MBT-204 ANALYTICAL TECHNIQUES	04	64	04	04
MBT-205 PRACTICAL COURSE	03	48	06	04
SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC)				
MBT – 206 SKEG (ANY ONE)	SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC/GC)			
SKEG-T103 COMMUNICATIVE ENGLISH	03	48	03	04
SKEG-T108 HEALTH EDUCATION				
SKEG-T116 MANAGERIAL SKILLS				
SKEG-T119 PERSONALITY DEVELOPMENT				
TOTAL	22	352	25	

Course	Max. Marks				Min. Marks		
	External Theory Examination	Internal Theory Examination	Practical Examination	TOTAL MARKS	External Theory Exam.	Internal Theory Exam.	Practical Marks
MBT-201 MOLECULAR BIOLOGY	70	30	-	100	28	12	-
MBT-202 BACTERIAL GENETICS AND GENETIC ENGINEERING	70	30	-	100	28	12	-
MBT-203 IMMUNOLOGY	70	30	-	100	28	12	-
MBT-204 ANALYTICAL TECHNIQUES	70	30	-	100	28	12	-
MBT-205 PRACTICAL COURSE	-	-	100	100	-	-	40
MBT – T 106 SKEG (ANY ONE) SKILL ENHANCEMENT COURSE	70	30	-	100	28	12	-
TOTAL MARKS	350	150	100	600	-	-	
GRAND TOTAL	600				270		

CHRISTIAN EMINENT COLLEGE, INDORE

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F-Sector, H.I.G., Ravi Shankar Shukla Nagar Main Road, Indore (M.P.) – 452011

2022-23

Scheme of Examination

M.Sc. (Biotechnology) Part II – Semester III

COURSE	CREDITS	TOTAL HOURS	LECTURE HOURS PER WEEK	MIN. GRADE POINT OUT OF 10
CORE COURSE				
MBT- T301 ENZYME TECHNOLOGY	04	64	04	04
MBT- T302 ENVIRONMENTAL BIOTECHNOLOGY	04	64	04	04
MBT- T303 FOOD SCIENCE & TECHNOLOGY	04	64	04	04
MBT- T304 RESEARCH METHODOLOGY, IPR & BIOSAFETY	04	64	04	04
MBT- P305 PRACTICAL COURSE	03	48	06	04
SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC)				
MBT – 306 SKEG (ANY ONE)	SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC/GC)			
SKEG-T108 HEALTH EDUCATION	03	48	03	04
SKEG-T109 INTRODUCTION TO PHARMACEUTICAL BIOTECHNOLOGY				
SKEG-T116 MANAGERIAL SKILLS				
SKEG-T/P114 INTRODUCTION TO ICT I	02 + 01	32 + 16	02 + 02	04
TOTAL	22	352	25/26	

Course	Max. Marks				Min. Marks		
	External Theory Examination	Internal Theory Examination	Practical Examination	TOTAL MARKS	External Theory Exam.	Internal Theory Exam.	Practical Marks
MBT- T301 ENZYME TECHNOLOGY	70	30	-	100	28	12	-
MBT- T302 ENVIRONMENTAL BIOTECHNOLOGY	70	30	-	100	28	12	-
MBT- T303 FOOD SCIENCE & TECHNOLOGY	70	30	-	100	28	12	-
MBT- T304 RESEARCH METHODOLOGY, IPR & BIOSAFETY	70	30	-	100	28	12	-
MBT- P305 PRACTICAL COURSE	-	-	100	100	-	-	40
MBT – T 106 SKEG (ANY ONE) SKILL ENHANCEMENT COURSE	70	30	-	100	28	12	-
TOTAL MARKS	350	150	100	600	-	-	
SKEG-T/P114 ELECTIVE COURSE	50	30	20	100	20	12	08
TOTAL MARKS	330	150	120	600	-	-	
GRAND TOTAL	600				270		

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2022-23

Scheme of Examination

M.Sc. (Biotechnology) Part II – Semester IV

COURSE	CREDITS	TOTAL HOURS	LECTURE HOURS PER WEEK	MIN. GRADE POINT OUT OF 10
CORE COURSE				
MBT- T401 BIOPROCESS TECHNOLOGY	04	64	04	04
MBT- T402 GENOMICS AND PROTEOMICS	04	64	04	04
MBT- T403 ANIMAL BIOTECHNOLOGY	04	64	04	04
MBT- T404 PLANT BIOTECHNOLOGY	04	64	04	04
MBT- P405 PRACTICAL COURSE	03	48	06	04
SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC)				
MBT – 406 SKEG (ANY ONE)	SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC/GC)			
SKEG-T108 HEALTH EDUCATION	03	48	03	04
SKEG-T110 INTRODUCTION TO AGRO BIOTECHNOLOGY				
SKEG-T116 MANAGERIAL SKILLS				
SKEG-T/P115 INTRODUCTION TO ICT II	02 + 01	32 + 16	02 + 02	04
INTERNSHIP / PROJECT WORK				
MBT- P407 INTERNSHIP/ PROJECT WORK	02	32	-	04
TOTAL	**24**	**384**	**25/26**	

Course	Max. Marks				Min. Marks		
	External Theory Examination	Internal Theory Examination	Practical Examination	TOTAL MARKS	External Theory Exam.	Internal Theory Exam.	Practical Marks
MBT- T401 BIOPROCESS TECHNOLOGY	70	30	-	100	28	12	-
MBT- T402 GENOMICS AND PROTEOMICS	70	30	-	100	28	12	-
MBT- T403 ANIMAL BIOTECHNOLOGY	70	30	-	100	28	12	-
MBT- T404 PLANT BIOTECHNOLOGY	70	30	-	100	28	12	-
MBT- P405 PRACTICAL COURSE	-	-	100	100	-	-	40
MBT – T 406 SKEG (ANY ONE) SKILL ENHANCEMENT COURSE	70	30	-	100	28	12	-
MBT- P407 INTERNSHIP/ PROJECT WORK	-	-	100	100	-	-	40
TOTAL MARKS	350	150	200	700	-	-	
MBT – T/P 406 SKEG (ANY ONE) SKILL ENHANCEMENT COURSE	50	30	20	100	20	12	08
TOTAL MARKS	330	150	220	700	-	-	
GRAND TOTAL	700				315		

Scheme of Examination

Under CBCS System

Part I & II – Semester I, II, III & IV

- Under CBCS System every PG Course and B.Ed. has been distributed in two parts namely – Core and Elective. The subjects related to course are Core and are compulsory. In each semester the students have to opt one Elective Course from prescribed electives.
- The minimum credits for each course are 20 and maximum may be 24. The credits are finalized with the requirements of respective course.
- The total minimum credits for completing the Post Graduate course and B.Ed are 80.
- For each course there will be 70% marks for External Examinations and 30% for Internal Examinations (CCE). The students have to clear both External and Internal Examinations separately.
- The pass marks in individual paper will be **40%** and in aggregate **45%**.
- The subject wise marks obtained by the student will be converted into prescribed 10 Point Grade Scale. The prescribed Grade Scale and related information are available in Examination Rules and for details follow or refer prescribed CBCS Guidelines.
- The students who are **awarded ATKT in two subjects** will be eligible to appear in the examination of next semester. However the student **will not be allowed** to appear in the next semester examination with more than **four ATKT at a time**.
- In case of more than two ATKT in a particular semester will be considered as fail in that semester and the student has to reappear in that particular semester examination.
- ATKT students have to follow the old syllabus but repeaters have to take the examination with the new syllabus.
- A student will have to compulsorily clear a program within **Three Academic Years** including the academic year of the admission, failing which he /she will not be allowed to continue the course. If a student doesn't clear all the semesters of the course in the above three years completely, then all his/ her previous result will be treated as null and void.
- Only those students who clear the program in one attempt and without gap will be eligible for position in the **Merit List**.
- A student who fails in aggregate is permitted to appear in **any one or two** papers of his/her choice to make up for the shortfall in the aggregate. Such a student can also appear in all the papers of that semester as an ex-student, provided the student applies for the same in the beginning of the semester.
- The students who are declared fail in aggregate will be eligible to appear in external theory examination of the corresponding papers only.
- Any point regarding the examination in the above scheme, which is not covered, will be applicable as per the examination scheme of respective course declared by the University or M.P. Government, whichever may be applicable, and the final decision in this regard will be taken by the Principal on the recommendation of Examination Committee.

Syllabus

M.Sc. (B.T.). Part I – Semester I

MBT – T101 – CORE COURSE I – BIOCHEMISTRY I

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Amino acids – Structure, Functions and Properties; Peptides and covalent structure of proteins; Elucidation of primary and higher order structures, Ramchandran Plot; Structure-function relationships in model proteins like Myoglobin, Hemoglobin, Tools to characterize expressed proteins.	
Unit-II	**13 Lectures**
Enzyme catalysis – General principles of catalysis; Quantification of enzyme activity and efficiency; Enzyme characterization and Michaelis-Menten Kinetics; Relevance of enzyme in metabolic regulation, Activation, Inhibition and Covalent Modification; Single Substrate enzymes.	
Unit-III	**14 Lectures**
Sugars- Mono, Di, and Polysaccharides; Suitability in the context of their different functions. Lipids – structure and properties of important members of storage and membrane lipids; their organization; Lipoproteins.	
Unit-IV	**12 Lectures**
Bioenergetics – Basic principles; Equilibria and concept of energy; Coupled processes; ATP as energy currency of cell. Glycolsis pathway, Glycogen metabolism, Gluconeogenesis; Kreb's cycle.	
Unit-V	**12 Lectures**
Oxidative phosphorylation, Nucleic acid and Nucleotides metabolism. Disorders of metabolisms; Photosynthesis; Regulatory steps; Signals and second messengers.	

BOOKS:

1. V. Voet and J.G. Voet, Biochemistry, 3rd Edition, John Wiley, New York, 2004
2. A. L. Lehninger, Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, 2004
3. L. Stryer, Biochemistry, 5th Edition, W.H. Freeman and Company, 2002

Syllabus

M.Sc. (B.T.). Part I – Semester I

MBT – T102 – CORE COURSE II – CELL AND DEVELOPMENTAL BIOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**14 Lectures**
Cell theory & Methods of study: Structure of Prokaryotic and Eukaryotic cells, Microscope and its modifications- Light, phase and interference, Fluorescence, Confocal, Electron (TEM and SEM) microscopy. Membrane Structure and Function: Structural models; Composition and Dynamics; Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis; Membrane carbohydrates and their significance in cellular recognition; Cellular junctions and adhesions; Structure and Functional significance of Plasmodesmata.	
Unit-II	**12 Lectures**
Organelles: Nucleus- Structure and function of nuclear envelope, Lamina and nucleolus; Macromolecular trafficking; Chromatin organization and packaging; Cell cycle and control mechanisms; Mitochondria- structure, organization of respiratory chain complexes, ATP synthase, Structure and function; Mitochondrial DNA and its significance; Chloroplast- Structure – function and relationship with prokaryotes; Chloroplast DNA and its significance;.	
Unit-III	**12Lectures**
Endo- membrane System and Cellular Motility: Structure and function of microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum; Organization and role of microtubules and microfilaments; Cell shape and motility; Actin binding proteins and their significance; Muscle organization and function; Intermediate filaments.	
Unit-IV	**12 Lectures**
Cellular Movements and Patterns formations: Differentiation of germ layers; Cellular polarity; Embryogenesis and early patterns formation in plants; Cell lineages and developmental control genes in Caenorhabditis.	
Unit-V	**14 Lectures**
Differentiation of Specialized Cells: Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of proto- oncogenes; Sex determination in Drosophila. Plant Meristem Organization and Differentiation: Organization of shoot Apical Meristem (SAM); Organization Root Apical Meristem (RAM).	

BOOKS:

1. Lodish et al., Molecular Cell Biology, 4thEdition, W.H. Freeman and Company, 2007
2. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996
3. Watson et al., Molecular Biology of the Gene, 5th Edition, Pearson Prentice Hall, USA, 2003
4. B. M. Turner, Chromatin & Gene Regulation, 1st Edition, Wiley Blackwell, 2002
5. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007

Syllabus

M.Sc. (B.T.). Part I – Semester I

MBT – T103 – CORE COURSE III – MICROBIOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Microbial diversity & Systematic: Classical and modern methods and concepts in classification of microorganisms; Classification of Bacteria according to Bergey's manual. Ultra structure of Archaea (Methanococcus); Eubacteria (*E.coli);* Unicellular Eukaryotes (Yeast).	
Unit-II	**13 Lectures**
Microbial Techniques: Principles of microbial nutrition, Types of culture media, Theory and practice of sterilization, Cultivation of microorganisms: Pure culture and Enrichment culture methods. Culture collection and maintenance of cultures. Control of microorganisms: Physical & chemical antimicrobial agents.	
Unit-III	**12Lectures**
Microbial Growth: Microbial Growth: Batch, Fed-batch, Continuous Culture and Synchronous growth. Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen. Methods of growth estimation of bacteria.	
Unit-IV	**13 Lectures**
Microbial Interaction and Infection: Host-Pathogen Interactions; Mechanism of pathogenesis, Pathogenicity islands and their role in bacterial virulence, Types of toxins and their structure and mode of action. Microbial Diseases. Normal flora of Human Body.	
Unit-V	**13 Lectures**
Virology and Mycology: Structure and Classification of Bacteriophage (Plant and Animal Viruses), Satellite virus, Viroids, Virusoids, Structure, classification and General features of fungi, Life cycle of Penicillium and Sacchromyces.	

BOOKS:

1. Pelczar M J Jr., Chan ECS and Kreig N R, Microbiology, 5thEdition, Tata McGraw Hill, 1993
2. Maloy S R, Cronan J E Jr. and Freifelder D, Microbial Genetics, Jones and Barlett Publishers, 2006
3. Crueger and A Crueger, (English Ed., TDW Brock); Biotechnology: A Text Book of Industrial Microbiology, Sinaeur Associates, 1990
4. G Reed, Prescott and Dunn's, Industrial Microbiology, 4th Edition, CBS Publishers, 1997
5. M. T. Madigan & J. M. Martinko, Biology of Microorganisms, 11th Edition, Pearson Prentice Hall, USA, 2006

Syllabus
M.Sc. (B.T.). Part I – Semester I

MBT – T104 – CORE COURSE IV – BIOSTATISTICS AND BIOINFORMATICS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**14 Lectures**
Fundamental concepts in probability; Collection and classification of DATA, Exploratory data analysis and statistical inference; Standard Deviation and Standard Error; Chi-square test for independence variables; P-value of the statistics; confidence limits; Introduction to one way and two way analysis of variance.	
Unit-II	**13 Lectures**
Sequence database and genome database; Data structures and databases; Databases such as Genebank; EMBL; DDBJ; Swissprot; Searching for sequence database like FASTA and BLAST algorithm.	
Unit-III	**13Lectures**
Introduction to Phylogenetic analysis; Cluster analysis; Phylogenetic clustering by simple matching coefficients; Sequence Comparison; Sequence pattern; Regular expression based pattern.	
Unit-IV	**12 Lectures**
Goals of microarray experiment; Normalization of microarray data; Detecting differential gene expression.	
Unit-V	**12 Lectures**
Protein secondary structure prediction; X-ray crystallography; NMR spectroscopy, Methods for modeling; Homology Modeling.	

BOOKS:

1. Wayne W. Daniel, Biostatistics: A Foundation for Analysis in the Health Sciences, 8thEdition, Wiley, 2006
2. Prem S. Mann, Introductory Statistics, 6thEdition, Wiley, 2006
3. Jhon A. Rice, Mathematical Statistics & Data Analysis, 3rdEdition, Doxbary Press, 2006
4. Campbell and Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition, Banjamin Cummings, 2002
5. Cynthia Gibas and Per Jam beck, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly Publication, 2001

Syllabus

M.Sc. (B.T.). Part I – Semester I

MBT – P105 – CORE COURSE V – PRACTICAL COURSE

MAX. MARKS: 100 **MIN. PASS MARKS: 40**

No. of Laboratory per Week: 06 Hours **Total Lectures: 96**

BIOCHEMISTRY AND CELL BIOLOGY

1. To prepare an Acetic- Na Acetate Buffer system and validate the Henderson-Hasselbach equation.
2. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
3. Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by TLC.
4. To determine an unknown sugar concentration by Nelson Somogyii's and DNS method.
5. Determination of enzyme activity and studying the effect of temperature, pH, enzyme concentration, substrate concentration on enzyme activity.
6. Isolation of Biomolecules from natural sources.
7. Microscopy: Bright field, Phase contrast & Fluorescence.
8. Microtomy.
9. Sub cellular fractionation and marker enzymes
10. Histochemical techniques.
11. Mitosis & Meiosis.

MICROBIOLOGY, BIOSTATISTICS AND BIOINFORMATICS

1. Sterilization, disinfection, safety in microbiological laboratory.
2. Preparation of media for growth of various microorganisms.
3. Identification and culturing of various microorganisms.
4. Staining and enumeration of microorganisms.
5. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
6. Isolation and identification of fungus.
7. Isolation of Bacteriophage.
8. Introduction to MS EXCEL-Use of worksheet to enter data, edit data, copy data, move data.
9. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc.
10. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data.
11. Introduction to SYSTAT package.
12. Searching PubMed, Introduction to NCBI, NCBI data bases, BLAST, BLASTn, BLASTp, PSI-BLAST, Sequence manipulation Suite, Multiple sequence alignment, Primer designing, Phylogenetic Analysis.

Syllabus

M.Sc. (B.T.). Part I – Semester I

MBT – 106 (SKEG) – SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC) –

SKEG- T-119 – PERSONALITY DEVELOPMENT

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week: 03 Hours **Total Lectures: 48**

SKEG-T103 – COMMUNICATIVE ENGLISH

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T116– MANAGERIAL SKILLS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T108 – HEALTH EDUCATION

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – T201 – CORE COURSE I – MOLECULAR BIOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**12 Lectures**
Genome organization: organization of bacterial genome; structure of eukaryotic chromosomes; Heterochromatin and Euchromatin; DNA re-association kinetics (Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting and buoyant density.	
Unit-II	**13 Lectures**
DNA structure ; replication ; Repair & Recombination: Structure of DNA – A, B, Z- and triplex DNA; Measurement and properties, Replication initiation , elongation and termination in prokaryotes and eukaryotes ; Fidelity; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair ; Mismatch correction; SOS repair , Recombination: Homologous and non-homologous; Site specific recombination; Gene targeting.	
Unit-III	**14 Lectures**
Prokaryotic and Eukaryotic Transcription: Prokaryotic Transcription; Transcription unit; Promotor constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination- Rho dependent and independent; Anti-termination; Transcriptional Regulation-Positive and negative; Operon concept-lac, trp, ara, operon; Transcript Processing of tRNA and rRNA. Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoter and Enhancers; General transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and post-transcriptional gene silencing.	
Unit-IV	**13 Lectures**
Post Transcriptional Modification: Processing of hnRNA, tRNA, rRNA; 5'- Cap formation; 3'- end processing and polyadenylation; Splicing; RNA Editing; Catalytic RNA. Translation and Transport: Translation Machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Wobble hypothesis; Mechanisms of initiation, elongation and termination; Co-and post-translational modifications of proteins.	
Unit-V	**12 Lectures**
Mutation, Types of mutations(base pair changes; Frameshift; insertions; deletions; tandem duplication); Reversion vs. suppression; Mutagenic agents; Mechanism of mutagenesis; assay of mutagenic agents(Ames test). Genetic Variation: Mutations; Kinds of mutation; agents of mutation; genome polymorphism; uses of polymorphism. Applications of mutations.	

BOOKS:

1. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007
2. J. D. Watson, N. H. Hopkins, J. W. Roberts, J. A. Seitz & A. M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007
3. Alberts et al; Molecular Biology of the Cell, 4th Edition, Garland, 2002
4. Glick B R & Pasternak J J, Molecular Biotechnology, 3rd Edition, ASM Press, 1988

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – T202 – CORE COURSE II – BACTERIAL GENETICS AND GENETIC ENGINEERING

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Gene transfer in bacteria: History; Transduction-generalized and specialized; Conjugation-F,F', Hfr; F transfer; ;Hfr – mediated chromosome transfer; transformation- natural and artificial transformation; Gene mapping; Transposable genetic elements; Insertion sequences; Composite and Complex transposons; Replicative and Non-replicative transposition.	
Unit-II	**13 Lectures**
Bacteriophages and Plasmids: Bacteriophage-structure; Assay; Lambda phage- genetic map, lysogenic and lytic cycle; Gene regulation; Filamentous phages such as M13; Plasmids- natural plasmids; their properties and phenotypes; Plasmid biology-copy number and its control; Incompatibility; Plasmid survival strategies; Antibiotic resistance markers on plasmids(mechanism of action and resistance); Genetic analysis using phage and plasmid. Restriction- modification system: History; Types of systems and their characteristics.	
Unit-III	**13Lectures**
Basic concepts of Genetic Engineering: Restriction enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide Kinase, Alkaline Phosphatase; Cohesive and blunt end ligation; linkers; Adaptors; Homopolymeric tailing; Labeling of DNA; Nick translation, Random priming, radioactive and Non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay.	
Unit-IV	**13 Lectures**
Cloning vectors: Plasmids, bacteriophages; M13 mp vectors; PUC19 and Bluescripts vectors, Phagemids; Lambda vectors; Insertion and replacement vectors; EMBL; Cosmids; Artificial chromosome vectors(YACs; BACs); Animal Virus derived vectors- SV-40; vaccinia/bacculo and retroviral vectors; Plant based vectors, Ti and Ri as vectors, Yeast Vectors, Shuttle vectors. DNA & Peptide Synthesis.	
Unit-V	**12 Lectures**
Cloning Methodologies: Insertion of foreign DNA into host cells; Transformation; construction of libraries; Isolation of mRNA and total RNA ; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping Gens; Yeast two hybrid system; Principles in maximizing gene expression. Applications of RDT.	

BOOKS:

1. S. R. Maloy, J. E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Barlett Publishers, 1994
2. N. Trun and J. Trempy, Fundamental Bacterial Genetics, Blackwell Publishing, 2004
3. Hartl L D and Jones B, Analysis of Genes and Genomes, 3rd Edition, Jones and Barlett Publishers, 1994
4. S. B. Primrose, R. M. Twyman and R. W. Old; Principles of Gene Manipulation, 6thEdition, S. B. University Press, 2001
5. J. Sambrook and D. W. Russel, Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001
6. Brown T A, Genomes, 3rd Edition, Garland Science, 2006
7. Campbell A M & Heyer L J, Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition, Benjamin Cummings, 2007
8. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – T203 – CORE COURSE III – IMMUNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Immunology- fundamental concepts and anatomy of the immune system: Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue (MALT & CALT).	
Unit-II	**14 Lectures**
Immunogens, Immunoglobulins and Immune response: Immuno-chemistry of antigens- Immunogenecity, antigenic determinants; haptens, Epitope Toxins- Toxoids, Hapten-carrier system; Role and properties of adjuvants. Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, B-cell receptor; Immunoglobulin superfamily; Basis of self - non-self discrimination; B cell maturation, activation and differentiation; Generation of antibody diversity; T- cell maturation, activation and differentiation and T- cell receptors; Functional T cell subsets; Cell mediated immune responses, ADCC. Complement pathways.	
Unit-III	**13Lectures**
Antigen-antibody interactions: Antigen-antibody Interaction, Affinity, Cross reactivity, Specificity. Precipitation, Agglutination and Complement mediated immune reactions; Monoclonal Ab production & applications. Immuno assays: RIA, ELISA, Western blotting, ELISPOT assay, Immunofluorescence and Immunoelectron Microscopy.	
Unit-IV	**12 Lectures**
Vaccinology: Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines.	
Unit-V	**12 Lectures**
Clinical Immunology: Major Histocompatibility Complex and HLA typing. Hypersensitivity – Type I, II, III and IV; Autoimmunity; Types of autoimmune diseases with e.g. Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer cells and immunodeficiencies.	

BOOKS:

1. Kuby, R A Goldsby, Thomas J Kindt, Barbara, A. Osborne Immunology, 6thEdition, Freeman, 2002
2. Brostoff J, Seaddin J K, Male D, Roitt I M, Clinical Immunology, 6thEdition, Gower Medical Publishing, 2002
3. Janeway et al., Immunobiology, 4thEdition, Current Biology Publications, 1999
4. Paul, Fundamental of Immunology, 4th Edition, Lippencott Raven, 1999
5. Goding, Monoclonal Antibodies, Academic Press, 1985

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – T204 – CORE COURSE IV – ANALYTICAL TECHNIQUES

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Basic Techniques: Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques Spectroscopy Techniques: UV, Visible; Theory and application of Fluorescence; NMR Spectroscopy.	
Unit-II	**14 Lectures**
Chromatography Techniques: TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Gas chromatography; Criteria of protein purity. Electrophoretic techniques: Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Pulsed field gel electrophoresis, SDS-PAGE.	
Unit-III	**13 Lectures**
Centrifugation: Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.	
Unit-IV	**12 Lectures**
Radioactivity: Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Autoradiography; Measurement of stable isotopes; Applications of isotopes in biochemistry; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.	
Unit-V	**12 Lectures**
Advanced Techniques: Protein crystallization; Theory and methods; MALDI-TOF; Mass spectrometry. GC-MS techniques and its application.	

BOOKS:

1. Freifelder D, Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2ndEdition, W. H. Freeman & Company, San Francisco, 1982
2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5thEdition, Cambridge University Press, 2000
3. D. Holme & H. Peck, Analytical Biochemistry, 3rdEdition, Longman, 1998
4. R. Scopes, Protein Purification – Principles & Practices, 3rd Edition, Springer Verlag, 1994
5. Selected Readings from Methods in Enzymolgy, Academic Press

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – P205 – CORE COURSE V – PRACTICAL COURSE

MAX. MARKS: 100 **MIN. PASS MARKS: 40**

No. of Laboratory per Week: 06 Hours **Total Lectures: 96**

MOLECULAR BIOLOGY AND BACTERIAL GENETICS AND GENETIC ENGINEERING

1. Isolation of Bacterial Genomic DNA.
2. Plasmid DNA Isolation and DNA Quantitation: Plasmid Minipreps
3. Restriction Digestion
4. Preparation of Competent Cells.
5. Agarose Gel Electrophoresis
6. Restriction Enzyme Digestion of DNA
7. Purification of DNA from an Agarose Gel
8. DNA Ligation
9. Transformation of E.Coli with Standard Plasmids, Calculation of Transformation Efficiency
10. Cloning of Genomic DNA in Standard Plasmid Vectors
11. Confirmation of the Insert, Miniprep of Recombinant Plasmid DNA, Restriction Mapping
12. Transformation of Yeast Saccharomyces Cerevisiae

IMMUNOLOGY AND ANALYTICAL TECHNIQUES

1. Selection of Animals, Preparation of Antigens, Immunization and Methods of Bleeding, Serum Separation, Storage.
2. Antibody Titre by ELISA Method.
3. Double Diffusion, Immuno-Electrophoresis and Radial Immuno Diffusion.
4. Complement Fixation Test.
5. Isolation and Purification of IgG From Serum or Igy from Chicken Egg.
6. SDS-PAGE, Immunoblotting, Dot Blot Assays
7. Blood Smear Identification of Leucocytes by Giemsa Stain
8. Separation of Leucocytes by Dextran Method
9. Demonstration of Phagocytosis of Latex Beads
10. Separation of Mononuclear Cells by Ficoll-Hypaque
11. Lymphoproliferation by Mitogen / Antigen Induced
12. Immunodiagnostics using Commercial Kits
13. Purification and Separation Techniques – Ammonium Sulfate Precipitation, Ion Exchange Chromatography, Gel Filteration Affinity Chromatography.

Syllabus

M.Sc. (B.T.). Part I – Semester II

MBT – 206 (SKEG) – SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC) –

SKEG- T-119 – PERSONALITY DEVELOPMENT

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week: 03 Hours **Total Lectures: 48**

SKEG-T103 – COMMUNICATIVE ENGLISH

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T116– MANAGERIAL SKILLS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T108 – HEALTH EDUCATION

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – T301 – CORE COURSE I – ENZYME TECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Introduction to enzymology and historical developments in enzymology. Enzyme classification, IUBMB enzyme classification. Enzyme Activity: Techniques of enzyme isolation, Principle and techniques of enzyme assay, factors affecting enzyme activity.	
Unit-II	**13 Lectures**
Intracellular localization of enzymes .Mechanism of Enzyme Action: Investigation of active site; Enzyme activators, co-enzymes and co-factors in enzyme catalysis. Purification of enzyme: Techniques of separation and purification test of homogeneity.	
Unit-III	**14 Lectures**
Enzyme Kinetics, Bioenergetics and Catalysis, Single substrate kinetics: Equilibrium and steady state kinetics, significance of K_m, V_{max} & K_{cat}. Multisubstrate reaction kinetics: General rate equation, ordered, random order.	
Unit-IV	**12 Lectures**
Enzyme inhibition and its kinetics: Reversible and irreversible inhibition, competitive, non-competitive and uncompetitive, mixed, partial and substrate inhibition. Thermal kinetics: Effect of temperature on reaction rate, enzyme stability.	
Unit-V	**12 Lectures**
Allosteric enzymes and Sigmoidal kinetics: Co-operativity, Isoenzymes, Multienzyme complex and multifunctional enzymes, and their physiological significance. Biosensors; Enzymes as analytical reagents. Ribozymes and Catalytic antibodies.	

BOOKS:

1. Enzymes, Dixon & Webb; 1976
2. Biological Chemistry, Mahler & Cordes, 1999
3. Principles of Biochemistry, Lehninger; 1976
4. Methods in Enzymology, Relevant volumes, Vol 1; 2006
5. Enzymes, Boyer; 1976

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – T302 – CORE COURSE II – ENVIRONMENTAL BIOTECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**14 Lectures**
Environment: basic concept and issues, Pollution: Types of pollution; effects of pollution on human health, methods for measurement of pollution, Methodology for environment management – the problem solving approach, its limitation.	
Unit-II	**12 Lectures**
Air and Water pollution: Air pollution and its control through Biotechnology, Water as scarce natural resources, Need for water management, Measurement of water pollution, Source of water pollution. Waste water treatment: physical, chemical and biological treatment processes, Microbiology of waste water treatment,	
Unit-III	**12Lectures**
Aerobic process: Activated sludge, Oxidation ditches, Trickling filter, Towers, Rotating disc, Rotating drums, and Oxidation ponds. Anaerobic digestion, Anaerobic filters, Up flow anaerobic sludge blanket reactor. BOD and COD. Treatment schemes for waste water of dairy, distillery, tannery, sugar and antibiotic industries.	
Unit-IV	**12 Lectures**
Microbiological degradation of xenobiotic in Environment. Ecological consideration, decay behavior & degradative plasmid. Hydrocarbons, Oil pollution, Surfactants, Pesticides.	
Unit-V	**14 Lectures**
Bioremediation of contaminated soils and waste land, Biopesticides in integrated pest management, Soil waste source and management (composting, vermiculture, methane production). Global environmental problems, Ozone depletion, UV-B, Green house effect, Acid rain, their impact and Biotechnological approaches for management.	

BOOKS:

1. Expanding Horizon by B.D. Singh, Kalyani Publishers, 1988
2. Environmental Biotechnology: Theory and Application, by Gareth M. Evans &Judith C. Furlong, 1986

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – T303 – CORE COURSE III – FOOD SCIENCE & TECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Introduction to Food Processing and Packaging: Biotechnology in relation to the food industry, nutritive value of food, Food as a substrate for microorganism, types of microorganisms associated with food, its sources, types and behavior in foods.	
Unit-II	**13 Lectures**
Food Preservation: Bioprocessing of meat, Fisheries, Vegetables, Dairy Products, Enzymes and Chemicals used In Food Processing. New Preservation Technologies. Natural Pigments and natural color used in food.	
Unit-III	**12Lectures**
Food Spoilage & Food Borne Diseases: Microbial spoilage of food, Food -borne infections & intoxications- bacterial and non-bacterial.	
Unit-IV	**13 Lectures**
Fermented Food Products: Dairy products, Pasteurization of Milk non-beverage plant products, beverages and related products of baking. Microbes as food, Probiotics, Prebiotics, single cell proteins, single cell oil.	
Unit-V	**13 Lectures**
Quality Control and quality assurance: Microbial analysis of food, Microbiological quality of milk Quality control, Food Hygiene, Food Regulations and Standards, GMP, HACCP	

BOOKS:

1. Food Biotechnology, Roger A., Gordan B., and John T., 1989.
2. Food Microbiology, Frazier
3. G. Reed, Prescott and Dunn's Microbiology, CBS Publishers,
4. Introductory Food Microbiology, H.A. Modi.

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – T304 – CORE COURSE IV – RESEARCH METHODOLOGY, IPR & BIOSAFETY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week: 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**14 Lectures**
Introduction to Research: Definition, Scope, Limitations and Types. Essential Steps in Research: Need for Review of Literature, Review process and Bibliography: Methods of Data Collection.	
Unit-II	**13 Lectures**
Research Report: Biological Experimental Designs: Components of a Research Report, Title, Authors and Addresses, Abstract, Summary, Synopsis, Key words, Materials and Methods, Discussion, Acknowledgements, Appendixes, References. Biological experimental Designs: Introduction, Observation, Hypothesis and Null-Hypothesis, Basic Principles of Experiments, Experimental Unit and Sampling Unit, Controls, Randomization, Measurement.	
Unit-III	**13Lectures**
Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Protection of GMOs, IP as a factor in R&D; IPs of relevance to Biotechnology.	
Unit-IV	**12 Lectures**
Basics of Patents and Concept of Prior Art: Introduction to Patents; Patent filing procedures: National & PCT filing procedure; Time frame and Cost; Status of the patent applications filed; Precautions while patenting-disclosure/non-disclosure; Financial assistance for patenting introduction to existing schemes., Patent licensing and agreement., Patent infringement – meaning scope, limitation case studies.	
Unit-V	**12 Lectures**
Biosafety: Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels: Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines- Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, for GMO applications in food and agriculture.	

BOOKS:

1. Indian Patent Act 1970 Acts & Rules, BAREACT, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Genetic Patent Law & Strategy, 1st Edition, Kankanala C., Manupatra Information Solution Pvt. Ltd., 2007

IMPORTANT LINKS:

- http://www.w3.org/IPR/
- http://www.wipo.int/portal/index.html.en
- http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
- www.patentoffice.nic.in
- www.iprlawindia.org/ - 31k - Cached - Similar page
- http://www.cbd.int/biosafety/background.shtml
- http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
- http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – P305 – CORE COURSE V – PRACTICAL COURSE

MAX. MARKS: 100 **MIN. PASS MARKS: 40**

No. of Laboratory per Week : 06 Hours **Total Lectures: 96**

ENZYME TECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

1. Determination of enzyme activity and studying effect of temp, pH, enzyme concentration, substrate concentration on enzyme activity.
2. Isolation of enzymes from Prokaryotic and Eukaryotic sources and assay of enzyme activity.
3. Thermal death time determination and thermal death point determination.
4. Analysis of BOD and COD and DO of given sample.
5. Analysis of microbial quality of air and water.

FOOD SCIENCE & TECHNOLGOY AND RESEARCH METHODOLOGY, IPR & BIOSAFETY

1. Microbial ethanol production.
2. Microbial quality control of foods and drugs (microbial limit test).
3. Sterility test of food and drug samples.
4. Toxicity and safety test for food and drugs.
5. Bacterial endo toxin test in references to pharmaceutical products.

Syllabus

M.Sc. (B.T.). Part II – Semester III

MBT – 306 (SKEG) – SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC) –

SKEG- T-109 – INTRODUCTION TO PHARMACEUTICAL BIOTECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week: 03 Hours **Total Lectures: 48**

SKEG-T/P114 – INTRODUCTION TO ICT I

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

PART A : THEORY - MAX. MARKS: 50 + 30 **MIN. PASS MARKS: 20 + 12**

No. of Lectures per week : 02 Hours **Total Lectures: 32**

PART B : PRACTICALS - MAX. MARKS: 20 **MIN. PASS MARKS: 08**

No. of Laboratory per week: 02 Hours **Total Lectures: 32**

SKEG-T116– MANAGERIAL SKILLS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T108 – HEALTH EDUCATION

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – T401 – CORE COURSE I – BIOPROCESS TECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**12 Lectures**
Basic principle of Bioprocess Technology: Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.	
Unit-II	**13 Lectures**
Upstream and Downstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Scale up and scale down process; Antifoam. Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.	
Unit-III	**14 Lectures**
Concepts of basic mode of fermentation processes: Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation - Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Measurement and control of bioprocess parameters.	
Unit-IV	**13 Lectures**
Microbial Technology – I: Microbial processes-production of primary (ethanol, organic acid – lactic acid; amino acids – glutamic acid and lysine; vitaminB12) and secondary metabolites (antibiotics – penicillin and streptomycin).	
Unit-V	**12 Lectures**
Microbial Technology – II: Industrial production, recovery, stability and formulation of bacterial and fungal enzymes-amylase, protease, Enzyme and whole cell Immobilization of and their industrial applications. Use of microbes in mineral beneficiation and oil recovery, Single Cell Proteins, Single Cell Oil, Bioinsecticides, Biofertilizers.	

BOOKS:

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997
4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986
5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973
6. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004
7. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – T402 – CORE COURSE II – GENOMICS AND PROTEOMICS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Introduction : DNA sequencing principles and Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides.	
Unit-II	**13 Lectures**
Tools for genome analysis:-RFLP, DNA fingerprinting, RAPD, Linkage and Pedigree analysis-physical and genetic mapping, PCR, Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products. T-vectors; Proof reading enzymes; PCR in gene recombination; Deletion; addition; Overlap extension; and SOEing; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection.	
Unit-III	**13Lectures**
Genome sequencing projects: Microbes, plants and animals- Genome database; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.	
Unit-IV	**13 Lectures**
Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Gene replacement; Gene targeting; Transgenics.	
Unit-V	**12 Lectures**
Proteomics : Protein analysis (includes measurement of concentration, Amino Acid Composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale solution, Isoelectricfocusing; Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF. Functional genomics and proteomics : Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays; Structural proteomics.	

BOOKS:

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
2. Brown TA, Genomes, 3rd Edition. Garland Science 2006
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – T403 – CORE COURSE III – ANIMAL BIOTECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**13 Lectures**
Structure and organization of animal cell. Equipment and materials for animal cell culture technology. Introduction to the balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum and protein free defined media and their application. Factors Affecting of Animal cell Culture.	
Unit-II	**14 Lectures**
Measurement of viability and cytotoxicty. Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture, Suspension Culture, maintenance of cell culture; cell separation. Primary and established cell line cultures.	
Unit-III	**13Lectures**
Scaling-up of animal cell culture. Cell synchronization. Cell fusion. Cell cloning and micromanipulation. Cell transformation. Somatic cell genetics. Cell line.	
Unit-IV	**12 Lectures**
Organ and histotypic cultures. Three dimensional culture and tissue engineering. Measurement of cell death. Apoptosis.	
Unit-V	**12 Lectures**
Transfection of mammalian cells. Application of animal cell culture: Production of biopharmaceuticals. Cell culture based vaccines. Stem cell cultures, embryonic stem cells and their applications. Transgenic animals.	

BOOKS:

1. Culture of Animal Cells, (3rd Edition), Freshney, Wiley-Liss
2. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, OXFORD
3. Cell Growth and Division: A Practical Approach. Ed. R. Basega, IRL Press
4. Cell Culture Lab Fax. Eds. M Butler and M. Dawson, Bios Scientific Publications Ltd. Oxford
5. Animal Cell Culture Techniques. Ed. Marin Clynes, Springer
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods. Ed. Jenni P Mather and David Barnes Academic Press

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – T404 – CORE COURSE IV – PLANT BIOTECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per Week : 04 Hours **Total Lectures: 64**

The Question Paper will contain questions equally distributed in all Units. The Internal Choice will be given in all Questions.

Unit-I	**14 Lectures**
Introduction to cell and Tissue Culture: Tissue culture media (composition and preparation), tissue culture as a technique to produce novel plants and hybrids. Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil. Shoot-tip culture: rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Anther, pollen and ovary culture for production of haploid plants and homozygous lines.	
Unit-II	**13 Lectures**
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 vectors, genetic markers, viral vectors and their application, multiple gene transfers, Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection. Transgene stability and gene silencing.	
Unit-III	**13 Lectures**
Application of plant Transformation for productivity and performance: Introduction to Somaclonal and Gametoclonal variations, Herbicide resistance, insect resistance, virus resistance, disease resistance, nematode resistance, abiotic stress.	
Unit-IV	**12 Lectures**
Metabolic Engineering and Industrial Products: Plant secondary metabolities, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway; alkaloids, polyhydroaxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology.	
Unit-V	**12 Lectures**
Molecular Marker aided-Breeding: Basic techniques or rDNA techniques RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection. Cryopreservation, slow growth and DNA Banking for germplasm conservation.	

BOOKS:

1. J. Hammond, P. McGarvey and V. Yusibov (Eds.): Plant Biotechnology. Springer verlag, 2000
2. T-J. Fu, G. Singh, and W.R. Curtis (Eds.); Plant Cell and Tissue Culture for the Production of Food Ingredients. Kluwer Academic/Plenum Press, 1999
3. H. S. Chawla: Biotechnology in Crop Improvement. International Book Distributing Company, 1998
4. R.J. Henry: Practical Application of Plant Molecular Biology. Chapman and Hall, 1996
5. P.K. Gupta : Elements of Biotechnology, Rastogi and Co. Meerut, 1996
6. S.S. Bhojwani and M.K. Razdan: Plant tissue culture: Theory and practice, a revised edition (1996)

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – P405 – CORE COURSE V – PRACTICAL COURSE

MAX. MARKS: 100 **MIN. PASS MARKS: 40**

No. of Laboratory per Week : 06 Hours **Total Lectures: 96**

BIOPROCESS TECHNOLOGY, GENOMICS AND PROTEOMICS

1. Isolation and screening of industrially important microorganisms.
2. Determination of thermal death point and thermal death time of microorganisms.
3. Production of microbial products in bioreactors.
4. Assay of antibiotics production.
5. Studying the kinetics of enzymatic reaction by microorganisms.
6. Production and purification of various enzymes from microbes.
7. Comparative studies of Ethanol production using different substrates.
8. Microbial production and downstream processing of an enzyme, e.g. amylase.
9. Various immobilization techniques of cells/enzymes, use of alginate for cell immobilization.
10. PCR amplification gene and analysis by agarose gel electrophoresis.
11. Polymerase Chain reaction, using standard 16srRNA eubacterial primers.
12. RFLP analysis of the PCR product.
13. Plasmid isolation and confirming recombinant by PCR and RE digestion.
14. Southern hybridization of *B. subtilis* genome with probe and non-radioactive detection.

ANIMAL AND PLANT BIOTECHNOLOGY

1. Preparation of media.
2. Surface sterilization.
3. Organ Culture.
4. Callus propagation, organogenesis, transfer of plants to Soil.
5. Protoplast isolation and culture.
6. Anther culture, production of Haploids.
7. Cytological examination of regenerated plants.
8. Agro bacterium culture, selection of transformants, reporter gene (GUS) assays.
9. Preparation of tissue culture medium and membrane filtration.
10. Preparation of single cell suspension from spleen and thymus.
11. Cell counting and cell viability.
12. Macrophage monolayer from PEC, and measurement of phagocytic activity.
13. Trypsinization of monolayer and sub-culturing.
14. Cryopreservation and thawing.
15. Measurement of doubling time.
16. Role of serum in cell culture.
17. Preparation of metaphase chromosomes from cultured cells.
18. Isolation of DNA and demonstration of apoptosis and DNA laddering.
19. MTT assay for cell viability and growth.
20. Cell fusion with PEG.

Syllabus

M.Sc. (B.T.). Part II – Semester IV

MBT – 406 (SKEG) – SKILL ENHANCEMENT / GENERIC COURSE - ANY ONE (SEC / GC) –

SKEG- T-110 – INTRODUCTION TO AGRO BIOTECHNOLOGY

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week: 03 Hours **Total Lectures: 48**

SKEG-T/P115 – INTRODUCTION TO ICT II

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

PART A : THEORY - MAX. MARKS: 50 + 30 **MIN. PASS MARKS: 20 + 12**

No. of Lectures per week : 02 Hours **Total Lectures: 32**

PART B : PRACTICALS - MAX. MARKS: 20 **MIN. PASS MARKS: 08**

No. of Laboratory per week: 02 Hours **Total Lectures: 32**

SKEG-T116– MANAGERIAL SKILLS

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

SKEG-T108 – HEALTH EDUCATION

MAX. MARKS: 70 + 30 **MIN. PASS MARKS: 28 + 12**

No. of Lectures per week : 03 Hours **Total Lectures: 48**

MBT- P407 PROJECT / INTERNSHIP

MAX.MARKS: 100 **MIN. PASSING MARKS: 40**

TOTAL CREDITS: 32

The Students have to prepare a Project/Internship Report under the guidance of respective faculty.
