

Gujarat University, Ahmedabad 380 009, Gujarat, India.

M.Sc. BIOTECHNOLOGY SYLLABUS

From June 2017

- ❖ There shall be four theory papers each of four hours (3+1) duration and two practical each of eight hours duration.
- ❖ Each theory paper shall carry hundred marks and each practical shall carry hundred marks.
- ❖ The candidate is required to show article to faculty in/before interpreting his/her experimental work.
- ❖ Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.
- ❖ Each theory paper is divided into four units. Each unit will have equal weightage while setting question paper. Question or its sub question including the options will be set from the same unit.
- ❖ There shall be one biotechnological study tour / field work during fourth or any semester of P.G. study. It will pertain to different biotechnological / environmental industries / research institute / various ecosystems even outside Gujarat State. The study tour is highly essential for studying biotechnological process and technology.
- ❖ Assignments and group discussions / industrial training accomplished with the bound copy of report are necessary for evaluation.
- ❖ At least two seminars should be delivered during fourth semester.
- ❖ Practical batch will be consisting of maximum 10 students.
- ❖ Student can select any one paper from the three elective papers given in semester III.

Paper no.	Title	No. of Hours per Week				Course Credits
		Lecture	Others	Practicals	Total	
Semester 1						
BT 401	Cellular Microbiology	3	1	-	4	4
BT 402	Advances in Biochemistry	3	1	-	4	4
BT 403	Genetics and Biostatistics	3	1	-	4	4
BT 404 E	Physiology and Immunology	3	1	-	4	4
BT 405 PR	Lab 1	-	-	12	12	4
BT 406 PR	Lab 2	-	-	12	12	4
Total		12	4	24	40	24
Semester 2						
BT 407	Applied Microbiology	3	1	-	4	4
BT 408	Gene regulation and recombinant DNA technology	3	1	-	4	4
BT 409	Tools and Techniques in Synthetic biology	3	1	-	4	4
BT 410 E	Advances in Microbial biotechnology	3	1	-	4	4
BT 411 PR	Lab 3	-	-	12	12	4
BT 412 PR	Lab4	-	-	12	12	4
Total		12	4	24	40	24

SEMESTER 1

BT 401: Cellular microbiology

Unit 1: Bacteriology

- Prokaryotic forms (bacteria and archaea) and function
- Prokaryotic shapes, arrangement and sizes
- The cell Envelope: The boundary layer of bacteria
- Bacterial internal structure
- Introduction to Bergey's manual of systematic bacteriology

Unit 2: Methods of studying Microorganisms

- Methods of culturing microorganisms
- Inoculation: producing a culture
- Isolation: Separating one species from another
- Media: providing nutrients in the laboratory
- Control of bacterial growth
- Magnification and microscope design
- Variations on the light microscope

Unit 3: Eukaryotic cell biology

- Forms and function of eukaryotic cells
- Locomotor appendages
- Boundary structures of eukaryotic cells
- The internal structure: Nucleus and cell organelles

Unit 4: Eukaryotic Microorganisms

- Fungal nutrition
- Structure and Reproduction
- Fungal identification and cultivation
- The role of fungi in nature and industry
- Biology and applications of algae
- Biology and applications of protozoa

BT 402: Advances in Biochemistry

Unit 1: Biomolecules

- Specific biomolecules their structure and function
- Carbohydrates: simple and complex
- Glycoconjugates- glycoproteins, proteoglycans and glycolipids
- Central metabolic pathways and feeder pathways
- Metabolism of fatty acids
- Metabolism of C₁ compounds
- Fate of pyruvate under anaerobic condition

Unit 2: Biosynthesis and regulation

- Biosynthesis and regulation of amino acids
- Biosynthesis and regulation of nucleotides
- Nitrogen metabolism: Nitrate and ammonia assimilation, their control and regulation of Nitrogenase

Unit 3: Enzymology I

- Extraction and purification of enzymes
- Structure of enzymes
- Protein folding and denaturation
- Mechanism of enzyme action- catalysis mechanisms and lysozyme
- Kinetics of enzyme catalysed reactions

Unit 4: Enzymology II

- Enzyme inhibition
- Allosteric enzymes- sigmoidal kinetics
- Immobilization of enzymes
- Clinical, analytical and industrial applications of enzymes
- Ribozymes and Abzymes

BT 403: Genetics and Biostatistics

Unit 1: Bacterial genetics and plasmid biology

- Mode of gene exchange in bacteria and their applications
- Use of gene exchange process in gene structure analysis
- Plasmid biology: types, compatibility, replication, control of copy number and segregation

Unit 2: Genetics of microorganisms

- Fungal genetics: tetrad analysis and mitotic recombination of *Neurospora*
- Bacteriophage genetics: T4, T7, Φ X 174 and MS2

Unit 3: Concepts of molecular biology

- Genome organization and DNA packaging
- DNA replication, transcription and translation
- Mutation
- DNA damage and repair

Unit 4: Biostatistics

- Meaning of data and their representation in biostatistics
- Measures of central tendency with computation and their application in biostatistics
- Measures of dispersion with computation
- Normal distribution curve, characteristics and uses with computation
- Correlation: meaning, types and methods of correlation
- Statistical inference and significance of test in biostatistics
- Significance difference between means and other biostatistics

BT 404: Physiology and Immunology

Unit 1: Principles of physiology

- Nutrient transport in prokaryotic cell
- Signal transduction in bacteria
- Mechanism of drug resistance
- Quorum sensing
- Bacterial Bioluminescence
- Bacterial differentiation

Unit 2: Microbial growth

- Batch and continuous culture, synchronous and diauxic growth
- Factors affecting growth
- Growth measurement
- Growth kinetics
- Control of microbial growth

Unit 3: Major histocompatibility complex

- Antigen processing and presentation
- MHC: structure and function
- Cytokines
- Compliment components and activation
- T cell and B cell receptors and activation

Unit 4: Immune disorders and immunological techniques

- Hybridoma technology of T and B cell
- Autoimmunity
- Transplantation immunology
- AIDS and other immune deficiencies
- Cancer and the immune system

BT 405: Practicals

1. Cultivation methods for bacteria.
2. Staining Techniques- structural and special.
3. Identification of economically important bacteria and fungi.
4. Preparation of standard solutions
5. Quantification of biomolecules:
 - Carbohydrates: Cole's, Folin's Wu, Nelson Somogyi, Anthrone method
 - Proteins: Folin Lowry's, Bradford's method
 - Lipids: Bligh and Dyer's method, Van Handel's method
 - Nucleic Acids: DNA by DPA; and RNA by Orcinol method
6. Qualitative analysis of biomolecules by chromatography: sugars, amino acids & organic acids
7. Horizontal gene transfer by conjugation
8. Demonstration of basic laboratory instruments

BT 406: Practicals

1. Determination of bacterial growth rate and factors influencing it
2. Study of enzyme kinetics of amylase
3. Determination of enzyme activity: protease, lipase
4. Ammonium sulphate precipitation method for enzyme purification
5. Electrophoretic separation of proteins by PAGE: SDS, NATIVE
6. Immunological interaction between Ag and ab:
 - Immunoprecipitation
 - Agglutination
 - Immunoelectrophoresis
7. Statistical analysis of data: Measures of central tendency

REFERENCES

<u>No.</u>	<u>Name</u>	<u>Author</u>
1.	A guide to identifying and classifying yeast	Burnet et.al
2.	Advances in microbial physiology	Volumes
3.	Agricultural statistics-techniques and procedures	Mandal & Nambiar
4.	Analytical biochemistry	D.J. Holme & H.Peck
5.	Annual review of microbiology	Volumes
6.	Bacteria in their natural environment	Fletcher
7.	Bacterial metabolism	Gottschalk, G.
8.	Bacterial respiration and photosynthesis	C.W. Jones
9.	Bergey's manual of systematic bacteriology vol.: I-V	Krieg & Holt
10.	Biochemical methods	Pingoud A. etl.
11.	Biochemistry and molecular biology	W. H. Elliott & D. C. Elliott
12.	Biochemistry Stryer 5 th edition	W.H. Freeman
13.	Biodiversity of microbial life	Ed. J. T. Staley & A.L. Reysenbach
14.	Bioinformatics databases, tools and algorithms	O. Bosu & S. K. Thukral
15.	Biology of industrial microorganisms	A.L. Duncun
16.	Biology of the conidial fungi	Cole & Kendrick
17.	Biology of the fungi	I.K. Ross
18.	Bioseparations: principles and techniques	B. Sivasankar, PHI, New Delhi
19.	Biostatistics	Lewis A.E.
20.	Biotechniques theory & practice	S. V. S. Rana
21.	Biotechnology and genomics	P. K. Gupta, Rastogi Publication
22.	Biotechnology of filamentous fungi	Finkelstein & Ball
23.	Biotechnology volumes	H.J. Rehm & Reed
24.	Biotechnology, biosafety and biodiversity	Sivramiah Shantharam & Jane. F. Montgomery
25.	Brock's biology of the microorganisms 8 th edition	M.T.Madigan,T.M.
26.	Cell and molecular microbiology	Garald Karp
27.	Comprehensive biotechnology vol.1-4	Conney & Humphrey
28.	Diversity-current perspectives and potential application	Satyanarayan and Johri (eds) IK Int. Publ.
29.	Elements of biostatistics	S. Prasad
30.	Energetics of microbial growth	E.H. Battley
31.	Enzymes and immobilized cells in biotechnology	A. L. Laskin
32.	Enzymes, biochemistry, biotechnology, clinical chemistry	Trevor Palmer
33.	Experimental ecology	R.M. Atlas
34.	Extremophiles	Johri B.N
35.	Fundamentals of enzymology	N.C.Price & L. Sterens, 3rd edn, Oxford press.
36.	Fundamentals of the fungi	E. Moore & Lendecker
37.	Gene function	Robert Glass
38.	Gene V- VII	Benjamin Lewin
39.	General genetics	L. Snyder et. al
40.	General microbiology	Michael, M.M.John Stanier <i>et al.</i>
41.	Genetics 3 rd edition	Peter J. Russel
42.	Genetics as a tool in microbiology	Gloover & Hopwood
43.	Genetics of bacteria	Scaife et.al
44.	Growth of bacterial cell	Ingraham et. al
45.	Harper's biochemistry	Murray et. al
46.	Introduction to biostatistics	R. N. Forthofer & Lee

47.	Laboratory exercise in microbiology	Harley & Prescott
48.	Microbial cell-cell interaction	Martin
49.	Microbial diversity	Colwd. D
50.	Microbial ecology	Bartha and Atlas, Pearson Edu
51.	Microbial physiology	Dawes & Southerland
52.	Molecular biology and biotechnology	Robert A., Meyers Eds.
53.	Molecular biology of gene	J.D.Watson
54.	Molecular biomethods handbook	Rapley & Walker
55.	Molecular biotechnology	Primrose
56.	Molecular cell biology	Lodish et.al
57.	Molecular genetics of bacteria	Snyder & champnes
58.	Moulds and filamentous fungi in technical microbiology	O. Fassatiova
59.	New approaches in microbial ecology	Tiwari & Saxena
60.	Practical biochemistry	Wilson & Goulding
61.	Practical biochemistry	Plummer
62.	Practical of biochemistry	Lehninger
63.	Principle of biochemistry 3 rd edition	Lehninger Nelson & Cox
64.	Principles of microbiology	RM. Atlas
65.	Prokaryotic developments ASM Press, 2000	Brun Y.V. & Shimketes
66.	Quantitative problems in biochemistry	E.A. Dewes
67.	Recent advances in biological N ₂ fixation	Subbarao
68.	Smith's introduction to industrial mycology	Onions et. al.
69.	Sources of experiments for the teaching of microbiology	Primrose & Wardlaw
70.	Statistical methods in Biology	N. T. J. Bailey
71.	Statistics and experimental design	G. M. Clarke
72.	Superbugs	Horikoshi & Grants
73.	Text book on principles of bacteriology, virology and immunology, IX edition (5 volumes), Edward, London, 1995	Topley and Wilson's
74.	Textbook of biotechnology	H.K.Das
75.	The genetics of bacteria and their viruses	Hayes W.
76.	The microbial cell cycle	C. Edwards
77.	The prokaryotes vol. I and II	Ed. Starr & others
78.	The yeasts	Rose & Harrison
79.	Topics in enzyme & fermentation biotechnology	Volumes by Wisemen

SEMESTER 2

BT 407: Applied Microbiology

Unit 1: Elements of Bioprocess

- Isolation, screening and preservation of industrially important microorganisms
- Media formulation, energy sources, antifoams and media optimization
- Fermenter design and types of fermenters
- Monitoring and control of process variables

Unit 2: Upstream and Downstream processing

- Sterilization of media, air and reactor
- Development of inocula
- Mass transfer of oxygen- factor affecting K_La
- Methods of cell separation and disruption

Unit 3: Dairy technology

- Starter cultures
- Cheese production
- Fermented foods and other dairy products
- Evaluation and role of Probiotics
- Nutraceuticals

Unit 4: Biomass production and applications

- Fungal biomass- baker's yeast and single cell oil
- Mushroom cultivation
- Use of Algal biomass
- Microbial production for food and feed
- Carotenoid pigments- β -carotene, lycopene

BT 408: Gene regulation and Recombinant DNA technology

Unit 1: Gene expression and regulation

- Transcriptional and translational control
- Lac, arabinose and tryptophan operon circuits
- Regulation of lytic and lysogenic cycle of λ phage

Unit 2: Enzymes in r-DNA Technology and DNA sequencing

- Extraction, purification, analysis and size fractionation of nucleic acid
- Enzymes involved in genetic engineering
- c-DNA formation and c-DNA library and genomic library
- cohesive and blunt end ligation
- DNA sequencing

Unit 3: Vectors and Probes

- Cloning and expression vectors
- Methods of introduction of r-DNA into host cell
- Expression and characterization of cloned genes
- Oligonucleotide probes and labelling of probes

Unit 4: Molecular markers and techniques

- Blotting and hybridization techniques
- DNA foot printing
- DNA fingerprinting
- Molecular markers- RFLP and RAPD
- Microarray technique

MIC 409: Tools and techniques in synthetic biology

Unit 1: Bio-nanotechnology

- Introduction to concept and principles of nanotechnology
- Properties of nanomaterials, carbon nanotubes
- Techniques and methodology used to study nanoparticles
- Application of nanoparticles in molecular biology, industry agriculture and environment

Unit 2: Advances in Instrumentation

Principle, protocol and applications of:

- Atomic Absorption Spectrophotometer
- High Performance Liquid Chromatography
- Mass Spectrophotometer
- Nuclear Magnetic Resonance
- Gas Liquid Chromatography
- Fourier Transformed Infrared Spectroscopy

Unit 3: Bioinformatics-I

- Introduction to bioinformatics
- Introduction to computers and bioinformatics
- Biological databases
- Application of bioinformatics in proteomics, genomics, HGP and rational drug discoveries

Unit 4: Bioinformatics-II

- Sequence comparison
- Multiple sequence alignment
- Profiles, motifs and feature identification
- Phylogeny

BT 410: Advances in Microbial Biotechnology

Unit 1: Microbial production of organic acids, solvents and beverages

- Organic acids: citric acid, acetic acid
- Solvents: ethanol, acetone-butanol
- Beverages: beer, wine

Unit 2: Microbial production of therapeutic agents

- Streptomycin, cephalosporin
- Anticancer agents
- Vaccines and Siderophores
- Ergot alkaloids

Unit 3: Microbial production of enzymes, vitamins and amino acids

- Enzymes: proteases, amylases and lipases
- Vitamins: B₂ and B₁₂
- Amino acids: lysine, glutamic acid and tryptophan

Unit 4: Other microbial products

- Microbial polysaccharides: Xanthan and Dextran
- Biosurfactants
- Steroid transformation
- Polyhydroxyalkanoates: PHA and PHB

BT 411: Practical

1. Bioinformatics:
 - Data base exploration
 - BLAST
 - Sequence alignment: Multiple and Pair-wise
 - Phylogenetic tree construction
 - Sequence submission
2. Isolation, quantification and determination of purity: DNA, RNA and Plasmid
3. Amplification of DNA by thermocycler
4. RE digestion of plasmid
5. Induction of mutants by physical and/or chemical mutagens and its characterization:
 - pigment variants
 - lac⁻ mutants
 - antibiotic resistant mutants
6. Determination of oxygen transfer rate (OTR)

BT 412: Practical

1. Isolation, screening and optimization of conditions for production:
 - Solid state fermentation: enzymes, alcohol
 - Submerged fermentation: enzymes, exopolysaccharide, alcohol, organic acids and antibiotics
2. Estimation, recovery and purification of fermentation products-enzymes, antibiotics, organic acids, alcohol, exopolysaccharide
3. Influence of different parameters on immobilisation of cells and enzymes
4. Isolation of probiotic culture from various sources
 - Evaluation and efficacy of probiotic culture
5. Production of fermented food and characterization of acidity, alkalinity and its microbial profile

REFERENCES

No.	Name	Author
1.	Genetic engineering	Rastogi & Pathak, Oxford
2.	Biotechnology and genomics	P. K. Gupta, Rastogi Publication
3.	The elements of immunology	F. H. Khan, Pearson Edu.
4.	Elements of molecular biology	J.K. Pal & S.S. Ghaskadbi, Oxford Pr.
5.	Biotechnology	U. Satyanarayana
6.	Molecular biology and genetic engineering	P. K. Gupta
7.	Immunology and immunotechnology	A. K. Chakravarty
8.	Immunology	I. R. Tizard
9.	Kuby Immunology	R.A. Goldsby, T.J. Kindt, B.A. Osborne
10.	Preservation and Sterilisation Methods in Microbiology	Norris & Ribbons
11.	Annual review of Microbiology	Volumes
12.	Principles of Microbiology	RM. Atlas
13.	Molecular biology of gene	J.D.Watson
14.	Genetics as a tool in Microbiology	Glover & Hopwood
15.	Genetics of Bacteria	Scaife et.al
16.	Molecular Genetics of Bacteria	Snyder & champnes
17.	Laboratory exercise in Microbiology	Harley & Prescott
18.	Molecular Biotechnology	Primrose
19.	Gene cloning and manipulation	Christopher Howe
20.	Essentials of Immunology, ELBS, 1998	Roitt, I. M.
21.	Immunology II, 1994	Kuby, J
22.	Immunology – understanding of immune system	Wiley-Liss Klaus 1996 D. Elgert
23.	Text book on principles of bacteriology, virology and immunology, IX edition (5 volumes),	Topley and Wilson's, Edward, London, 1995
24.	Molecular Biology and Biotechnology	Robert A., Meyers Eds.
25.	Textbook of Biotechnology	H.K.Das
26.	Principle of Gene Manipulation, An Introduction to Genetic Engineering	R. W. Old & S.B. Primrose
27.	Essential of Molecular Biology	George M. Malacinski
28.	Recombinant DNA Principles and Methodology	James J Greene & Venigalla B. Rao
29.	Molecular Bio methods Handbook	Rapley & Walker
30.	Cell and Molecular Microbiology	Garald Karp
31.	Biotechnology An Introduction	Susan R. Barnum
32.	Topics in Enzyme & Fermentation Biotechnology	Volumes by Wisemen
33.	Biology of Industrial Microorganisms	A.L. Duncun
34.	Bioprocess Engineering	P.K. Ghosh
35.	Biotechnology	U. Satayanarayan
36.	Biotechnology secondary metabolites	K. G. Ramawat and J. M. Merillon
37.	Biotechnology Volumes	H.J. Rehm & Reed
38.	Comprehensive Biotechnology Volumes	Conney & Humphrey
39.	Fermentation Microbiology and Biotechnology	EL-Mansi & C.F.A.Bryce eds
40.	Genetic Engineering	S. Mitra
41.	Manual of Industrial Microbiology and Biotechnology	Demain & Davies, 2 nd ed.
42.	Microbial Biotechnology	A. N. Glazer and H. Nikaido
43.	Molecular Industrial Mycology	Leong & Berka
44.	Principles of Fermentation Technology	Stanbury, Whittaker & Hall
45.	Process Biotechnology Fundamentals	S. N. Mukhopadhyay
46.	Recombinant DNA Methodology II	Ray Wu
47.	Sources of experiments for the teaching of microbiology	Primrose & Wardlaw

48.	Elements of molecular biology	J.K. Pal & S.S. Ghaskadbi, Oxford Press
49.	Molecular biology and genetic engineering	P. K. Gupta
50.	How computer works	Rem White
51.	How the internet works	Priston Grall & Techmich
52.	Bioinformatics 2000	Higgins & Taylor
53.	Bioinformatics, 1998	Baxevanis
54.	N ₂ Fixation	Muller & Newton

Gujarat University, Ahmedabad 380 009, Gujarat, India.

M.Sc. BIOTECHNOLOGY SYLLABUS

From June 2017

Paper no.	Title	No. of Hours per Week				Course Credits
		Lecture	Others	Practicals	Total	
Semester 3						
BT 501	Plant Biotechnology	3	1	-	4	4
BT 502	Environmental Biotechnology	3	1	-	4	4
BT 503	Biogeohydrotechnology and Biofuels	3	1	-	4	4
BT 504 E1	Animal Tissue Culture and Pharmaceuticals Biotechnology	3	1	-	4	4
BT 504 E2	Recombinant DNA Technology					
BT 504 E3	Biopharmaceuticals and Drug Development					
BT 505 PR	Lab 5	-	-	12	12	4
BT 506 PR	Lab 6	-	-	12	12	4
Total		12	4	24	40	24
Semester 4						
BT 507 PT	Project			-	16	16
BT 508 S	Seminar / Field Work / Study Tour			6	6	4
BT 509 M	Assignments, Group Discussion / Industrial Training			6	6	4
Total		0	0	12	28	24

SEMESTER 3

BT 501: Plant Biotechnology

Unit 1: Microbes in agriculture

- Biofertilizer: types, production and its application
- Mycorrhizae: classification and significance
- Vermicomposting
- Organic matter decomposition
- Bioinsecticides and their production by bacteria, fungal and viral
- Integrated pest management

Unit 2: Plant Tissue Culture- Techniques and Methodology

- Introduction to plant tissue culture and its techniques
- Callus and suspension cultures, cloning and regeneration
- Micropropagation and applications of plant tissue culture
- Microbial plant hormones

Unit 3: Plant Tissue Culture- Application and its uses

- Production of haploid plants
- Germplasm conservation and cryopreservation
- Protoplast isolation and regeneration
- Transgenic plants and its application

Unit 4: Plant as Bioreactor

- Types of Plant reactor
- Secondary metabolites: production and extraction
- Molecular marker aided breeding, assistant selection and its DNA based application
- Production of industrial enzymes, biodegradable plastics, biopolymers and antibiotics

BT 502: Environmental Biotechnology

Unit 1: Environmental problems and monitoring

- Environmental monitoring: environmental impacts and their assessments using bio-indicators, biomarkers, biosensors and toxicity testing, rDNA technology
- Conservation strategies
- Environmental laws and policies in India

Unit 2: Bioremediation

- Bioremediation principles
- Strategies and techniques of bioremediation: *in situ* and *ex situ*
- Bioremediation of metals
- Phytoremediation
- GMOs and their impact on bioremediations

Unit 3: Biodegradation

- Principles of biodegradation and mechanism of detoxification
- Biodegradation of detergent, pesticide, lignin, hydrocarbon and dyes

Unit 4: Biodeterioration

- Principles and mechanisms of biodeterioration
- Methodology to assess biodeterioration
- Prevention and control of biodeterioration
- Biodeterioration of selected materials

BT 503: Biogeohydrotechnology and Biofuels

Unit 1: Fuel Biotechnology

- Types of energy resources and their uses
- Biotechnology for biogas, bioethanol, biodiesel and biohydrogen production
 - Desirable and undesirable features of biofuels
 - Energy crops
 - MEOR
 - Mode of utilization of biomass

Unit 2: Microbiology of Minerals

- Bioleaching and Bio-oxidation
- Biogeohydrotechnology of sulphidic minerals
- Biobeneficiation
- Acid mine drainage formation and control
- Bioleaching methods and factors affecting bioleaching

Unit 3: Waste treatment

- Classification and characterization of waste
- Principles and mechanisms of waste treatment
- Biological methods of liquid waste treatment
- Biological methods for solid waste management

Unit 4: Marine Biotechnology

- Marine environment and bacterial diversity
- Cultivation and enumeration of marine bacteria
- Application of indicators of marine microbial enzymes, polysaccharide, antimicrobial peptides and carotenoids

BT 504 E1: Animal Tissue Culture and Pharmaceutical Biotechnology

Unit 1: Animal tissue culture

- Primary culture and established cell line cultures
- Equipment and material for animal cell technology
- Basic media and techniques of mammalian cell culture
- Manipulation and application of animal cell culture

Unit 2: Bioprocess economics and IPR

- Expenses for industrial materials, equipment, product recovery and effluent treatments
- Cost recovery due to waste usages and recycling
- IPR and patent process
- Benefits, problems and management of IPR
- International harmonization of patent law
- Patents of biotechnological process and their protection
- Indian scenario

Unit 3: Regulatory affairs

- Introduction to pharmacopoeia, good microbiological techniques and good laboratory practice (GLP)
- Basic principles of quality control (QA) and quality assurance (QC)
- Guidelines for QA and QC: raw materials, sterilization, media, stock cultures and products
- Validation study and toxicity testing
- Role of culture collection centre, public health laboratories and regulatory agencies

Unit 4: Biosafety and bioethics

- Biosafety guidelines
- Risk and risk assessment
- Biosafety levels, laboratory biosecurity concepts
- Introduction to drug design
- Pre-clinical and clinical trials
- Basics of bioethics principles, international codes and guidelines in India
- Ethics in post-genomic era

BT 504 E2: Recombinant DNA Technology

Unit 1

- Core techniques and essential enzymes used in rDNA.
- Restriction digestion, ligation and transformation.

Unit II

- Cloning vectors-plasmids, phages and cosmids.
- Cloning strategies. Cloning and selection individual genes,
- gene libraries: cDNA and genomic libraries.

Unit III

- Specialised cloning stratifies. Expression vectors, Promoter probe vectors,
- vectors for library construction-artificial chromosomes.

Unit IV

- PCR methods and application.
- DNA sequencing methods; dideoxy and chemical method.
- Sequence assembly. Automated sequencing. Genome sequencing and physical mapping of genes

BT 504 E3: Biopharmaceuticals and Drug Development

Unit 1

- Introduction to pharmaceuticals of animal, plant and microbial origin
- Hematopoietic growth factors and coagulation factors
- Interferons and cytokines for anti-infective and cancer therapy
- Insulin and growth hormones
- Vaccine: genetically improved vaccines, synthetic peptide based vaccines, nucleic acid vaccines

Unit II

- Recombinant thrombolytic agents: tissue type plasminogen activator, first and second generation of thrombolytic agents
- Concept and approaches for gene therapy, ex vivo and in vivo gene therapy
- Potential target diseases for gene therapy (inherited disorders and cancer)
- Antigene and antisense therapy

Unit III

- Xenotransplantation in pharmaceutical biotechnology
- The role of biotechnology in forensic sciences
- Estimation of toxicity: LD50 and ED50
- Pre-clinical and clinical trails

Unit IV

- Introduction to pharmacopoeia, guide to good manufacturing practice
- Manufacturing facility
- Final product fills and analysis
- Validation study
- Introduction to drug designing
- Search of database

BT 505: Practicals

1. Bioremediation of inorganic pollutants and phytoremediation of metals
2. Characterization of waste water:
 - Physical: odour, colour, turbidity, temperature, salinity
 - Chemical: acidity, alkalinity, sulphate, copper
3. Analysis of drinking water by MTT and MFT
 - Biological characterization: BOD
4. Estimation of phosphatase activity of soil: acid and alkaline
5. Initiation of callus and development
6. Isolation of bioactive compounds from callus
7. Initiation and development of haploid plants
8. Identification of bioactive compounds from plant extracts

BT 506: Practicals

1. Bio-oxidation and determination of oxidation rate: Fe, Cu, S
2. Bioleaching of Cu from sulphidic ore
3. Desulphurization of coal
4. Biocatalyst from marine microbes
5. Microbial load determination
6. Decolourization of dye
7. Biodeterioration of lignocellulosic waste and pharmaceutical products:
 - Determination of microbial load
 - Characterization of biodeteriorating microorganisms
8. Characterization of Rhizobium as biofertilizer
9. Antioxidant activity of pigment

REFERENCES

No.	Name	Author
1.	Geomicrobiology	Ehrlich & Newman, CRC Press
2.	Environmental engineering and management	S. K. Dhameja, Publ: Kataria & Sons
3.	Microbial ecology	Bartha and Atlas, Pearson Edu
4.	A text book of environmental chemistry and pollution control	S. S. Dara
5.	Biotechnology	U. Satyanarayana
6.	General Microbiology	Michael, M.M.John Stanier <i>et al.</i>
7.	Experimental ecology	R.M. Atlas
8.	Principles and Practice of Disinfection	Russel et.al
9.	Preservation and Sterilisation Methods in Microbiology	Norris & Ribbons
10.	Annual review of Microbiology	Volumes
11.	Scientific American	Volumes
12.	Principles of Microbiology	RM. Atlas
13.	Laboratory exercise in Microbiology	Harley & Prescott
14.	Agricultural Statistics-Techniques and Procedures	Mandal & Nambiar
15.	Basic Biotechnology	Colin Ratledge and Bjor
16.	Biochemical Methods	Pingoud A. etl.
17.	Textbook of Biotechnology	H.K.Das
18.	Methods in Biotechnology	Hans-peter-schmauder
19.	Biotechnology An Introduction	Susan R. Barnum
20.	Practical biochemistry	Plummer
21.	Topics in Enzyme & Fermentation Biotechnology	Volumes by Wisemen
22.	Assessing Ecological Risks of Biotechnology	Lev R. Ginzburg
23.	Basic biotechnology	C. Ratledge & B. Kristiansen (eds)
24.	Biology of Industrial Microorganisms	A.L. Duncun
25.	Bioprocess Engineering	P.K. Ghosh
26.	Biotechnology, Biosafety and Biodiversity	Sivramiah Shantharam & J.F. Montgomery
27.	Biotechnology secondary metabolites	K. G. Ramawat and J. M. Merillon
28.	Biotechnology Volumes	H.J. Rehm & Reed
29.	Comprehensive Biotechnology Volumes	Conney & Humphrey
30.	Environmental Biotechnology	B.C. Bhattacharyya and R. Banerjee
31.	Environmental biotechnology	G. M. Evans and J. C. Furlong
32.	Environmental biotechnology	A. Scragg, Oxford
33.	Environmental Microbiology – A Laboratory Manual	Pepper et. al
34.	Environmental Science	S. C. Santra, Central, India
35.	Fermentation Microbiology and Biotechnology	EL-Mansi & C.F.A.Bryce eds
36.	Genetic control of environmental pollutants	Gilbert & Alexander
37.	Handbook of water and waste water treatment technology	Paul
38.	How computer works	Rem white
39.	Introduction to environmental Microbiology	Michael R.
40.	Manual of Environmental Microbiology, 2 nd ed.	C. J. Hurst <i>et al</i> (eds)
41.	Manual of Industrial Microbiology and Biotechnology,	Demain & Davies, 2 nd ed.
42.	Microbial Biotechnology	A. N. Glazer and H. Nikaido
43.	Microbial Mineral Recovery	Ehrlich & Bierley
44.	Microbiological Quality Assurance	Brown & Gilbert
45.	Principles of Fermentation Technology	Stanbury, Whittaker & Hall
46.	Process Biotechnology Fundamentals	S. N. Mukhopadhyay

47.	Sources of experiments for the teaching of microbiology	Primrose & Wardlaw
48.	Waste Water Treatment	Arceivala

SEMESTER 4

BT 507 PT: Project / Dissertation Work Theory

- ❖ The candidate is required to show article to faculty in/before interpreting his/her experimental work.
- ❖ Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.

BT 508 S: Seminar / Field Work / Study Tour

- ❖ At least two seminars should be delivered during fourth semester.
- ❖ There shall be one microbiological study tour / field work during fourth or any semester of P.G. study. It will pertain to different microbiological / environmental industries / research institute / various ecosystems even outside Gujarat State. The microbiological tour is highly essential for studying microbiological process and technology.

BT 509 M: Assignments, Group Discussion / Industrial Training

- ❖ **Assignments and group discussions / industrial training accomplished with the bound copy of report are necessary for evaluation.**

THE INTERNAL ASSESSMENT OF BT:508 AND BT:509 WILL HAVE A PORTION OF MCQ BASED QUESTIONS

Suggested areas to be focused for preparing seminars and assignments

- Computational approaches in Biotechnology
- Tools and techniques in Biotechnology
- Environmental gene mining and metagenomics
- Industry and entrepreneurship in Biotechnology
- Proteomics, proteome analysis and protein array
- Protein interactions, yeast two hybrid systems
- Principles and concepts of metabolomics
- Basics concepts in metabolic engineering
- Strategies used in metabolic engineering
- Applications in metabolomics