SCHEME

OF

STUDIES AND EXAMINATIONS

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M. Tech. 1st YEAR (SEMESTER – I) (BIOTECHNOLOGY)
Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Schedule			Marks of Class work	Examination Marks		Total	Credit	Duration of Exam
			L	P	Total		Theory	Practical			
1	BT501B	GENETIC ENGINEERING-II	4	-	4	25	75	-	100	4	3
2	BT503B	INDUSTRIAL BIOTECHNOLOGY- II	4	-	4	25	75	-	100	4	3
3	BT505B	ANIMAL CELL CULTURE TECHNOLOGY	4	-	4	25	75	-	100	4	3
4	BT507B	BIOANALYTICAL TECHNIQUES- II	3	-	3	25	75	-	100	3	3
5	BT	ELECTIVE-I	3	-	3	25	75	-	100	3	3
6	BT509B	GENETIC ENGINEERING- II LAB	-	4	4	20	-	30	50	2	3
7	BT511B	INDUSTRIAL BIOTECHNOLOGY- II LAB	-	4	4	20	-	30	50	2	3
8	BT513B	BIOANALYTICAL TECHNIQUES- II LAB	-	2	2	20	-	30	50	1	3
TOTAL			**18**	**10**	**28**	**185**	**375**	**90**	**650**	**23**	

ELECTIVE - I:

1. BT521B: METABOLIC ENGINEERING
2. BT523B: MEDICAL MICROBIOLOGY
3. BT525B: IPR AND BIOSAFETY ISSUES IN BIOTECHNOLOGY

NOTE:

1. **The students will be allowed to use non-programmable scientific calculator. However, sharing/ exchange of calculator is prohibited in the examination.**
2. **Electronic gadgets including cellular phones are not allowed in the examination.**
3. **The choice of students for any elective shall not be a binding on the department.**

DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONEPAT)
SCHEME OF STUDIES & EXAMINATIONS
M. Tech. 1st YEAR (SEMESTER – II) (BIOTECHNOLOGY)
Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Schedule	Marks of Classwork	Examination Marks	Total Credit	Duration of Exam	Examination Marks	Total Credit	Duration of Exam	Total Credit	Duration of

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T522B: BIONANOTECHNOLOGY

2. BT524B: FOODMICROBIOLOGY

3. BT526B: BIODIVERSITY AND BIORESOURCE TECHNOLOGY

NOTE:

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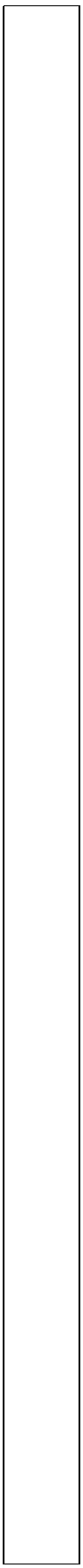

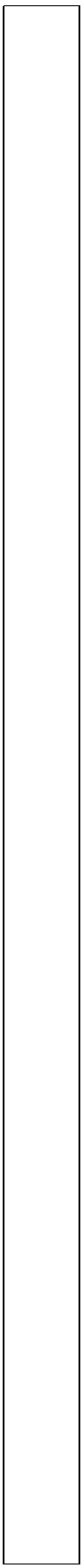

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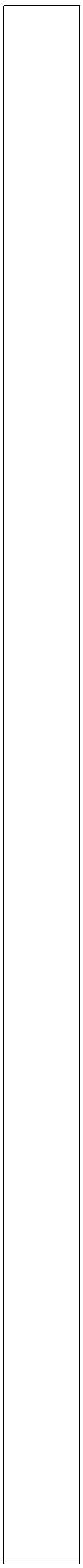

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SCHEME OF STUDIES

& EXAMINATIONS M. Tech. 2nd YEAR (SEMESTER – III) (BIOTECHNOLOGY) Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Schedule	Marks of Classwork	Examination

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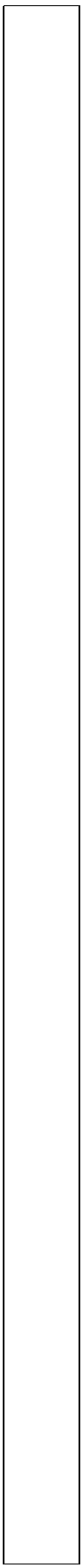

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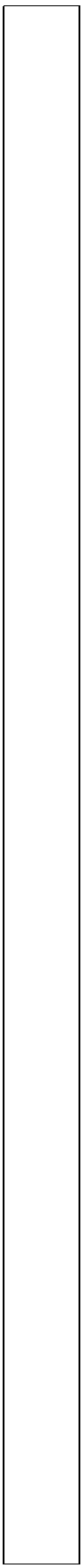

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SCHEME OF STUDIES & EXAMINATIONS M. Tech. 2nd YEAR (SEM

ESTER – IV) (BIOTECHNOLOGY) Credit Based Scheme w.e.f. 2012-13

S. No.	Course No.	Course Title	Teaching Schedule	Marks of Classwork	Examination Marks	Total Credit	Duration of Exam	Examination Marks

Total Credit Duration of Exam	Total Credit Duration of Exam	Credit Duration of Exam	Duration of Exam	L	P	T	otal	L	L	P	Total	Theory	Practical	L	P	P	Total	Total	Theory	Theory	Practical	Theory	Practical

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SYLLABUS

BT501B GENETIC ENGINEERING- II

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
4	--	4	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT-I: **Basic principles of Genetic Engineering:** Introduction, gene cloning- basic steps; tools and vehicles of genetic cloning- restriction enzymes, modifying enzymes, ligases, polymerases, linkers and adaptors; cloning vectors (in brief): plasmids, bacteriophages, cosmids and phasmids, artificial chromosomes as vectors.
Cloning, Recombinant Selection and Expression: Cloning strategy, construction of genomic and cDNA library, integration of DNA insert into the vector, introduction of the rDNA into host cells; recombinant selection and screening methods: genetic, immunochemical, nucleic acid hybridization, HRT and HART; expression strategies: principles in maximizing gene expression, expression in bacteria, yeast and mammalian cells.

UNIT-II: **Gene Transfer to Animal and Plant Cells:** Direct gene transfer methods, *Agrobacterium* mediated transfer, plant and animal viruses as vector systems, transgene expression, genetic manipulation of animals, animal cloning-a brief account.
Gene Targeting and Gene Inactivation: Gene targeting in animals and plants, targeted gene replacement, gene inactivation, gene silencing, antisense RNA technology.

UNIT-III: **Molecular probes, PCR and hybridization techniques:** DNA and RNA as probes, labeling (radioactive *vs* non-radioactive) and uses of probes, PCR: history and principle, modified PCR (inverse PCR, anchored PCR, PCR for mutagenesis, RT-PCR, asymmetric PCR), cloning of PCR products, hybridization techniques (Southern, Northern, and Western).

UNIT-IV: **Applications of Genetic Engineering:** Applications in research- in studying gene location, structure, expression and function, in studying regulation of gene expression; applications in producing industrially important molecules, improving agronomic traits by genetic modifications; using genetic modifications to study, prevent and cure diseases, applications in forensic science- DNA profiling and DNA fingerprinting.

TEXT/ REFERENCE BOOKS:

1. Primrose, S.B., and Twyman, R.M. Principles of Gene Manipulation and Genomics. 7th Edition, Blackwell Publishing (2001).
2. Old, R.W. and Primrose, S.B. Principles of Gene Manipulation- an introduction to genetic engineering. Blackwell Publishing.
3. Sambrook, J. and Russel, D.W. Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL. (2001).
4. Brown T.A. Genomes., 3rd ed. Garland Science. (2006).
5. Selected papers from scientific journals.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT503B INDUSTRIAL BIOTECHNOLOGY- II

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
4	--	4	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT-I: **Introduction and Basics of Industrial Microbiology**: Introduction, objectives and applications, cultivation & maintenance of microorganisms: different types of culture medium, C/ N/ P balance and design of culture medium, substrates for industrial microbial processes, industrially important microbes: isolation, preservation and improvement of industrially important microorganisms, selection of mutants, and use of recombinant DNA technology.

UNIT-II: **Production and Process Technology for Microbial Products**: Microbial growth kinetics, primary metabolite: ethanol, citric acid, vinegar and amino acid, production of alcoholic beverages-wine and beer, microbial production of industrial enzymes: amylase, cellulase, glucose isomerase and lipase, enzymes for the food industries.

UNIT-III: **Microbial Production of Secondary Metabolites:** Antibiotics eg. penicillin, tetracyclin; process technology for the production of microbial biomass: introduction, conventional protein sources, substrates, microorganisms used, SCP from CO_2, carbohydrates, hydrocarbons.

UNIT-IV: **Microbial Transformations & Heterologous Gene Expression:** Transformation of alkaloids, steroids, carotenoids and sterols, applications of microbes for designing vaccines and drugs, production of recombinant molecules in heterologous system, problems associated with strain improvement programme, improvement of characters other than products and its application in the industry.

Uses of Microbes in Industry and Medicine- Expression of foreign genes in bacteria and yeast, microbes as biosensors, microbial fuel cells, cancer therapy, biofertilizers, bioremediation, paper industry, biohydrometallurgy, biomineralization.

TEXT/ REFERENCE BOOKS:

1. Casida, L.E. Industrial Microbiology. New Age International (P) Ltd. New Delhi. (1998).
2. Prescott & Dunn, Industrial Microbiology. Ed. E.G. Reed. CBS Publishers, New Delhi. (1987).
3. Crueger, W. and Crueger, A. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Panima Publishing Corporation, New Delhi. (2000).
4. Palmer, T. Enzymes: Biochemistry, Biotechnology, Clinical chemistry. Horwood publishing Colphon. (2000).
5. Arnold L.D. and Julian E.D. Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. ASM Press Washington D.C. (1999).
6. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. Microbiology. Tata McGraw Hill, New Delhi. (1993).
7. Microbiology: Prescott et al., 5th edition, Mc Graw Hill, USA. (2003).
8. Brock, T.D. Biotechnology: A Text Book of Industrial Microbiology: Smaeur Associates. (1990).
9. Madigan M.T. and Martinko, J.M. Brock Biology of Microorganisms, 11th Edition, Pearson Prentice-Hall. (2006).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions

will carry equal marks.

BT505B ANIMAL CELL CULTURE TECHNOLGOY

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT –I: **Lab Equipment and Media of Animal cell culture:** Planning, construction and services, aseptic concepts, maintenance of sterility, cell culture vessels, common cell culture contaminants, cell culture media, serum free media, maintenance of the culture and cell lines, detection of contamination and laboratory management.

UNIT-II: **Different Types of Cell Cultures:** History of animal cell culture, types of primary culture, chicken embryo fibroblast culture, chicken liver and kidney culture, secondary culture, trypsinization, cell separation, continuous cell lines, suspension culture, monolayer culture etc., behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number, development of cell lines, characterization and maintenance of cell lines, cryopreservation of animal cell lines.

UNIT-III: **Characteristics of Animal Cells**: Metabolism, regulation and nutritional requirements for mass cultivation of animal cell cultures, kinetics of cell growth and product formation and effect of shear force, product and substrate transport, micro & macro-carrier culture, hybridoma technology, Cloning in animals, genetic engineering in animal cell culture.

UNIT-IV: **Cell Culture Technology:** integration of DNA into mammalian genome, viral vectors, shuttle vectors of other viruses, gene cloning methods in cell lines, stem cell culture, embryonic stem cells and their applications.

Tansgenics and Gene Therapy: Transgenics and gene knockout technology, objectives of gene transfer, vectors, gene constructs, promoters, transfection methods, embryonic stem cell transfer, targeted gene transfer, transgene integration, detection of transgenic and of trans gene function, transgenic animals produced, ethical issues related to transgenic animals, gene therapy.

TEXT / REFERENCE BOOKS:

1. Genes VIII by Benjamin Lewin, 2004
2. Gene transfer to animal cell by R.M. Twyman, 2005
3. Animal cloning by Joseph Pano, 2005
4. Analysis of gene and genome by Richard J. Reece, 2004
5. Animal Biotechnology M.M. Ranga, Agrobios Publishers, India, 2003
6. A Text book of Biotechnology, Dubaey, R. C. 1993, S. Chand & Co. New Delhi
7. Principles of Gene Manipulations: An Introduction to Genetic Engineering, Blackwell Sci. Publ.
8. Biotechnology, KalyaniPublishrs, New Delhi

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT507B BIOANALYTICAL TECHNIQUES- II

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
3	--	3	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT-I: **Cellular Imaging Techniques:** Microscopy- Light, electron (scanning & transmission), phase contrast, fluorescence microscopy, phase contrast, fluorescence, atomic force microscopy.

UNIT-II: **Applications of spectroscopy to the study of biomolecules:** UV-Vis spectroscopy, circular dichroism, fluorescence, NMR, mass, IR and Raman spectroscopy, X-Ray diffraction.

UNIT-III: **Biophysical techniques to purify and study proteins:** Dialysis, salting out and precipitaion by organic solvents, ion exchange, gel filtration, reverse phase, affinity chromatography, and ultracentrifugation.
Analysis of Proteins: Electrophoretic separation of proteins (single dimension native and denaturing gels, 2D and digital electrophoretic analysis), detection (staining, blotting and immuno-detection, ELISA, RIA) and purification of proteins by various chromatography, HPLC, immunoprecipitation.

UNIT-IV: **High resolution separation for value added biotechnological products:** Difficulties with traditional methodologies; affinity precipitation and partitioning, MF/UF/NF for high resolution separation, measurement of radioactivity, use of radioisotopes in research, *in vivo* and *in vitro* labeling techniques.

TEXT / REFERENCE BOOKS:

1. Campbell and Durek, Biological Spectroscopy.
2. D.Friefelder, Freeman W.H. Physical Biochemistry, 2nd edition, U.S.A.
3. Robert. D. Braun. Introduction to instrumental analysis. McGraw Hill International Edition, Chemistry Series. (1987).
4. Kenkel J. Analytical Chemistry for technicians. Lewis Publishers. Boca Raton. (1994).
5. Wilson K. and Walker J. Principles and techniques of Practical Biochemistry. Cambridge University Press, Cambridge. (1994).
6. Upadhyay A. Upadhyay K. and Nath N. Biophysical Chemistry: Principle and Techniques, 2nd edition. Himalaya Publication House.Delhi. (1998).
7. Vanholde K. E. Physical Biochemistry, 2nd edition. Prentice Hall Inc., New Jersey. (1985).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT509B GENETIC ENGINEERING- II LAB

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
--	4	2	**Class Work**	**:**	**20 Marks**
			Examination	**:**	**30 Marks**
			Total	**:**	**50 Marks**
			Duration of Examination	**:**	**3 Hours**

List of Experiments/ Exercises:

1. Isolation of plasmid and genomic DNA from bacteria.
2. Extraction of eukaryotic genomic DNA followed by agarose gel electrophoresis.
3. Restriction endonuclease profile analysis.
4. Extraction of genomic RNA from viral samples.
5. Polyacrylamide gel electrophoresis (PAGE) of DNA/ RNA.
6. Restriction endonuclease digestion of vector molecule followed by its dephosphorylation.
7. Construction of recombinant DNA and transformation of bacterial DNA with rDNA.
8. To perform polymerase chain reaction.
9. Cloning of PCR products followed by nucleic acid sequencing.
10. *Agrobacterium*- mediated transformation in plants.
11. RFLP/ RAPD analysis.
12. Southern hybridization/ Northern hybridization.

TEXT /REFERENCE BOOKS:

1. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
2. Sambrook J & Russel DW. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Lab. Press.
3. Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.
4. Specific journals and published references.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT501B (Genetic Engineering-II).

BT511B INDUSTRIAL BIOTECHNOLOGY- II LAB

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
--	4	2	**Class Work**	:	**20 Marks**
			Examination	:	**30 Marks**
			Total	:	**50 Marks**
			Duration of Examination	:	**3 Hours**

List of Experiments/ Exercises:

1. Different types of culture media used for microbial culturing.
2. Isolation, purification and preservation of industrially important microorganisms.
3. Production of microbial enzymes, viz., amylase, protease and lipase.
4. Creation and selection of mutants.
5. Ames test to test mutagenicity and carcinogenicity of a compound.
6. To check the antimicrobial activity of chemical compounds.
7. Recombinant DNA technology for the production of microbial products.
8. Production technology for Bt-based biopesticides.
9. Microbial production of antibiotics (penicillin, streptomycin etc).
10. Production technology of citric acid.

TEXT/ REFERENCE BOOKS:

1. Manual of Industrial Microbiology and Biotechnology: 2nd Edition, Denain Daeivs, J. E. A. S.M press (1999).
2. Microbiology Lab manual: 4th edition, Cappuccino, J. and Sherman, N. Addison Wesley, California. (2004).

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT503B (Industrial Biotechnology-II).

BT513B BIOANALYTICAL TECHNIQUES- II LAB

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
--	2	1	**Class Work**	:	**20 Marks**
			Examination	:	**30 Marks**
			Total	:	**50 Marks**
			Duration of Examination	:	**3 Hours**

List of Experiments/ Exercises:

1. Verification of Beer Lambert Law.
2. Separation of aminoacids/ sugars by paper chromatography.
3. Extraction of lipids from tissues and their separations by using TLC.
4. Isolation of chloroplasts from plant leaves.
5. To fractionate leaf cell by differential centrifugation technique.
6. To purify lysosomes by sucrose density gradient centrifugation.
7. Extraction and purification of proteins.
8. Gel electrophoretic separation of proteins/DNA.
9. Separation of proteins by SDS-PAGE.
10. Study the enzyme linked immunosorbent assays (ELISA) and conduct suitable practical.

TEXT/ REFERENCE BOOKS:

1. Principles & Techniques of Practical Biochemistry, ed. K. Wilson & J. Walker. Cambridge University Press, Cambridge. (1994).
2. Introductory Practical Biochemistry, ed., S.K. Sawhney & Randhir Singh. Narosa Publishing House, New Delhi. (2000).
3. An introduction to Practical Biochemistry by David T. Plummer. McGraw Hill, Book Company. U.K. (1998).

Note: T*he students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT507B (Bioanalytical Techniques-II).*

BT521B METABOLIC ENGINEERING
M. Tech. Semester - I (Biotechnology)

L	P	Credits			
3	--	3	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Introduction:** Identification of metabolic regulation, basic concepts of metabolic engineering-overview of cellular metabolism, different models for cellular reactions, feedback regulation, synthesis of primary metabolites, amino acid synthesis pathways and its regulation at enzyme level and whole cell level, alteration of feedback regulation, limiting accumulation of end products.

UNIT-II: **Biosynthesis of Secondary Metabolites:** Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, catabolite regulation by passing control of secondary metabolism, producers and applications of secondary metabolites, bioconversions-an introduction.

UNIT-III: **Regulation of Enzyme Production:** Strain selection, genetic improvement of strains, metabolic pathway manipulations to improve fermentation, catabolite repression, optimization and control of metabolic activities, modification of existing – or the introduction of entirely new metabolic pathways, metabolic flux – distribution, analysis and applications.

UNIT-IV: **Applications of Metabolic Engineering:** Application in pharmaceuticals, chemical bioprocesses, food technology, agriculture, environmental bioremediation and biomass conversion.

Metabolic engineering with Bioinformatics: Metabolic pathway modeling, analysis of metabolic control and the structure metabolic networks, metabolic pathway synthesis algorithms.

TEXT / REFERENCE BOOKS:

1. Wang, D.I.C., Cooney C.L., Demain A.L., Dunnil, P., Humphrey, A.E. and Lilly M.D. Fermentation and Enzyme Technology. John Wiley and Sons. 1980.
2. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Specific journals and published references.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT523B MEDICAL MICROBIOLOGY

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
3	--	3	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT-I: **Microbial Pathogenesis:** Classification of medically important micro organisms; normal microbial flora of human body; role of the resident flora; normal flora and the human host. establishment, spreading, tissue damage and anti-phagocytic factors; mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiritory, enteric and urogenital tracts, role of aggressins, depolymerising enzymes, organotropisms, variation and virulence, organs and cells involved immune system and immune response.

UNIT-II: **Microbial Diseases Caused by Bacteria:** Medically important pathogenic bacteria: S*taphylococcus, Streptococcus, Clostridium, Enterobacteriacea, Haemophilus, Mycobacteria, Spirochaetes,* a detailed account of pathogenesis, virulence & treatment.

UNIT-III: **Microbial Diseases Caused by Viruses:** Medically important pathogenic viruses- Orthomyxoviruses, Paramyxoviruses, Hepatitisviruses, Oncogenicviruses, HIV viruses, a detailed account of pathogenesis, virulence & treatment.

UNIT-IV: **Microbial Diseases Caused by Fungi:** Medically important pathogenic fungi- dermatophytic & dimorphic fungi, opportunistic fungal pathogens, a detailed account of pathogenesis, virulence & treatment. Anti-bacterial chemotherapy using various inhibitors, anti-viral & anti-fungal chemotherapy, drug resistance.

TEXT / REFERENCE BOOKS:

1. Ananthanarayanan, R. and Jayaram Panicker C.K. Text of Microbiology, Orient Longman. (1997).
2. Mackie and McCartney, Medical Microbiology Vol.1: Microbial Infection Vol.2: Practical Medical Microbiology Churchill Livingstone. (1996).
3. Shanson D.C., Microbiology in Clinical Practice. Wright PSG. (1982).
4. Baron E.J., Peterson L.R. and Finegold S.M. Mos, Bailey and Scott′s Diagnostic Microbiology. (1990).
5. Jawetz *et. al.* Medical Microbiology.
6. Davis Harper, Microbiology, Row publisher.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT525B IPR AND BIOSAFETY ISSUES IN BIOTECHNOLOGY

M. Tech. Semester - I (Biotechnology)

L	P	Credits			
3	--	3	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Introduction To Intellectual Property:** Types of IP- Patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs, International framework for the protection of IP, IP as a factor in R&D, IPs of relevance to Biotechnology and few case studies, introduction to history of GATT, WTO, WIPO and TRIPS.

UNIT-II: **Concept of 'Prior Art':** Invention in context of "prior art", patent databases, searching international databases, country-wise patent searches (USPTO, EPO, India etc.), analysis and report formation. **Basics of Patents:** Types of patents, Indian Patent Act 1970, recent amendments, filing of a patent application, precautions before patenting- disclosure/non-disclosure, WIPO Treaties, Budapest Treaty, PCT and implications, role of a country patent office, procedure for filing a PCT application.

UNIT-III: **Patent filing and Infringement:** Patent application- forms and guidelines, fee structure, time frames, types of patent applications- provisional and complete specifications, PCT and convention patent applications, International patenting- requirement, procedures and costs, publication of patents-gazette of India, status in Europe and US, patenting by research students, lecturers and scientists (University/organizational), rules in India and abroad, credit sharing by workers, financial incentives, patent infringement.

UNIT-IV: **Biosafety:** Introduction, historical backround, 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, RCGM, GEAC etc. for GMO applications in food and agriculture, environmental release of GMOs, risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant International agreements including Cartagena Protocol.

TEXT / REFERENCE BOOKS:

1. Thomas, J.A. and Fuch, R.L. Biotechnology and Safety Assessment. Academic Press. (2002).
2. Sateesh, M.K. Bioethics & Biosaftey, IK Publishers. (2008).
3. Sasson A. Biotechnologies in developing countries, UNESCO Publishers, (1993).
4. Singh K., Intellectual Property Rights on Biotechnology BCIL, New Delhi. (2008).

Important Links

- http://www.wipo.int/portal/index.html.en
- http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
- www.patentoffice.nic.in
- http://www.cbd.int/biosafety/background.shtml

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit.

All questions will carry equal marks.

BT502B ENZYMOLOGY AND ENZYME TECHNOLOGY- II

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Introduction to Enzymes:** History, nomenclature and classification of enzymes, isoenzymes, enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apo-enzyme, units of enzyme activity (definition of IU, Katal), specific activity of enzyme, measurement of enzyme activity, enzyme turnover, ribozymes and abzymes– a brief account.

UNIT-II: **Enzyme Catalysis:** Role of enzymes in energy of activation, factors of affecting action of enzymes- proximity and orientation, strain and distortion, acid base catalysis and covalent catalysis, determination of active site, mechanism of action of chymotrypsin, ribonuclease, carboxypeptidase and lysozyme.
Strategies for Enzyme Production, Isolation and Purification: method of calculating the purification fold, estimation of enzyme activity, characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight and the number of sub-units of an enzyme, enzyme immobilization, protein engineering, enzyme reactors.

UNIT-III: **Enzyme Kinetics:** Enzyme kinetics and its importance, methods used for investigating the kinetics of enzyme catalyzed reactions, factors affecting the velocity of enzyme catalysed reaction, Michaelis-Menten equation, Vmax, Km and its significance, Lineweaver Burk plot- its advantages and limitations, Eadie- Hofstee and Hanes plots, enzyme inhibition, types of enzyme inhibitions- competitive, uncompetitive, noncompetitive, mixed type inhibition and determination of Ki, feedback inhibition, Bisubstrate reactions- brief introduction to sequential and ping -pong mechanism with examples.

UNIT-IV: **Applications of Enzymes and Immobilized Enzymes in:** medicine, textile, leather, detergent, paper, bakery, dairy industry, beverage and fruit processing, food processing and preservation, clinical applications of enzyme estimation, enzymes as biosensors.

TEXT / REFERENCE BOOKS:

1. Nature of Enzymology By RL Foster.
2. A textbook of enzyme biotechnology By Alan Wiseman.
3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry By Trevor Palmer.
4. Enzymes: By M Dixon and EC Webb. EC Longmans, London.
5. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (Paperback) By Nicholas C. Price and Lewis Stevens. Oxford University Press.
6. Advances in Enzymology: V. 47 (Hardcover) By Alton Meister. John Wiley and Sons Inc.
7. Lehninger Principles of Biochemistry 4th EdBy David L. Nelson and Michael M. Cox,WH Freeman and Company.
8. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) By D Voet. John Wiley and Sons.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT504B GENOMICS AND PROTEOMICS- II
M. Tech. Semester - II (Biotechnology)

L	P	Credits			
4	--	4	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT-I: **Genome organization and mapping:** Structural organization of prokaryotic, eukaryotic and organellar genomes; genome content- gene distribution and arrangement in prokaryotes and eukaryotes; mapping genomes- genetic and physical mapping, molecular markers for construction of maps, restriction mapping, FISH, STS mapping.

UNIT-II: **Genome sequencing, analysis and annotation**: Sequencing principle and techniques: automated, whole genome, and shotgun sequencing, clone-contig assembly, human genome sequencing project; analysis of sequence data- finding gene location, recognition of coding and non-coding sequences, analysis of genetic variation, determination of functions of individual genes, genome sequence annotation.
Transcriptomics Studying transcriptome by sequence analysis, SAGE, parallel signature sequencing, studying transcriptome by microarray analysis, mRNA profiling;

UNIT-III: **Protein Expression Analysis:** Protein analysis: protein profiling- 2-D separation of total cellular proteins, isolation and sequence analysis of individual protein spots, MALDI-TOF for protein identification, protein characterization by mass spectrometry, protein expression analysis using microarrays.
Structural and Functional Proteomics: Structural analysis of proteins- X-ray crystallography and NMR spectroscopy; protein-protein interactions- phage display, yeast two-hybrid system; analysis of protein complexes- affinity purification and mass spectrometry, metabolomics and systems biology.

UNIT-IV: **Applications of genomics and proteomics:** in research, human health care, and in agriculture, pharmacogenomics, high throughput screening in genome for drug discovery and identification of gene targets, comparative genomics, future perspectives and developments.

TEXT / REFERENCE BOOKS:

1. Brown TA, Genomes, 3rd Edition. Garland Science Pub (2006).
2. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Pearson Education (2007).
3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell (2006).
4. Gibson G and Muse SU, A Primer of Genome Science, Sinauer Associates. (2004).
5. Sensen CW, Handbook of Genome Research, Vol. I and II. Wiley CVH. (2005).
6. Pennington SR and Dunn MJA, Proteomics: From Protein Sequence to Function by *Viva Books Private Limited* (2001).
7. Daniel C. Liebler, Introduction to Proteomics. *Humana Press*.
8. Twyman RM, Principle of Proteomics. *BIOS Scientific Publishers.* (2004).
9. Kamp RM, Methods in Proteome and Proteome Analysis. Springer. (2004).
10. Jolles P and Jornvall H, Proteomics in Functional Genomics: Protein Structure Analysis. Birkhauser (2000).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT506B BIOTECHNOLOGY IN HEALTHCARE

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT–I: **Biology of Infectious diseases:** Disease Burden- medically important diseases caused by bacteria, viruses, fungi and parasites, studies of some representative diseases like AIDS, typhoid, tuberculosis, cancer, hepatitis, influenza and dermatophytic diseases.

UNIT–II: **Immune system and Immune Response:** Immune system- overview, humoral and cell mediated immune responses, antigen & antibodies, structure & function transplantation, hypersensitivity, cancer, & autoimmunity.

UNIT–III: **Therapeutics:** Oligonucleotides- gene therapy, antisense therapy, ribozyme, oligosaccharides- glycoproteins, polysaccharides, bacterial vaccines, carbohydrate- based cancer vaccines, oligopeptides- endogeneous peptides and proteins with modifications. radiological agents- radiosensitizers and radioprotective agents, Drug targeting- basic concepts & novel advances

UNIT–IV: **Recent developments in genomics and pharmaceutical sciences:** Sequencing of human genome, brief account of repetitive sequences present in human genome, human genome project, latest developments in human genetics. Chemotherapeutic agents- synthetic antibacterial agents, antifungal, anti- protozoal, antiviral agents, endocrine drugs- sex hormones and analogs, agents affecting the immune response, cardiovascular drugs- hematopoietic agents, anticoagulants, antithrombotics etc.,

TEXT / REFERENCE BOOKS:

1. Christine M. and Bladon John Pharmaceutical Chemistry. Wiley & Sons, Ltd. (2002).
2. Manfred E.,Wolff. Burger′s Medicinal Chemistry and Drug Discovery (5th edition). A Wiley Sons, Inc. (2000).
3. Gritje Molema and Dirk K. F. Meijer. Drug Targeting Organ-Specific Strategies. Wiley (2002).
4. Ananthanarayanan R. and Jayaram C.K. Panuker Textbook of Microbiology R, Drient Longman.
5. Immunology by kuby JWH Freeman and company, New York.
6. Jawetz. Review of Medical Microbiology.
7. Specific Journals and published references.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT508B BIOINFORMATICS- II

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
3	--	3	**Class Work**	:	**25 Marks**
			Examination	:	**75 Marks**
			Total	:	**100 Marks**
			Duration of Examination	:	**3 Hours**

UNIT–I: **Introduction:** Introduction to bioinformatics, **Sequence Analysis:** File formats for bio-molecular sequences- GenBank, FASTA, GCG, MSF etc., sequence similarity, identity and homology, homologues, orthologues, paralogues and xenologues.
Scoring Matrices and Database searches: Matrices for nucleic acid and protein sequences, PAM and BLOSUM series; Keyword-based Entrez and SRS, sequence-based- BLAST & FASTA, their use in sequence analysis, on-line use of these tools and interpretation of results from various sequences.

UNIT–II: **Pairwise and Multiple Sequence Alignments:** Needleman and Wunsch, Smith and Waterman algorithms, gap penalties, use of pairwise alignments for analysis of nucleic acid and protein sequences; various approaches for MSA (progressive, hierarchical etc.), CLUSTALW and PileUp algorithm, their application in sequence analysis, dendrograms.
Sequence Patterns and Profiles: Sequence patterns, motifs and profiles, pattern representations *viz.* consensus, regular expression (Prosite-type) and sequence profiles, profile-based database searches using PSI-BLAST, analysis and interpretation of profile-based searches.

UNIT–III: **Taxonomy and Phylogeny:** Basic concepts in systematics, taxonomy and phylogeny, molecular evolution, nature of data used in taxonomy and phylogeny, phylogenetic trees- various types and their construction, mathematical basis for phylogenetics, genetic algorithms, multiple alignment.
Phylogenetic Analysis– building the data model, extraction of a phylogenetic data set, tree building methods, distance methods, character based method, phylogenetic software- gene prediction methods, genome analysis and annotation, large–scale genome analysis and computational tools.

UNIT–IV: **Protein and nucleic acid properties:** Computation of parameters using proteomic tools at the ExPASy server, GCG utilities and EMBOSS; secondary structure prediction- **a**lgorithms viz. Chou Fasman, GOR methods, Mathew′s correlation coefficient; **t**ertiary structure prediction- methods for 3D structure prediction (sequence similarity/ identity of target proteins, protein folding etc.), homology modeling, fold recognition, threading approaches, ab-initio structure prediction methods.
Drug Designing: Fundamentals of docking small and macromolecules to proteins and nucleic acids, Bioinformatics in drug designing- drug discovery cycle, physicochemical principles of drug action, lead discovery, lead modification, optimization, docking– docking algorithms, structure based drug design- rational design, pharmacophores, QSAR, ADME/T, drug delivery.

TEXT / REFERENCE BOOKS:

1. Pennington SR, Dunn MJ, "Proteomics from Protein Sequence to Function", Viva Books Ltd, 2002
2. David W Mount, "Bioinformatics: Sequen
3. Leach A.R. , "Molecular Modelling - Principles and Applications", 2nd Edition, Prentice Hall, 2001.
4. Prasad R.K., "Quantum Chemistry", Halsted Press, 1992.
5. Ramachandran K. I., Deepa G., Namboori K., "Computational Chemistry and Molecular Modeling: Principles and Applications", Springer, 2008.
6. Young, D.C., "Computational Chemistry: A Practical Guide for Applying Techniques to Real-World Problems", Wiley-Interscience, 2001.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT510B ENZYMOLOGY AND ENZYME TECHNOLOGY- II LAB

M. Tech. Semester – II (Biotechnology)

L	P	Credits			
--	4	2	**Class Work**	:	**20 Marks**
			Examination	:	**30 Marks**
			Total	:	**50 Marks**
			Duration of Examination	:	**3 Hours**

List of Experiments/ Exercises:

1. Assay of enzyme catalysed reaction.
2. To study time course of the reaction catalyzed by alkaline phosphatase.
3. To examine the effect of enzyme concentration on the rate of an enzyme catalyzed reaction.
4. To determine temperature optima for alkaline phosphatase.
5. To examine the effect of pH on activity of alkaline phosphatase.
6. To study the effect of substrate concentration on activity of alkaline phosphatase and determine Km and Vmax of the reaction.
7. Demonstration of enzyme immobilization
8. Partial purification of an enzyme by ammonium sulphate fractionation
9. Concentration of a protein sample by lyophilisation
10. Sub -cellular fractionation of organelles from liver cells/plant tissue

TEXT /REFERENCE BOOKS:

1. Principles & Techniques of Practical Biochemistry, ed. K. Wilson & J. Walker, 1994, Cambridge University Press, Cambridge.
2. Introductory Practical Biochemistry, ed., S.K. Sawhney & Randhir Singh, 2000, Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw Hill, Book Company. U.K.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT502B (Enzymology and Enzyme Technology-II).

BT512B BIOTECHNOLOGY IN HEALTHCARE LAB

M. Tech. Semester – II (Biotechnology)

L	P	Credits			
--	4	2	**Class Work**	:	**20 Marks**
			Examination	:	**30 Marks**
			Total	:	**50 Marks**
			Duration of Examination	:	**3 Hours**

List of Experiments/ Exercises:

1. To perform single radial immunodiffusion test for disease diagnosis.
2. To perform double immunodiffusion test for immunodiagnosis.
3. To perform different types of ELISA.
4. To detect antigen or antibody by latex agglutination method.
5. To isolate B and T lymphocytes from blood.
6. To study the biochemical profile of pathogenic bacteria by IMVIC test.
7. To distinguish between given bacterial pathogens on the basis of catalase activity.
8. To study the carbohydrate fermentation patterns of the pathogenic microbes.
9. To perform Triple-Sugar-Iron Agar test to characterize the pathogenic microorganisms.
10. To determine the ability of microorganisms to produce urease.

TEXT /REFERENCE BOOKS:

1. Kuby′s Immunology (4th edition) R. A. Goldsby, T. J. Kindt, B. A. Osborne, J.W.H. Freeman & company, New York.
2. Talwar, G.P. Practical Immunology. Volume 1&2.
3. Cappucino. Laboratory Manual in Microbiology.
4. Specific journals and published references.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT506B (Biotechnology in Healthcare).

BT514B BIOINFORMATICS- II LAB

M. Tech. Semester – II (BIOTECHNOLOGY)

L	P	Credits			
--	2	1	**Class Work**	:	**20 Marks**
			Examination	:	**30 Marks**
			Total	:	**50 Marks**
			Duration of Examination	:	**3 Hours**

List of Experiments/ Exercises:

1. Retrieval of sequences from NCBI, DDBJ.
2. ORF Finder.
3. Retrieval of structures from PDB.
4. Rasmol, Pymol, Jmol.
5. KEGG, OMIM.
6. Sequence analysis by online tools: BLAST, FASTA, CLUSTALW, PHYLIP etc.
7. Construction of molecules.
8. Secondary structure prediction.
9. Molecular visualization – JMOL, VMD.
10. Homology modelling – Insight II, Modeller.
11. Docking- Autodock, Discovery Studio, Schrodinger.
12. Molecular dynamics – AMBER.

TEXT /REFERENCE BOOKS:

1. Pennington SR, Dunn MJ, "Proteomics from Protein Sequence to Function", Viva Books Ltd, 2002
2. David W Mount, "Bioinformatics: Sequen
3. Leach A.R. , "Molecular Modelling - Principles and Applications", 2nd Edition, Prentice Hall, 2001.
4. Prasad R.K., "Quantum Chemistry", Halsted Press, 1992.
5. Ramachandran K. I., Deepa G., Namboori K., "Computational Chemistry and Molecular Modeling: Principles and Applications", Springer, 2008.

Note: The students will be required to perform 08 experiments/ exercises from the above list and the other two experiments may be designed by the department based on the theory courses: BT508B (Bioinformatics-II).

BT522B BIONANOTECHNOLOGY

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
3	--	3	Class Work	:	25 Marks
			Examination	:	50 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Introduction to Nanoscience and Nanotechnology:** History of nanoscience and technology; nanomaterials- structural, chemical and physical properties; mechanical, optical and electrical behaviour of nano structures.

Nanofabrication and Nanosynthesis: Synthesis techniques- gas phase synthesis, controlled flame synthesis, liquid phase synthesis, mechanical synthesis, other related methods; nanolithography; nanocoating, biological production of nanoparticles- fungi, bacteria, yeast and actinomycetes.

UNIT-III: **Nanostructures and Nanomaterials:** Introduction; fullerenes; carbon nanotubes; quantum nanodots; nanorods; nanocomposites; polymeric nanomaterials; bionanostructures: protein-based nanostructures, DNA-based nanostructures, DNA-protein nanostructures, DNA gold nanoparticle conjugates, DNA-templated electronics.

UNIT-III: **Instrumentation techniques for Nanotechnology:** Low energy electron diffraction (LEED), scanning probe microscopy, SEM, TEM, XRD (Powder/ Single/ Crystal), atomic force microscopy (AFM), scanning tunneling microscopy (STM), various forms of spectroscopy for the analysis of biological systems, nuclear magnetic resonance (NMR).

UNIT-IV: **Applications of Bionanotechnology:** Nanomedicine- therapeutic nanodevices; nanoparticles- for disease diagnosis, for drug solubilization and delivery; nanoparticles as biosensors, biochips; use of nanoparticles- as molecular imaging probes, as non-viral transfection agents; nanoparticles for cleaning environment, particularly heavy metal bioremediation and for enhanced oil-recovery; .

TEXT / REFERENCE BOOKS:

1. Goodsell, David S. Bionanotechnology- Lessons from Nature. John Wiley & Sons, INC., Publication. (2004).
2. Niemeyer C.M. and Mirkin, C.A. Nanobiotechnology- Concepts, Applications and Prespectives, Wiley-VCH Verlag. (2004).
3. Avouris, P., Klitzing, K. Von, Sakaki, H. and Wiesendanger, R. NanoScience and Technology Series. Springer. (2003).
4. Bauerlein, E. Biomineralization- From Biology to Biotechnology and Medical Applications. Wiley-VCH Verlag. (2000).
5. Cao, G. Nanostructures and Nanomaterials. Imperial College Press. (2004).
6. Bhushan, Bharat. Handbook of Nanotechnology. Springer. (2004).
7. Kohler, M., Fritzsche, W. Nanotechnology-An Introduction to nanostructuring Techniques. Wiley-VCH Verlag. (2005).
8. Scherge, M. and Gorb, S.N. Biological Micro- and Nanotribology- Natures solution, Springer. (2003).
9. Schmid, G., Nanoparticles- From Theory to Applications. Wiley-VCH Verlag. (2004).
10. Lyshevski, Sergey Edward. Nano- and Microscience, Engineering, Technology, and Medicine Series. CRC press. (2001).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT524B FOOD MICROBIOLOGY

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
3	--	3	Class Work	:	25 Marks
			Examination	:	50 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Historical Background**: Historical developments and history of microorganisms in food, role and significance of microorganisms in foods, intrinsic and extrinsic factors of food that affect microbial growth.
Microbiology of Foods: Microorganisms in fresh meats and poultry, processed meats, seafoods, fermented and fermented dairy products and miscellaneous food products.

UNIT-II: **Genetics of Starter Cultures:** cultures for cheeses, beer, wine and distilled spirits, SCP, medical foods, recent trends in starter culture technology.
Concept of Probiotic and Prebiotic: Characteristics needed for probiotic cultures and potential health benefits of fermented food products, nutritional importance of prebiotics.

UNIT-III: **Brewing, malting, mashing, hops, primary & secondary fermentation:** Biotechnological improvements, high gravity brewing, beer, wine and distilled spirits.
Nutritional Boosts and Flavor Enhancers: Emerging processing and preservation technologies for milk and dairy products.
Innovative Molecular Techniques in Foods: Air sampling, metabolically injured organisms, enumeration and detection of food-borne organisms, bioassay and related methods, enzymatic and DNA methods to study food adulteration.

UNIT-IV: **Food Preservation, storage and Stablity:** Food preservation using irradiation, characteristics of radiations of interest in food preservation, principles underlying the destruction of microorganisms by irradiation, processing of foods for irradiation, applications of radiations, effect of irradiation of food constituents. indicator and food-borne pathogens
Psychrotrophs, Thermophiles and Radiation-Resistant Microorganisms: Characteristics and growth of thermophilic microorganisms, nature of radiation resistance in microorganisms. Consumer perspective and future of food biotechnology**.**

TEXT / REFERENCE BOOKS:

1. James M. Jay, Modern Food Micro-Biology, 6th edition, An Aspen Publication, Maryland, USA (2000).
2. Doyle, M.P., Beuchat, L.R., and Montville, J.T., Food Microbiology: Fundamentals and frontiers, 2nd edition, ASM press, USA (2001).
3. Lopez, G.F.G. & Canovas, G.V.B. Food Science and Food Biotechnology. CRC Press, Florida, USA (2003).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT526B BIODIVERSITY AND BIORESOURCE TECHNOLOGY

M. Tech. Semester - II (Biotechnology)

L	P	Credits			
3	--	3	Class Work	:	25 Marks
			Examination	:	50 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Concept and Principles:** Genetic diversity, molecular taxonomy, species and population biodiversity, 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.

UNIT-II: **Biodiversity Loss:** Causes and consequences of biodiversity loss, habitual loss and alteration, endangered species/ exotic species, preventing biodiversity loss, conservation of biodiversity- **n**eed and types, role of biotechnology in biodiversity conservation, *in vitro* conservation.
Biodiversity Management: Identifying land for natural resources, managing wild life resources, **b**iodiversity and germplasm- **g**ermplasm conservation, classical and new approaches, collection and exchange of germplasm, cryopreservation, stability of conserved germplasm.

UNIT-III: **Tools to Study Biodiversity:** DNA extraction from different species and preserved specimens, screening methods- **i**sozymes, RFLP analysis, DNA fingerprinting, PCR, RAPDs, AFLP, data analysis-measure of polymorphisms within and among populations, bioprospecting of microbial, animal and plant biodiversity resources in India.

UNIT-IV: **Bioresource Technology:** An overview of commercial products/ services through process biotechnology, issues pertaining to development of biotechnology, general aspects related to the quality control of bioprocesses, health hazards in biotechnology and containment, biosafety considerations and containments, sources of gene escape, ecological risks of genetically modified plants, implications of intellectual property rights on the commercialization of biotechnology products.

TEXT / REFERENCE BOOKS:

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

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT601B ADVANCES IN APPLIED BIOTECHNOLOGY

M. Tech. Semester - III (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Advances in Agricultural Biotechnology: Molecular breeding:** Role of molecular markers (RAPD, SSR, AFLP etc) in crop and farm animal improvement, marker assisted selection; QTL mapping, RNAi, virus induced gene silencing. **Genetic engineering of plants:** Molecular and biochemical basis of various abiotic stresses like drought, salinity, heavy metals, high temperature etc.; production of transgenic plants for fungal, bacterial and viral disease resistance; modification of nitrogen fixing capabilities; gene pyramiding, chloroplast genetic engineering. **Molecular farming:** Use of plants and animals for production of neutraceuticals, edible vaccines and other desired products.

UNIT-II: **Advances in Medical Biotechnology: Disease Diagnosis:** Biotechnological techniques for earlier detection and improved diagnosis of human genetic predisposition to diseases, diagnosis through ligase chain reaction, neoplastic disease diagnosis. **Therapeutics:** Therapeutic agents, biotechnological techniques for development of drugs, rational drug design, gene therapy, pharmacogenomics ("custom drugs"). **Drug synthesis:** Natural products, endogenous hormones, molecular principles and advances in drug targetting and drug delivery, controlled release systems, site specific delivery- different techniques.

UNIT-III: **Advances in Environment Biotechnology: Global Environmental Problems:** Ozone depletion, UV-B and greenhouse effect, acid rain, environmental pollution, its impact and biotechnological approaches for management, ecofarming. **Biotechnology for pollution management:** Biotechnological advances in pollution control through GEMs, newer approaches to sewage treatment- treatment of liquid and solid waste, microbes in deodorization and desulphurization, biotechnology of transformation of xenobiotics, mineral leaching, and microbial enhanced oil recovery. **Environment and Energy:** Bioenergy, biotechnology of biofuels and biofertilizers, fuel alcohol production, hydrogen gas production, biogas technology, factors affecting bioenergy production and its status in India.

UNIT-IV: **Advances in Industrial Biotechnology: Industrial production of primary and secondary metabolites:** Advances in the production of commercially important organic acids, amino acids and alcohols; antibiotics, beta lactams, aminoglycosides, macrolides, vitamins and steroids. **Industrial production of enzymes and other bioproducts:** Production of industrial enzymes (proteases, amylases, lipases, cellulases etc.), eco- friendly agricultural chemicals, biopesticides, biofertilizers, biopreservatives, biopolymers and single cell protein, role of microbial enzymes in various industrial processes. **Industrial production of modern biotechnology products:** Production of recombinant proteins having therapeutic and diagnostic applications, vaccines and monoclonal antibodies, products of plant and animal cell culture, biotransformations and bioaugmentation.

TEXT/ REFERENCE BOOKS:

1. Arie Altman. Agricultural Biotechnology, Marcell Dekker, Inc, (2001).
2. Chrispeels, M.J. and Sadava, D.E. Plants, Genes and Crop biotechnology, 2nd Edition, American Society of

Plant Biologists, Jones Bartlett publishers. (2003).
3. Baron E.J., Peterson L.R. and Finegold S.M. Mos, Bailey and Scott's Diagnostic Microbiology, (1990).
4. Jawetz et. al. Medical Microbiology.
5. P. Odum: Fundamentals of Ecology.
6. Amann, R.I. Stromley, J. Stahl: Applied and Environmental Microbiology.
7. Varma and Agarwal: Environmental Biology.
8. Asthana and Asthana: Environment Problems and Solutions.
9. Casida, L.E. Industrial Microbiology. New Age International (P) Ltd. New Delhi. (1998).
10. Crueger, W. and Crueger, A. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Panima Publishing Corporation, New Delhi. (2000).

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT603B PLANT MOLECULAR BIOLOGY

M. Tech. Semester - III (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Genetic Engineering for Plant Metabolism:** Introduction to plant genetic system; general organization of nuclear, mitochondria and chloroplast genomes; structure, organization and regulation of nuclear genes; genetic interactions between nucleus, chloroplast and mitochondria; chloroplast and mitochondrial transformation; .*Arabidopsis* in molecular biology.
Metabolic Engineering of Plant Secondary metabolism: Secondary metabolite production, plants as bioreactors, concept of biofactories; production of pharmaceutically important compounds; crop plants for molecular farming.

UNIT-II: **Molecular Mapping and Marker Assisted Selection (MAS):** quantitative and qualitative traits; MAS for genes of agronomic importance, eg., insect resistance, grain quality and grain yield; molecular polymorphism; RFLP, RAPD, STS, AFLP, SNP markers; construction of genetic and physical map.

UNIT-III: **Plant Genetic Modification and Plant Proteomics:** Gene isolation, plant transformation technology, gene transfer methods: *Agrobacterium* mediated transformation, particle bombardment, control and silencing of transgenic expression, screenable and selectable markers, characterization of transgenics; plant proteomics: protein separation, identification and quantification.

UNIT-IV: **Genetic Modifications for Crop Improvement:** Biotic and abiotic stress resistance/ tolerance; quality improvement:: modification for higher carbohydrate, protein and oil content; molecular basis of abiotic stress; antisense gene approach; ribozyme approach; terminator seed technology; Golden rice, FlavrSavr tomato (a case study); plant-derived vaccines.

TEXT/ REFERENCE BOOKS:

1. Handbook of Plant Biotechnology, Vol. I and II. By Paul Christou and Harry Clee. John Wiley and Sons, Ltd
2. Slater A., Scott N., and Fowler M. Plant biotechnology: the genetic manipulation of plants. 1st edition. Oxford University press. 2003.
3. Chrispeels M.J. and Sadava D. Plants, genes and crop biotechnology. 2nd edition. American society of plant biologists. Jones and Bartlett Publishers, USA. 2003.
4. Altman A. and Dekker, M. Agricultural biotechnology. 2001.
5. Biochemistry and molecular biology of plants. Edited by Buchanan, Gruissem and Jones. American Society of Plant Biologists, USA. 2000.
6. Specific journals and published references.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT605B SCIENTIFIC WRITING AND PRESENTATION SKILLS

M. Tech. Semester - III (Biotechnology)

L	P	Credits			
4	--	4	Class Work	:	25 Marks
			Examination	:	75 Marks
			Total	:	100 Marks
			Duration of Examination	:	3 Hours

UNIT-I: **Accumulation and Analysis of Data for Scientific Writing and Presentation:** Gathering data for selecting and defining research problem- scientific literature search, using the library/internet, surveys and interviews, execution of research objectives, biostatistical analysis of experimental data, effective organization and tabulation of experimental results for writing and presentation.

UNIT-II: **Scientific Document Writing: S**cientific document types- research papers, review articles, short communications, monographs, technical and survey reports, authored books, edited books and thesis, organization of a scientific document, elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; significance of drafting titles and framing abstracts, problems while writing a scientific document, plagiarism- concept and consequences.

UNIT-III: **Designing and Writing Projects & Documents:** Preparation of R&D projects for funding- selecting a research problem by identifying gap areas in the subject, organization and layout of research proposal, aims and objectives of the project, possible outcome of the project, financial requirements of the project, knowledge of funding agencies and biological resource centers; writing specific documents- letters and memos, job applications, cover letters and resume.

UNIT-IV: **Presentation Skills: F**ormal presentation skills, preparing and presenting using over head projector & power point, defending interrogation, preparation for presentation in conferences- poster and oral, seminar on all important and current scientific milestones in Biotechnology.

Computing skills for Scientific Research: Using Internet as a writing tool, web browsing for information search, search engines and their mechanism of searching, hidden web and its importance in scientific research, internet as a medium of interaction between scientists, designing and writing for multi-media.

TEXT / REFERENCE BOOKS:

1. Sides, C.H. How to Write & Present Technical Information, 3rd Edition. Cambridge University Press. (1999).
2. Stevens, P.E. and Riardaw, D.G. Technical Report Writing Today. New Delhi AITBS. (1998).
3. Effective writing for engineers, managers, scientists, by A.J. Tichy, Wiley, New York and London.
4. Scientific and Technical Papers, by S.F. Tribcase, M.I.T. Press, Cambridge, London.
5. How to write and publish a scientific paper, by R.A. Day, IST Press, Philadelphia.

Note: In the semester examination, the examiner will set 08 questions in all, selecting two from each unit. The candidates will be required to attempt five questions in all, selecting at least one from each unit. All questions will carry equal marks.

BT607B INDEPENDENT STUDY SEMINAR

M. Tech. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	2	2	Total	:	50 Marks

The objectives of the course remain:

- To learn how to carry out literature search.
- To learn the art of technical report writing.
- To learn the art of verbal communication with the help of modern presentation techniques.

A student will select a topic in emerging areas of Biotechnology and will carry out the task under the supervision of a teacher assigned by the department. He/She will give a seminar talk on the same before a committee constituted by the Chairperson of the department. The committee should comprise of 2 or 3 faculty members from different specializations. The teacher(s) associated in the committee will each be assigned 2 hours teaching load per week. However, supervision of seminar topic will be in addition to regular teaching load.

BT609B SYNOPSIS SEMINAR

M. Tech. Semester - III (Biotechnology)

L	P	Credits	Class Work	:	50 Marks
--	2	2	Total	:	50 Marks

The objectives of the course remain:

- To define the aims and objectives of the study.
- To carry out literature search and to enlist the methodology involved.
- To discuss the significance of the proposed research work.

Each student will be required to present a synopsis seminar before a committee constituted by the chairperson of the department for finalization of the topic of the research problem. The committee should comprise of at least three faculty members as stated under:

Chairperson of Department	:	Chairperson
M.Tech. Coordinator/Senior faculty	:	Member Secretary
Respective dissertation supervisor	:	Member

Other faculty members with specialization area pertaining to the research problem of the student may be included as members. The teacher(s) associated in the committee will each be assigned 2 hours teaching load per week.

BT611B DISSERTATION (PHASE-I)

M. Tech. Semester - III (Biotechnology)

L	P	Credits			
--	08	08	Class Work	:	100 Marks
			Total	:	100 Marks

The primary objective of this course is to develop in a student the capacity for analysis & judgment and the ability to carry out independent investigation through a dissertation work involving creativity, innovation and ingenuity. Each student will carry out independent dissertation under the supervision of a teacher who will be called as Supervisor. The work must start with comprehensive literature search and critical appreciation thereof so as to select a research problem in consultation with the supervisor. The dissertation involving laboratory work which commences in the IIIrd semester will be completed in the IVth Semester. The evaluation of the dissertation phase-I will be done by a committee of at least three members constituted as under:

Chairperson of Department	:	Chairperson
M.Tech. Coordinator/Senior faculty	:	Member Secretary
Respective dissertation supervisor	:	Member

Other faculty members with specialization area pertaining to the research problem of the student may be included as members.

The student will be required to submit two copies of his/ her report to the department for record (one copy each for the department and the participating teacher).

BT602B DISSERTATION (PHASE-II)

M. Tech. Semester - IV (Biotechnology)

L	P	Credits			
--	20	20	**Class Work**	:	**100 Marks**
			Examination	:	**100 Marks**
			Total	:	**200 Marks**
			Duration of Examination	:	**3 Hours**

The Dissertation Phase-I of the IIIrd Semester will be continued as Dissertation Phase-II in the 4th Semester. At the end of the semester, each student will be required to submit three bound copies of his/ her Master's dissertation in the concerned Department. Out of these, one copy will be kept for the department record and one copy shall be for the supervisor. A copy of the dissertation will be sent to the external examiner by the concerned department, after his/ her appointment and intimation from the University. The external examiner shall be appointed by the University from a panel of examiners submitted by the respective Head of the department and approved through board of studies.

Final dissertation will be assessed by a panel of examiners consisting of the following:

Chairperson of Department	:	Chairperson
Respective Supervisor(s)	:	Member(s)
External expert	:	To be appointed by the University

The dissertation will be evaluated as per the M.Tech ordinance (through interim report, presentation and discussion thereon) of the University.