

August 2008 Onwards

SCHEME OF EXAMINATION

&

SYLLABUS FOR M.Tech.

in

Biotechnology

Implemented from August 2008

UNIVERSITY SCHOOL OF BIOTECHNOLOGY

GGs INDRAPRASTHA UNIVERSITY

KASHMERE GATE

DELHI - 110 403

M.TECH. SYLLABUS

SCHEME OF EXAMINATION FOR M.TECH. (BIOTECHNOLOGY)

FIRST SEMESTER EXAMINATION (M.Tech)

Code No. Credits	L	T	
THEORY PAPERS			
BT-501 Advances in Agricultural Biotechnology	3	1	4
BT-503 Proteomics	3	1	4
BT-507 Genomics	3	1	4
BT-509 Seminars*	0	0	4
Elective Paper (any one)			
CT-513 Environmental Engineering and waste management	3	1	4
MS-101 Management Function and Organizational Behavior	4	0	4
TOTAL			20

NUES: Non University Examination Subject

SECOND SEMESTER EXAMINATION (M.Tech)

Code No. Credits	L	T/P	
THEORY PAPERS			
BT-502 Pharmaceutical Biotechnology	3	1	4
BT-506 Advances in Bioprocess Engineering	3	1	4
BT-512 Advanced Bioinformatics	3	1	4
BT-514 Term Paper			4
Elective Paper (any one)			
BT-504 Biodiversity and Biotechnology	3	1	4
CT-520 Design and Analysis of Bioreactors	3	1	4
MS-106 Marketing Research	4	0	4
TOTAL			20

THIRD SEMESTER EXAMINATION (M.Tech)

Code No. Credits	L	T/P	
BT- 601 Biotechnology in Health Care	3	1	4
BT-651 (Project work) : Seminar/oral presentation, mid term progrees report submission	0	0	16
TOTAL			20

FOURTH SEMESTER EXAMINATION (M.Tech)

Code No. Credits	L	T/P	
BT-652 (Dissertation) Presentation and Viva, Dissertation submission	0	0	20
TOTAL			20

Each student shall be allotted research project in the beginning of the 3rd semester and it shall be pursued all through the IIIrd and IVth semester. Mid term evaluation of the project will be done at the end of the 3rd semester through seminar/oral presentation and submission of progress report. This will carry 16 credits and shall be evaluated for 50 marks by external examiner and for 50 marks by internal examiner who would normally be the supervisor under whose guidance final dissertaion will be submitted.

Student will submit M.Tech dissertation at the end of IVth semester. Final evaluation of the dissertation will be done though presentation and viva voce. It will carry 20 credits and shall be evaluated for 50 marks by external examiner and 50 marks by internal examiner under whose guidance the dissertation has been submitted. Out of total 80 credits, one has to earn at least 75 credits to qualify for M.Tech degree, however the student is required to appear in all the courses.

FIRST SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-501 ADVANCES IN AGRICULTURAL BIOTECHNOLOGY

1. **Molecular breeding:** Concept and methodology of different types of molecular markers. Role of molecular markers in crop and farm animal improvement, conservation of biodiversity; marker assisted selection; QTL mapping. **(6)**
2. Molecular and biochemical basis of plant disease resistance, signaling pathways, protein kinases, virus induced gene silencing. **(5)**
3. Molecular basis of plant resistance to various abiotic stresses like drought, salinity, heavy metals, high temperature etc. **(5)**
4. **Genetic engineering of plants:** production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance; quality parameters: Modification of nitrogen fixing capabilities; gene pyramiding **(5)**
5. **Choloroplast genetic engineering:** Methodology, applications in herbicide resistance, production of biopharmaceuticals, edible vaccines, foreign gene expression, Limitations. **(5)**
6. Transgenic animals for better farming, whole genome cloning **(3)**
7. **Molecular farming:** Use of plants and animals for production of neutraceuticals, edible vaccines and other desired products **(4)**
8. **World Food Security:** Causes of food insecurity, social economic issues, ensuring food security **(3)**
9. **Plant Microbe interaction:** Host-pathogen interaction, host-symbiont interaction, host-*Agrobacterium* interaction. **(4)**

Text / Reference Books:

1. Agricultural Biotechnology by Arie Altman. *Marcel Dekker, Inc.* (2001).
2. Plants, Genes and Crop Biotechnology (2003) 2nd Edition by Chrispeels, M.J. & Sadava D.E. American Society of Plant Biologists, *Jones and Bartlett Publishers, USA.*
3. Biochemistry and Molecular Biology of Plants: Edited by Buchanan B.B., Grissem W, and Jones RL (2000), *American Society of Plant Biologists, USA.*
4. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews.

FIRST SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-503 PROTEOMICS

1. **Introduction:** The proteome and the Genome, life and death of a protein, protein a modular structure functional protein families, need for proteomics, scope of proteomics, challenges of proteomics. **(4)**
2. **Strategies for protein separation .** Two-dimensional polyacrylamide gel electrophoresis for proteome analysis Brief history of 2-DE, 2-DE with immobilized pH gradients, sample preparation, solubilization, Reduction, The first dimension: IEF with IPG, Equilibration between dimensions, The second dimension: SDS-PAGE, resolution, reproducibility of 2-DE, liquid chromatography in proteomics. **(6)**
3. **Detection of proteins in polyacrylamide gels and on electroblot membranes:** Organic dyes and silver stains, Reverse stains, Colloidal dispersion stains, organic fluorophore stains, metal chelate stains. **(3)**
4. **Image analysis of two-dimensional gels:** Data acquisition, digital image processing, Protein spot detection and quantitation, Gel matching, Data analysis, data presentation, data bases. **(3)**
5. **Protein modification in proteomics:** Introduction, phosphoproteins; glycoproteins, Ubiquitin etc. **(4)**
6. **Enhancing high-throughput proteome analysis:** the impact of stable isotope labeling: Sample preparation, two-dimensional gel separation and analysis, Mass spectrometry: protein identification using MS data, Mass spectrometry: protein identification using MS/MS data. **(5)**
7. **Protein chips and functional proteomics:** Introduction, different types of protein chips, detection and quantification of proteins bound to protein chips, emerging protein chips technologies. **(5)**
8. **Applications of Proteome analysis:** Mining proteomes, protein expression profile, identification of protein-protein interactions and protein complexes, mapping proteins complexes. **(6)**
9. **Recent advances in Proteomics.** **(4)**

Text / Reference Books:

1. Proteomics: From Protein Sequence to Function by S.R. Pennington and M.J. Dunn. *Viva Books Private Limited* (2001).
2. Introduction to Proteomics by Daniel C. Liebler. *Humana Press*.
3. Principle of Proteomics by R. M. Twyman. *BIOS Scientific Publishers* (2004)

FIRST SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-507 GENOMICS

1. **Introduction:** Features of prokaryotic, eukaryotic & organellar genomes, Genome sizes – C value paradox, Structural, Functional genomics. (5)
2. **DNA Sequencing:** Principles of DNA sequencing, Pyrosequencing, Automated DNA sequencing, Shotgun sequencing – contig assembly, High through put sequencing (5)
3. **Analysis of sequence data:** Analysis & Annotation – ORF, Exon – Intron boundaries, Other features of nucleic acid sequencing, Protein motifs & domains, Databanks, Sequence comparisons. (5)
4. **Analysis of Genetic Variation:** Nature of genetic variation Methods to study variation – RFLP, PCR based methods – SNP, Genome – wide comparisons. (5)
5. **Comparative Genomics:** Comparison of plant, animal, human, microbial and other genome projects, Synteny, Genome evolution, Genomics, assisted crop improvement (5)
6. **Analysis of Gene Expression:** Analysing transcription – Northern blot, RNase protection assay, Real Time-PCR, Primer extension analysis, SI-nuclease protection assay, Comparing transcriptomes- subtractive hybridization, differential display, SAGE, Microarrays (7)
7. **Genetics and Society:** Genetic diseases in humans and genetic counseling (4)
8. **Human Genome Project:** Genetic diseases in humans, Human Genome project, genetic counseling ling Genetics and society. (2)
9. **Recent advances in Genomics.** (2)

Text / Reference Books:

1. Handbook of Comparative Genomics: Principles and Methodology by Cecilia Saccone, Graziano Pesole. *Wiley-LISS Publication* (2003).
2. Comparative Genomics by Melody S. Clark. *Kluwer Academic Publishers* (2001).
3. Essentials of Genomics & Bioinformatics C.W. Sensen, *Wiley* (2003).
4. Discovering Genomics, Proteomics & Bioinfo, A.M. Campbell, *C.S.H. Press*, (2003)
5. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews.

FIRST SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

CT-513 ENVIRONMENTAL ENGINEERING AND WASTE MANAGEMENT

1. **Ecology and Environment:** Source of air, water and solid wastes.
2. **Air pollution:** Micrometeorology and dispersion of pollutants in environment. Fate of pollutants.
3. **Air pollution control technologies:** Centrifugal collectors, electrostatics precipitator, bag filter and wet scrubbers. Design and efficiencies. Combustion generated pollution, vehicle emission control. Case studies.
4. **Water pollution:** Water quality modeling for streams. Characterization of effluents, effluent standards.
5. **Treatment methods:** Primary methods; setting, pH control, chemical treatment. Secondary methods; Biological treatment, Tertiary treatments; like ozonization, disinfection, etc.
6. **Solid waste collection:** treatment and disposal. Waste recovery system.

Text/ References books:

1. L.Canter "Environment Impact Assessment", *McGraw Hill*.
2. E.P.Odum "Fundamentals of Ecology" *V.B.Saunders and Co.* 1974.
3. W.J.Weber "Physics-Chemical Process for water quality control, *Wiley-international* Ed.
4. L.L.Gaccio water and water population Handbook *Marcel Dekkar*, New York

FIRST SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	0	4	40

MS- 101 MANAGEMENT PROCESS & ORGANISATIONAL BEHAVIOUR

- 1. Introduction:** Meaning and Nature of Management, Management Approaches, Processes, Managerial Skills, Tasks and Responsibilities of a Professional Manager. (3)
- 2. Planning:** Need for Planning, Types and Processes of Planning, Management By Objectives. (3)
- 3. Organizational Structure:** Organizational Structure and Design. Fundamentals of Organizing. (3)
- 4. Managerial Decision Making and Controlling:** Types/Models of Decision Making problem solving techniques. Group Decision Making. Controlling: Process and Techniques. (4)
- 5. The Foundations of Organizational Behavior:** Introduction to Organizational Behavior. Today's Organization: Information Technology, Learning Organization. Contemporary Challenges: Diversity, Contingent Workforce, Work/Life Balance. (5)
- 6. Organizational Process:** Organizational Culture and Climate, Managerial Communication. Managerial Ethics. (6)
- 7. Micro Perspectives of Organizational Behavior:** Individual Determinants of Organizational Behavior: Perception, Learning, Personality, Attitudes and Values, Motivation, Job Anxiety and Stress. (8)
- 8. Macro Perspectives of Organizational Behavior:** Group Dynamics and Interpersonal Relations, Management of Organizational Conflicts, Management of Change, Leadership: Theories and Styles. (8)

Text/ References books:

1. Fundamental of Management, Robbins, S.P. & Decenzo, D (2002). *Pearson Education*.
2. Management, Stoner, et.al. (2002). *Prentice Hall of India*.
3. Organizational Behavior, Luthans, F (2004). *McGraw Hill*, International Edition.

SECOND SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-502 PHARMACEUTICAL BIOTECHNOLOGY

1. **Pharmaceuticals, biologicals and biopharmaceuticals:** An overview Pharmaceutical & Biopharmaceutical biotechnology, current status & future prospsects. Pharmaceuticals of animal origin, plant origin, and of microbial origin. (4)
2. **The drug development process:** Drug discovery, rational drug design. Delivery of biopharmaceuticals, Pre-clinical trials, and clinical trials. The role of regulatory authorities. (4)
3. **Biopharmaceuticals:** Description, pharmacology, formulation, pharmaceutical concern, clinical use recombinant vaccines, edible vaccines (4)
4. **Drug manufacturing process:** International pharmacopocia. Guide to good manufacturing practice. Manufacturing facility. Sources of pharmaceuticals, production of final product and analysis of final product. (4)
5. **Strategies in the search for new lead drugs/compounds:** Improvement of existing drugs. Pros & cons of therapeutic copies. Systematic screening, including high-throughput screening. Exploitation of biological information and planned research & rational al approach. (4)
6. **Natural products as pharmaceuticals and source of new lead structures:** Design of effective natural products based approach to drug discovery. Examples of natural products or analogs as pharmaceuticals. (4)
7. **Combinatorial chemistry:** Principles of combinatorial chemistry, synthetic methodology including solid phase synthesis. compound Library purification, & analytical tools in solid-phase synthesis. (4)
8. **Production and formulation of Biotech Compounds:** Cultivation, production and purification, downstream processing, Excipients, microbiological consideration, shelf life, Doses, Therapeutic response, Route of drug administration, Delivery system. (4)
9. **Proteins based drugs:** Source, structure, folding, stability, analytical technique, purification, characterization, therapeutic protein, pharmacokinetic and pharmacodynamics of peptides and proteins. Absorption, distribution, metabolism, elimination, protein binding. Protein engineering peptidomimetics. (4)
10. **Post production handling and delivery:** Preparation, storage, handling, administration, Rationale and basic principles, physiologic and mechanistic approaches, approaches using devices, molecular approaches. (4)

Text/ References books:

1. Biopharmaceuticals and industrial prospective. Gray Walsh & B. Murphy, *Kluwer publishers* (1999).
2. Biopharmaceuticals. Gray Walsh, *Wiley John & Sons, Inc.* (2003).
3. The practice of Medicinal chemistry. Camille G. Wermuth, Academic Press, (2003).
4. Pharmaceutical Biotechnology by Dann, J.A, Crommelin & Robert D., Sindelar, Oct. 2002, *Taylor & Francis.*

SECOND SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-506 **ADVANCES IN BIOPROCESS ENGINEERING**

1. **Unstructured Models:** Unstructured Models of growth, substrate utilization and product formation. Transient growth Kinetics. (5)
2. **Structured Models:** Structured kinetic Models of growth and product formation Compartment Models, Metabolic Models, Cybernetic Models. (5)
3. **Bioreactor Design and Analysis:** Ideal and Non-Ideal reactors, mixing and residence time distribution studies in a bioreactor. (5)
4. **Mass and heat transfer:** Modeling mass and heat transfer in complex systems (5)
5. **Reactors of specific applications:** Packed Bed, Bubble columns, fluidized bed and trickle bed bioreactors, Bioreactor design for animal cell culture, Bioreactor design for waste treatment. (5)
6. **Measurement and control of Bioprocess:** On and off-line sensors for a modern bioreactor, Analysis of cell and medium composition, Kinetic and stoichiometric measurements, Data analysis, Smoothing, interpolation, States and parameters of estimation. (5)
7. **Bioprocess control:** Process control, direct regulatory control, cascade control, advanced control strategies. (5)
8. **Optimizing recombinant protein production:** Analyzing plasmid instability and strategies to overcome them. Host and vector design for optimum expression. Feeding strategies pre and post induction. Case studies for understanding the bottlenecks in recombinant protein expression. (5)

Reference Text Books:

1. Biochemical Engineering Fundamentals 2nd edition *Bailey and Ollis*
2. Biotechnology (2nd edition) Vol 3 (Bioprocessing) and volume 4 (Measuring Modeling and control) Edited by Rehm and Reed).

SECOND SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT-504

BIODIVERSITY AND BIOTECHNOLOGY

- 1. Concept and Principles:** Origin of biodiversity/evolution, Definition of biodiversity, Types of biodiversity, Levels of biodiversity, Genetic resources, Conservation of biodiversity, endangered species, impact of pollution on biodiversity, loss of biodiversity. **(4)**
- 2. Conservation of Biodiversity:** Need for conservation of biodiversity, types of conservation, role of biotechnology in biodiversity conservation, in vitro conservation, application of in vitro conservation, limitation of in vitro conservation. **(5)**
- 3. Bio-diversity and Germplasm:** Germplasm conservation, classical and new approaches to conservation, collection and exchange of germ plasm, cryopreservation, stability of conserved gumplasm. **(4)**
- 4. Loss of Biodiversity:** Causes and consequences of biodiversity loss, habital loss and aleteration, Endangered species/exotic species, effect of pollutants on species loss, loss of genetic diversity. Preventing biodiversity loss. **(5)**
- 5. Management of Biodiversity:** Identifying land for Natural resources, managing wild life resources, Biodiversity in a changing world, Wealth of Nature. **(4)**
- 6. Tools to study bio-diversity:- DNA extraction** from difficult species and preserved specimens; **Screening methods:** Isozymes. RFLP analysis, DNA fingerprinting, PCR, RAPDs, AFLP, **DATA analysis:** measure of polymorphisms within and among populations, distance data, discrete data and Case studies. **(8)**
- 7. Economic importance of Biodiversity:** Bioprospecting of microbial, animal and plant biodiversity resources of India. **(4)**
- 8. Laws:** National Environmental policy act, Endangered Species Act. National Biodiversity Authority (NBDA), Plant Variety protection & Regulatory Authority (PVPRA) Internal, Laws and special problems in developing countries. **(6)**

Reference Books:-

1. Plant biotechnology and Biodiversity conservation by U. Kumar and A.K. Sharma published by *Agrobios* (India)
2. Conservation and biodiversity by Andrew Dobson, *palgrave macmillon*
3. Essentials of conservation Biology 3rd Edition by Riicherd B. Primack; Sinauer Associates, Inc. Publishers. W.K.
4. Life by Purves w.k; Sadava D., Orians, G.H.and Heller, H.C. published by Sinauer Associates Inc; & *W.K. Freeman and Company*.
5. Molecular tools for Screening Biodiversity Ed. Angela Karp, Peter G. Isaac and David S. Ingram published by *Chapman & Hall*.

THIRD SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

CT-520 DESIGN & ANALYSIS OF BIOLOGICAL REACTORS

1. **Ideal Bioreactors:** Fed-Batch Reactor, Enzyme-catalysed reactions in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug-flow tubular reactor.
2. **Reactor Dynamics:** Dynamics model, Stability
3. **Reactors with non-ideal mixing:** Mixing time in agitated tanks, Resident time distributions, Models for no-ideal reactors, Mixing-Bio reaction interactions.
4. **Sterilization Reactors:** Batch Sterilization, Continuous Sterilization
5. **Immobilized Bio Catalysts:** Formulation and characterization of immobilized cell bio catalysts, Application of immobilized cell bio catalysts
6. **Multiphase Bio reactors:** Conversion of heterogeneous substrates, Packed bed reactors, Bubble column Bio-reactors, Fluidised bed Bio-reactors, Trickle bed reactors
7. **Fermentation Technology:** Medium formulation, Design and operation of a typical aseptic, aerobic fermentation process, Alternate bio reactor configuration.
8. **Animal & Plant Cell Reactor Technology:** Environmental requirements for animal cell cultivation, Reactor for large-scale production using animal cells, Plant cell cultivation.

Text / Reference Books:

1. Biochemical Engineering Fundamentals by James E. Bailey & David F. Ollis, Publishers: *McGraw-Hill*.
2. Bioprocess Engineering by Shuler & Kargi, *Prentice Hall*
3. Encyclopedia of Chemical Engineering by Kirk & Othmer,

THIRD SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
4	0	4	40

MS-106 MARKETING MANAGEMENT

1. **Introduction to Marketing** : Meaning, Nature and Scope of Marketing; Marketing Philosophies; Marketing Management Process; Concept of Marketing Mix; Market Analysis: Consumer delivered value, relationship marketing Understanding Marketing Environment. **(5)**
2. **Market Segmentation, Targeting and Positioning**: Concept of market segmentation, basis of market segmentation, ways of market targeting, targeting invasion plan, positioning strategies. **(5)**
3. **Consumer and Organization Buyer Behavior**: Consumer decision making model, factors influencing consumer behavior, significance of these factors influencing behavior of consumers; model of buyer behavior and the factors influence the organizational behavior. **(5)**
4. **Demand measurement**: The Concept of consumer demand, deference between industry demand, market demand, company demand, methods of demand measurement and sales forecasting. **(5)**
5. **Product Planning and Pricing**: Product Concept; Types of Products; Major Product Decisions, Brand Management; Product Life Cycle, New Product Development Process. **(4)**
6. **Pricing Decisions**: Determinants of Price; Pricing Process, Policies and Strategies. **(3)**
7. **Promotion decisions**: Communication Process; Promotion Tools-Advertising, Personal Selling, Publicity and Sales Promotion. **(3)**
8. **Distribution decisions**: Distribution Channel Decisions-Types and Functions of Intermediaries, Selection and Management of Intermediaries. **(5)**
9. **Marketing Organization and Control**: Emerging Trends and Issues in Marketing –Consumerism, Rural Marketing, Social Marketing; Direct and Online Marketing; Green Marketing. **(5)**

Text / Reference Books:

1. Philip Kotler. Marketing Management: Analysis, Planning, Implementation & Control. *Prentice Hall of India* (2003).
2. Michael, J. E., Bruce, J. W. and Williom, J. S. (13rd Edition), Marketing Management. *Tata McGrawHill*, New Delhi, (2004).

THIRD SEMESTER EXAMINATION (M.Tech)

L	T	Credits	Hours
3	1	4	40

BT- 601 BIOTECHNOLOGY IN HEALTH CARE

1. **Therapeutic Aspects of Biomacromolecules:** Introduction, Endogenous peptides and proteins, Modification of endogenous peptides and proteins (4)
2. **Immune System:** Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer immunotherapy (4)
3. **Oligonucleotides:** Overview, Gene therapy, Antisense therapy, Ribozyme (4)
4. **Oligosaccharides:** Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer Vaccines (5)
5. **Radiological Agents:** Radiosensitizers and Radioprotective agents (3)
6. **Cardiovascular Drugs:** Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, antithrombotics and haemostatics (5)
7. **Chemotherapeutic Agents:** Synthetic antibacterial agents, antifungal, anti-protozoal, Antihelminthic agents Antiameobic agents, Antiviral agents (5)
8. **Endocrine Drugs:** Sex hormones and analogs, Agents affecting the immune response (5)
9. **Drug Targeting:** Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery. (5)

Text / Reference Books:

1. Pharmaceutical Chemistry by Christine M. Bladon. *John Wiley & Sons, Ltd.* (2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E. Wolff. *A Wiley & Sons, Inc.* (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. *Wiley-VCH.* (2002).