

Gujarat University, Ahmedabad 380 009, Gujarat, India.

M.Sc. BIOTECHNOLOGY SYLLABUS

From June 2011

- 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.
- Atleast 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	Biodiversity and Physiology	3	1	-	4	4
BT 402	Biochemistry and Genetics	3	1	-	4	4
BT 403	Enzymology and Bioinstrumentation	3	1	-	4	4
BT 404 E	Immunology and Biostatistics	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	Biochemical Engineering and Bioinformatics	3	1	-	4	4
BT 408	Molecular Biology and Genetic Engineering	3	1	-	4	4
BT 409	Bioprocess Technology	3	1	-	4	4
BT 410 E	Microbial Technology	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: Biodiversity and Physiology

Unit 1: Principles of biodiversity

- Evolution of life
- Principles and concepts of microbial diversity
- Methods of studying diversity
- Conservation of biodiversity
- Exploitation of biodiversity

Unit 2: Principles of physiology

- Membrane structure and nutrient transport
- Signal transduction
- Mechanism of drug resistance
- Quorum sensing
- Bioluminescence
- Bacterial differentiation

Unit 3: Physiological and metabolic diversity of microorganisms and their importance

- Evolution of energy metabolism
- Evolution and diversity of photosynthetic and autotrophic bacteria
- Diversity of microbial heterotrophic metabolism
- Fungal diversity in soil ecosystem
- Physiological evolution in fungi

Unit 4: Microbial diversity and physiology of extreme environment

Habitat, diversity, physiology, survival and adaptation and biotechnological potentials of :

- Cold and thermal environment
- Saline and deep sea environment
- Osmophilic and xerophilic environment
- Alkaline and acidic environment

BT 402: Biochemistry and Genetics

Unit 1: Advances in metabolism and regulation

- Glycolysis and feeder pathways
- Fate of pyruvate under anaerobic condition
- Polysaccharides and glycoconjugates
- Metabolism of fatty acids
- Concept of bioenergetics

Unit 2: Biosynthesis and regulation

- Biosynthesis of C₁ compounds
- Biosynthesis and regulation of amino acids
- Biosynthesis and regulation of nucleotides

Unit 3: 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 4: Genetics of microorganisms

- Fungal genetics: tetrad analysis and mitotic recombination of *Neurospora*
- Bacteriophage genetics: T₄, T₇, φ174, MS₂,
- Viroids and prions

BT 403: Enzymology and Bioinstrumentation

Unit 1: Enzymology I

- Enzyme kinetics and its analysis
- Enzyme inhibitions
- Enzyme turnover
- Protein folding and denaturation
- Immobilization of enzyme

Unit 2: Enzymology II

- Enzymology of nitrogen metabolism
- Nitrogenase complex
- Factors affecting nitrogenase activity
- Clinical, analytical, industrial enzymology

Unit 3: Microbial cell as enzyme reactor

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

Unit 4: Bioinstrumentation

Principle, working and application of

- Chromatography: liquid-solid, liquid-liquid, gas-liquid
- Spectrometry: UV-Vis, atomic absorption spectrophotometer
- Electrophoresis: paper and gel
- Polarograph and voltameter

BT 404 E: Immunology and Biostatistics

Unit 1: Major histocompatibility complex

- Antigen processing and presentation
- MHC: structure and function
- Cytokines
- Compliment system

Unit 2: Immune disorders and immunological techniques

- Hybridoma technology of T and B cell
- Autoimmunity
- Tumour and transplantation immunology
- AIDS and other immune deficiencies
- Immunodiagnostic techniques

Unit 3: Principles of biostatistics

- Principles, data representation and measures of central tendency and dispersion
- Normal, poisson and binomial distribution
- Test of significance,
- Analysis of variance

Unit 4: Design of statistical experiments and analysis of co-variance

- Basic principles of experimental design
- CRD, RBD, LSD, factorial experiments and Plackett-Burman design
- Chi-square
- Analysis of covariance
- Correlation and regression
- Application of biostatistics

BT 405: Practicals

1. Microbial diversity study: colonial, morphological, metabolic and physiological
2. Isolation of extremophiles
3. Preparation of standard solutions
4. Estimation of carbohydrate, proteins and lipids
5. Estimation of DNA and RNA
6. Conjugation
7. Phage titration and one step growth curve
8. Demonstration of HPLC, IC, AAS, voltameter, fermentor, biolog, ultrasonicator, flame photometer
9. Ultraviolet spectroscopy of protein
10. Absorption spectrum of prodigiosin
11. Chromatography and Electrophoresis: protein, carbohydrate, nucleic acid, amino acid, organic acid

BT 406: Practicals

1. Effect of water activity on microbes of different environment.
2. Evaluation of bacterial growth in liquid media and factors affecting growth.
3. Enzyme kinetic study of amylase
4. Enzyme assay: protease, lipase
5. Enzyme purification: ammonium sulphate method and dialysis
6. SDS PAGE
7. Single radial immunodiffusion
8. Double diffusion method of Ouchterlony
9. Immunoelectrophoresis
10. Estimation of antigen-antibody response
11. Electrophoretic separation of bovine protein
12. Agglutination reaction
13. Statistical analysis of data, S.D., significance test of the results obtained in each experiments.
14. Hypothesis testing : T- test, F- test, Chi-square test

Besides these practicals, other practicals of relevance shall be introduced as per the need.

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	Glover & 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: Biochemical Engineering and Bioinformatics

Unit 1: Fermentor design and mass transfer

- Fermentor designs: batch and continuous
- Measurement and control systems
- Mass transfer: oxygen transfer, determination of K_{La} and factors affecting K_{La} ,
- Heat transfer

Unit 2: Fermentation kinetics and control

- Kinetic models, utilization of fermentation input and growth
- Biosensors for monitoring and control
- Micro process based control systems and data analysis

Unit 3: Bioinformatics

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

Unit 4: Applications of bioinformatics

- Bioinformatics in genomics
- Human genome project
- Rational drug design
- Network bioinformatics

BT 408: Molecular Biology and Genetic Engineering

Unit 1: Concepts of molecular biology

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

Unit 2: Gene expression and regulation

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

Unit 3: Fundamentals of genetic engineering

- Enzymes involved in genetic engineering
- Extraction, purification, analysis and size fractionation of nucleic acid
- Blotting, PCR, electroporation, DNA sequencing and microarray techniques
- Synthesis of oligonucleotides and cDNA

Unit 4: Cloning and expression

- Cloning and expression vectors
- Characterization of cloned gene
- Expression of cloned genes
- Metagenomics
- Gene library
- Application and safety of rDNA technology

BT 409: Bioprocess Technology

Unit 1: Elements of bioprocess

- Screening for novel products
- Isolation, screening, strain improvement and maintenance of industrial cultures
- Media formulation and modification
- Mixed culture and mixed substrate

Unit 2: Upstream processing

- Solids and liquid handling, sterilization of media, air and reactors
- Inoculum development
- Aeration and agitation and maintenance of optimum fermentation condition

Unit 3: Downstream processing

- Characterization of products and by-products, flocculation and conditioning of broth
- Methods of cell separation, disruption, product recovery and purification
- Case studies: antibiotics, biopolymers

Unit 4: Scale-up of bioprocess

- Fundamentals of fermentation scale-up
- Scale-up steps, problems and monitoring mechanisms
- Scale-up of sterilization
- Scale-up of aeration and agitation
- Scale-up of inoculum

BT 410 E: Microbial Technology

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
- rDNA and nanobiotechnology

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

- Enzymes: protease, amylase, lipase
- Vitamins: B₂, B₁₂
- Amino acids: lysine, glutamic acid, tryptophan

Unit 4: Other microbial products

- Biopolymers and EPS
- Bioplastics
- Biosurfactants
- Steroid transformation
- Ergot alkaloids

BT 411: Practicals

1. Bioinformatics: data base exploration, BLAST, multiple sequence alignment, primer design, phylogenetic tree construction
2. Isolation, quantification and amplification of DNA, RNA and plasmids from prokaryotic and eukaryotic cells or tissues
3. RE digestion of plasmid and mapping
4. Transformation and cloning
5. DNA fingerprinting
6. Blotting experiment
7. Gene expression
8. Isolation of antibiotic resistance mutants and pigment variant mutants
9. Characterisation of mutants with altered pigmentation
10. Induction of mutant by radiation and chemicals
11. Selection for enrichment of auxotrophs by antibiotics
12. Oxygen transfer rate (OTR)
13. Determination of del factor

BT 412: Practicals

1. Strain improvement study
2. Study of rheological changes of broth due to fungal growth
3. Recovery and purification of fermentation products-enzymes, antibiotics, organic acids, alcohol, exopolysaccharide
4. Influence of medium composition
5. Immobilisation of cells and enzymes
6. Scale up from flask to lab fermentor
7. Solid state fermentation
8. Submerged fermentation

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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
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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

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From June 2011

Paper no.	Title	No. of Hours per Week				Course Credits
		Lecture	Others	Practicals	Total	
Semester 3						
BT 501	Food and Agriculture Biotechnology	3	1	-	4	4
BT 502	Environmental Biotechnology	3	1	-	4	4
BT 503	Biotechnology of Natural Resources	3	1	-	4	4
BT 504 E1	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: Food and Agriculture Biotechnology

Unit 1: Food and dairy microbiology

- Microbial production of SCP and mushroom
- Microbial production of SCO
- Microbial production of flavours and fragrances
- Probiotics and nutraceuticals
- Fermented dairy products and Fermented foods

Unit 2: Microbes in agriculture

- Biofertilizer, mycorrhizae
- Vermicomposting
- Biopesticides and bioinsecticides
- Integrated pest management

Unit 3: Agriculture biotechnology - I

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

Unit 4: Agriculture biotechnology - II

- Production of haploid plants
- Micropropagation, germ plasm conservation and cryopreservation
- Transgenic plants and its applications
- Transgenic plants as bioreactors
- Molecular-aided plant breeding

BT 502: Environmental Biotechnology

Unit 1: Environmental problems and monitoring

- Global environmental problems: global warming, acid rain, ozone depletion
- 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 and mechanism of biodegradation, detoxification and waste water treatment
- Biodegradation of detergent, pesticide, oil, surfactant, lignin, hydrocarbon and dyes

Unit 4: Waste treatment

- Stoichiometry for waste treatment processes
- Kinetics for waste treatment processes
- Biological methods of liquid waste treatment
- Biological methods for solid waste management
- Economics and special aspects of waste treatment

BT 503: Biotechnology of Natural Resources

Unit 1: Geomicrobiological processes

- Types of microbial activities influencing geological processes
- Molecular and non-molecular methods for studying geomicrobial process
- Biogeotechnology of MEOR

Unit 2: Microbiology of minerals

- Mechanisms of biogehydrotechnology of sulphidic minerals
- Methods of biogehydrotechnology
- Biobeneficiation
- Acid mine drainage formation and control

Unit 3: 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
- Modes of utilization of biomass

Unit 4: Biotechnology of the marine environment

- Introduction
- Products from marine environment
- Marine pollution and their microbial indicators
- Extremophilic products from marine environment

BT 504 E1: Tissue Culture and Pharmaceuticals Biotechnology

Unit 1: Animal tissue culture

- Primary culture and established cell line cultures
- Equipments 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, equipments, 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 vector's, 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
- Hemotopoietic 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. Microbial precipitation of metals
2. Biotransformation of metals
3. Phytoaccumulation of metals
4. Bioremediation of organic and inorganic pollutants
5. Physical characterisation of waste
6. Chemical characterisation of waste
7. Biological characterization: BOD
8. Biotreatment of domestic water
9. Analysis of drinking water by MTT and MFT
10. Biodegradation of hydrocarbon
11. Development of SCP
12. SCO production by yeast
13. Estimation of phosphatase and dehydrogenase activity of soil
14. Isolation and evaluation of probiotic culture
15. Production of Indian fermented foods
16. Production of bread and yoghurt

BT 506: Practicals

1. Biooxidation of ferrous
2. Biooxidation of sulphur in soil
3. Bioleaching study
4. Desulphurisation of fuel
5. Validation of instruments and lab material
6. Quality assurance
7. Development of economic media
8. Biocatalyst from marine microbes
9. Bioassay
10. Sterility testing
11. Microbial load determination
12. Microbial production of biogas
13. Development of biofertilizer and biopesticides
14. Plant tissue culture and micropropagations
15. Animal tissue culture

Besides these practical, other practical of relevance shall be introduced as per the need.

REFERENCES

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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
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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

- Atleast two seminars should be delivered during fourth semester.
- 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.

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.