COURSE STRUCTURE
AND
DETAILED SYLLABUS

for
M.Tech course
in
BIOTECHNOLOGY

(with effect from the Academic year 2012-2013)

SREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY
(An Autonomous Institution approved by UGC and affiliated to JNTUH)
Yamnampet, Ghatkesar, R.R.District-501 301.

M.Tech (Biotechnology)
Course Structure and Syllabus
Academic Regulations: 2012

I YEAR - I Semester

Code	Subject	L	T	P	C	Marks	
						Int.	Ext.
122BT01	Microbial Engineering	3	1	--	3	40	60
122BT02	Molecular Biology & Virology	3	1	--	3	40	60
122BT03	Enzyme Engineering & Technology	3	1	--	3	40	60
122BT04	Principles of Transport Phenomena	3	1	--	3	40	60
	Preparatory core	3	1	--	3	40	60
	Professional Elective- I	3	1	--	3	40	60
122BT71	Molecular Biology and Immunology lab	--	--	6	3	40	60
122BT72	Technical paper writing and seminar	--	--	3	2	50	--
Total Credits		**18**	**6**	**9**	**23**	**330**	**420**

L - Lectures; T = Tutorial; P = Practical; C = Credits

Preparatory Core
(One of these shall be allotted to each student depending on their background)

1. 122MA01 Engineering Mathematics
2. 122BT05 Immunology

Professional Elective – I (Any one subject to be selected)

1. 122BT06 Plant Biotechnology
2. 122BT07 Biochemical & Biophysical Techniques
3. 122BT08 Animal Cell Science & Technology
4. 122BT09 Nano Biotechnology

M.Tech (Biotechnology)
Course Structure and Syllabus
Academic Regulations : 2012

I YEAR - II Semester

Code	Subject	L	T	P	C	Marks	
						Int.	Ext.
122BT10	Bioreactor Engineering	3	1	--	3	40	60
122BT11	Recombinant DNA Technology	3	1	--	3	40	60
122BT12	Downstream Processing	3	1	--	3	40	60
122BT13	Bioinformatics	3	1	--	3	40	60
	Professional Elective- II	3	1	--	3	40	60
	Open Elective	3	1	--	3	40	60
122BT73	Bioprocess Engineering lab	--	--	6	3	40	60
122BT74	Technical Seminar (Independent Review Paper)	--	--	3	2	50	--
Total Credits		**18**	**6**	**9**	**23**	**330**	**420**

Professional Elective – II

1. 122BT14 Environmental Biotechnology
2. 122BT15 Advanced Immunology & Immuno-Technology
3. 122BT16 Biotechnology for Crop Improvement
4. 122BT17 Bioreactor & Plant Design

Open Elective

1. 122BT 18 Bioethics, Biosafety and Intellectual Property Rights (IPR)
2. 122MB 47 Entrepreneurship and Innovation
3. 122SE 22 Object-oriented programming through JAVA

M.Tech (Biotechnology)
Course Structure and Syllabus
Academic Regulations : 2012

II YEAR - I Semester

Code	Subject	L	T	P	C	Marks	
						Int.	Ext.
122BT75	Comprehensive viva-voce	--	--	--	2	--	50
122BT76	Project Seminar-I	--	--	--	2	50	--
122BT77	Project Work (Part I) (Progress Status Report) (Excellent / Good / Satisfactory / Unsatisfactory)	--	--	--	18	Grading	--
Total Credits		--	--	--	**22**	**50**	**50**

II YEAR - II Semester

Code	Subject	L	T	P	C	Marks	
						Int.	Ext.
122BT78	Project Seminar-II	--	--	--	2	50	-
122BT79	Project Work and Dissertation (Excellent / Good / Satisfactory / Unsatisfactory)	--	--	--	20	--	Grading
Total Credits		--	--	--	**22**	**50**	--

L - Lectures; T = Tutorial; P = Practical; C = Credits

I Year-I sem M.Tech (BT)

122BT01 MICROBIAL ENGINEERING

L	T	P	C
3	1	-	3

UNIT I : Introduction Introduction to biotechnology and biochemical engineering, bioprocess techniques, biotechnology products. Raw materials used for Industrial fermentation and its processing. Chemical, physical and physiochemical treatment.

UNIT II : Material balance and Energy balance Material balance- Thermodynamic preliminaries, system and process, steady state and equilibrium, law of conservation of mass, types of material balance problem, material balances with recycle and bypass streams, Energy balance- Basic energy concepts, intensive & extensive properties, Studies of enthalpy for reactive & non reactive processes. Heat of combustion, heat of reaction at Non standard conditions .Thermodynamics of microbial growth, energy balance equation for cell culture, unsteady state energy balance equations.

UNIT III : Medium optimization and Sterilization Medium optimization techniques with special emphasis on statistical techniques, Placket-Burman design, ANOVA, response surface methodology. Sterilization: Media sterilization: kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilisers, coupling of Arrhenius equation and cell death kinetics, sterilization of air and filter design.

UNIT IV : Growth Stoichiometry Stoichiometry of bioreaction and energetic of microbial growth, Yield coefficients, Growth stoichiometry and elemental balances, electron balances, productivity and their correlation with the stoichiometry.

UNIT V : Unstructured Models Unstructed model for microbial growth. The development of different microbial growth kinetics like Malthus, Pearl and read, Monod Model, Konark Model. The limitation of Monod model and development of other constitutive models. Multisubstrate model, inhibition models for substrate, Product and toxic substances, development of logistic equation. Maintenance and endogenous metabolism kinetics.

UNIT VI: Structured Models Kinetics based on molecular mechanism, Model for Plasmid Structured models - a few examples, Single cell model, Product formation expression and replication, model of gene expression, Segregated model, Models of plasmid stability. Engineering and social considerations for the production of r-DNA products; Safety, Good Laboratory and manufacturing practices .Parameter estimation, Model validation and bioprocess optimization

TEXT BOOKS

1) Bailey JE, Ollis DF; Biochemical Engineering fundamentals Year of Publication 1986

2) Blanch HW and Clark DS: Biochemical Engineering Marcel Decker Year of Publication 1987

REFERENCES:

1) Biochemical Engineering Principles and functions by Syed Trnveer Ahmed Inamdar, PHI Learning Private limited.

2) Wiseman, A: Handbook of Enzyme Biotechnology, 3rd Edition, Ellis Horwood Publication, Year of Publication 1999

3) Moser, A; Bioprocess technology, kinetics and reactors; Springer Verlag, Year of Publication1988

4) Schugerl K: Bellgart K H (Eds); Bioreaction Engineering, Modeling and control; Springer – verlog, berlin Year of Publication 2000

I Year-I sem . M.Tech(BT)

122BT02 MOLECULAR BIOLOGY AND VIROLOGY

L	T	P/D	C
3	1	-	3

UNIT I: DNA Structure and Replication

DNA Structure, Replication and repair. Genes arrangement. Eukaryotic chromosome. Structure and replication, Repetitive DNA, CpG islands, Gene amplification, Extra chromosomal DNA (plasmids, transposable elements and TY elements).

UNIT II: RNA and Transcription Different classes of RNA and their functions. Transcription, splicing, post-transcriptional modifications, RNA export. Control of gene expression in prokaryotes. Transcriptional control in Eukaryotes.

UNIT III: Translation Protein synthesis, Protein turn-over and translational control.

UNIT IV: Modulation of Gene Expression Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, RNAi, applications of antisense and ribozyme technology

UNIT V: General Virology Structure and replication of viruses, Replication of plant and animal viruses

UNIT VI: Viral Pathogenesis Disease and disease process- A note on SV40 and Retroviruses in transformation.

TEXT BOOKS :

1) "Molecular Biology of the gene" by Waston et al 4th ed.

2) "Genes VI" by Benjamin Lewis

3) Biochemistry and Molecular biology, William H. Elliott and Daphne C. Elliott, Third Edition, Indian edition, Oxford University press, 2005.

REFERENCES:

1. "Genetics" by Ursula Goodenough
2. "Cytogenetics" by lGarl P. Swanson, Mertz & Young
3. "General Virology" by Luria & Darnell
4. "Biochemistry" by Stryer.

I Year-I sem . M.Tech(BT)

122BT03 ENZYME ENGINEERING AND TECHNOLOGY

L	T	P/D	C
3	1	-	3

UNIT I: Introduction to Enzyme Engineering and Technology

Industrial Enzymes- their source, Isolation, characterization and their purification. Applications of enzymes in Industry, Medicine, Analytical Chemistry, Chemical, Pharmaceutical & Food Sectors. Specific activity, Turnover number. Basis of enzymatic reaction, collision theory and transition state theory.

UNIT II: Enzyme Kinetics

Kinetics of single substrate enzyme catalyzed reaction, equilibrium, steady state assumption - Michaelis-Menten (Briggs- Haldane) equation. Transformation of Michaelis- Menten equation. The Lineweaver Burk, Eadie-Hofstee and Hanes plots. Determination of Vmax, Km, Kcat, Specificity constant (Kcat/Km) and their significance.

UNIT III: Mechanism of Enzyme Catalysis and Inhibition

Nature and conformation of active site. Models for identification of functional groups essential for catalysis. Hydrolytic, covalent, acid-base, electrostatic and metal ion involved catalysis. Mechanism of enzyme action- Lysozyme, Carboxy peptidase, Chymotrypsin and Ribonuclease. Enzyme inhibition: Reversible inhibition-Competitive, Noncompetitive (pure, mixed) inhibition, Substrate inhibition, allosteric and irreversible inhibition. Feedback inhibition.

UNIT IV: Energetics of Enzyme reaction

Temperature dependence of rate constants of enzymatic reaction, thermal deactivation, pH effect on rate constants and protein structure. Stoichiometry of bioreaction and energetics of enzymatic reaction, ATP and redox potential balance.

UNIT V: The Steady State Kinetics

Pre-steady–state kinetics, determination of rate constants, rapid mixing, stopped flow and relaxation technique. Enzyme kinetics at limiting condition, enzyme kinetics at interface and kinetics of multi substrate reactions.

UNIT VI: Immobilization of Biocatalysts and Modern Concepts

Immobilization of biocatalysts an introduction, Electrostatic Effect, effect of charged and uncharged support, Effect of external and internal mass transfer, Modern concepts of evolution of catalysis – catalytic RNA (Ribozymes), Abzymes (catalytic antibodies). Protein Engineering of Enzymes

TEXT BOOKS:

1) Blanch HW and Clark DS: Biochemical Engineering Marcel Decker Year of Publication 1987.
2) Enzymes by palmer
3) Blanch HW and Clark DS: Biochemical Enginering, Marcel Decker

REFERENCES:

1. Bailey JE, Ollis, DF: Biochemical Engineering Fundamentals
2. Schugerl K., Bellgart KH (Eds): Biorection Engineering, modeling and control: Springer-Verlag, Berlin
3. Wiseman, A: Handbook of Enzyme Biotechnlogy, 3rd Edition, Ellis Horwood Publication
4. Moser, A: Bioprocess technology, kinetics and reactors: Springer Verlag

I year - I semester M. Tech(BT)

122BT04 PRINCIPLES OF TRANSPORT PHENOMENA

L	T	P	C
3	1	-	3

UNIT- I: Concepts

Brief overview, concepts of unit operation & unit process with examples, units and dimensions, dimensional analysis, Presentation and analysis of data.

UNIT- II: Fluid Mechanics I

Newtonian and Non Newtonian fluids, examples from biotechnology, control volume approach, Integral equations for conservation of mass, momentum and energy, mechanical energy balance, Bernoullis equation

UNIT –III: Fluid Mechanics II

Differential euations of fluid flow,Navier-Stokes equations, boundary layer concept, turbulent flow, mixing length and phenomenological theories

UNIT- IV: Heat Transfer

Differential equations of heat transfer, unsteady state conduction-analytical solutions, convective heat transfer, correlations.

UNIT-V: Heat transfer equipment

Types of heat exchangers, concept of LMTD, overall heat transfer coefficient, NTU method of heat exchanger anlaysis, problems.

Unit-VI: Mass Transfer

Steady state mass transfer, one dimensional with and without chemical reaction, analytical solution, unsteady state molecular diffusion, analytical solutions, concentration boundary layer concept, continuous contact equipment analysis.

TEXT BOOKS:

1. Fundamentals of Momentum, Heat and mass transfer,Welty,Wicks,Wilson,John wiley,New York.
2. Christi J. Geankoplis, Transport process & Unit operations, Ill ed., Prentice Hall India Pvt. Ltd.

I year - I semester M. Tech(BT)

(Preparatory Core)

122MA01 ENGINEERING MATHEMATICS

L	T	P	C
3	1	-	3

UNIT I:
Trigonometry- relations related to compound angles, multiple and sub-multiples, transformations, hyperbolic functions

UNIT II:
Concepts of limit, continuity, differentiation, product rule, quotient rule. Differentiation of trigonometric, logarithmic, exponential functions.

UNIT III:
Applications of differentiation – problems on tangent, sub tangent normal, sub normal. Introduction to partial differentiation, Euler's theorem.

UNIT IV:
Introduction, Integration of different functions, methods of Integration, Integration by parts.

UNIT V:
Concept of definite integrals. Applications of definite integrals – problems on areas.

UNIT VI :
Forming of differential equation by eliminating arbitary constants, first order and first degree – variables and seperables, exact, homogeneous and linear.

Textbooks:

1. Engineering Mathematics-N.P. Bali and others.
2. Engineering mathematics-B.V. Ramana

References:

1. Differential Calculus-Shanthi Narayan
2. Integral Calculus-Shanthi Narayan

I year - I semester M. Tech(BT)

(Preparatory Core)

122BT05 IMMUNOLOGY

L	T	P	C
3	1	-	3

Unit I: Innate immunity and inflammation : Pathogen-associated molecular patterns (PAMPs) and their recognition by innate immune system receptors with special emphasis on Toll-like receptors. Phagocytosis and inflammation. Role of cytokines, chemokines and adhesion molecules such as ICAM, integrins and selectins in inflammation

Unit II: Signal transduction: Adaptor proteins, protein kinases, transcription factors and gene activation. Study with reference to IFN-gamma and TNF-alfa.

Unit III: T-helper cell subsets and their role in immunity : Th cell subsets determine the type of immune response. Th-1 versus Th-2 cytokine profile. Therapeutic strategies based on tilting the balance of Th-1 and Th-2 cell subsets.

Unit IV: Immunological tolerance and autoimmunity: Central tolerance, pheripheral tolerance. Failure of tolerance leading to autoimmunity. Mechanisms for autoimmunity induction. Organ-specific and systemic autoimmune diseases.

Unit V: Cancer immunology and immunotherapy: Immunosurveillance and cancer. Mechanisms that downregulate tumour immunity. Vaccination strategies for cancer with special emphasis on recent concepts like vaccination with dendritic cells pulsed with peptides and adoptive immunotherapy using T cells.

Unit VI: Immunity to infection and vaccination strategies: Innate immune mechanisms that restrict early stages of infection. Interferons, NK cells and dendritic cells. Adaptive immunity – Cytotoxic T cell-mediated killing mechanisms. Microbial strategies to evade immune response. Vaccination strategies to viral infections – human, avian and swine influenza viruses, hepatitis B and HIV viuses. Strategies of vaccination for tuberculosis and malaria.

TEXT BOOKS:

1. "Essential Immunology" by Ivan M. Roitt (1980). (Blackwell Scientific Publications, Oxford, London) fourth edition
2. "Immunology" by Ivan M. Roitt, Jonathan Brostoff and David K. Male (1985) (Glower Medical Publishing, London) first edition.
3. "Immunology Today".
4. Current topics in Microbiology & Immunology

I year - I semester M. Tech(BT)

(Professional Elective-I)

122BT06 PLANT BIOTECHNOLOGY

L	T	P	C
3	1	-	3

UNIT I: Cell and Tissue Culture: Concept of Totipotency, Tissue culture media (composition, preparation); Initiation and maintenance of callus and cell suspension culture, Somatic embryogenesis, Organogenesis; Clonal propagation

UNIT II: Tissue Culture Applications: Protoplast isolation, culture fusion and somatic hybridization; Haploid Production, its application and limitations; Somaclonal variations; Short term and long term Germplasm conservation

UNIT III: Production of Phytochemicals: Production of chemicals and other important compounds from plant cell cultures; Strategies for enhancing product yield; Bioreactor systems for mass cultivation of plant cells and production of Phyto-pharmaceuticals (Shikonin, Berberine, Ginsenosides)

UNIT IV: Transformation Technology: Promoters, Selectable markers, reporters involved in transformation, genetic transformation techniques; *Agrobacterium* mediated gene transfer; Direct gene transfer methods - chemical methods, electroporation, microinjection and particle bombardment, gene silencing in plants

UNIT V: Transgenic Plants: Production of transgenic plants for Abiotic (Drought, temperature, salt) and Biotic (Herbicide resistance, Insect resistance, Disease resistance, Virus resistance) stress tolerance

UNIT VI: Molecular Farming: Application of Plant biotechnology for the production of quality oil, Industrial enzymes, Therapeutic proteins, Antigens (edible vaccine) and Plantibodies.

TEXT BOOKS:

1. Roberta Smith, Plant Tissue Culture: Techniques & Experiments. 2nd ed., Acad. Press, 2000.
2. Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice. Elsevier Science, 2004
3. H. S. Chawla, Introduction to Plant Biotechnology, 3rd Edition, Science publishers, 2009

REFERENCES:

1. Bhojwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier,1990.
2. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production & Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
3. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
4. I. Potrykus and G. Spangenberg, Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
5. John Hammond, Peter Mc Garvey, Vidadi Yusibov, Plant Biotechnology: New products and applications, Springer verlag, 1999.

I year - I semester M. Tech (BT)

(Professional Elective-I)

122 BT08 BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES

L	T	P	C
3	1	-	3

UNITI: Introduction

Types of analytical methods, Classification of Instrumental methods for analytical Chemistry, methods of calibration and validation of Instruments. Errors, precision and Accuracy, sensitivity and detection limit of instruments

UNIT II: Electrophoresis

Electrophoresis: Different methods of electrophoresis for protein, nucleic acids, small molecular weight compounds and immuno precipitates (Immuno electrophoresis). Peptide mapping and combination of electrofocussing and SDS-PAGE.

UNIT III: Bioseperation Techniques

Theory of centrifugation and application to biological systems. Rotors angle/vertical/zonal/continuous flow centrifuge, differential centrifugation density gradient centrifugation. Ultra centrifugation: principle and application. Chromatography – adsorption, affinity, partition, Ion exchange, gel permeation, GLC, TLC, RPC, HPLC etc.

UNIT IV: Spectroscopy

Introduction to principles and applications of (a) spectroscopic methods (UV, Vis, IR, Fluorescence, ORD,CD & PAS) (b) NMR, ESR & Mass spectrometry. Use of radioactive and stable isotopes and their detection in biological systems.

UNIT V: Microscopy

Introduction to Principles and working of Bright field, Dark field, Fluorescent, Phase contrast, Confocal Microscopy, Electron Microscopy-SEM, TEM

UNIT VI: Analytical Techniques for Biotechnology

Automatic analyzer for amino acids, protein sequenater, peptide synthesizer & nucleic acid synthesizer. Cell sorters and their applications. Theory of lyophilization and its applications to biological systems. Introduction to principles and working of light & Electron microscope.

TEXT BOOKS:

1. Introduction to Biophysics by Pranab Kumar Banerjee, S Chand and company, 2008.
2. Instrumental methods of chemical analysis by G. R Chatwal and S .K Anand, Himalaya publishing house, 2008.

REFERENCES:

1. Biotechnology Procedures and Experiments handbook by S. Harisha, Infinity Science Press LIC, 2008.

I year - I semester M. Tech (BT)

(Professional Elective-I)

122BT08 ANIMAL CELL SCIENCE AND TECHNOLOGY

L	T	P	C
3	1	-	3

UNIT I: Animal cell culture and Media

Media-balanced salt solution and simple growth medium, Role of serum, Serum and protein free media, cell growth factors, Equipments and materials for animal cell culture , Chemical, physical and metabolic functions of different constituents of culture medium

UNIT II: Establishing Cell lines

Cell culture techniques, disaggregation of tissue-trypsinization, Primary and established cell lines, maintenance of cell culture, cell separation, Stem cells –Types and applications

UNIT III: Cell Viability

Measurement of viability and cytotoxicity, Biology and characterization of the cultured cells, measuring parameters of growth, apoptosis and necrosis

UNIT IV: Cell synchronization and Transformation

Cell synchronization, cell transformation, applications of animal cell culture- vaccines, Cell culture based recombinant products- scaling up of animal cell culture

UNIT V: Induced animal Breeding and Trangenics

Introduction, artificial insemination, cloning, invitro fertilization and embryo transfer, selective animal breeding, gene pharming, gene therapy, Concept of Transgenics, Production of transgenic animals-mouse, sheep

UNIT VI: Tissue Engineering

Organ culture and histotypic cultures, Three dimensional cultures and Tissue Engineering

TEXT BOOKS:

1. Culture of Animal Cells, (3rd Edition), F1. Ian Freshney, Wiley-Liss
2. Animal Cell Culture-Practical approach, Ed. John R.W.Masters, Oxford

REFERENCES:

1. Cell Culture Lab Fax. Eds.M.Butler & M.Dawson, Bios Scientific Publications Ltd, Oxford
2. Animal Cell Culture Techniques, Ed. Martin Clynes, Springer
3. Methods in Cell Biology, vol 57, Animal Cell Culture Methods, Ed. Jenni P, Mather and David Barnes, Academic press
4. Cell Growth and Division: A Practical Approach. Ed R.Basega, IRL Press

I year - I semester M. Tech(BT)

(Professional Elective-I)

122BT09 NANO BIOTECHNOLOGY

L	T	P	C
3	1	-	3

UNIT I: General Principles

Definition of nano scale with reference to biosystems, Scope and future prospects, Challenges of nanotechnology., Smart Materials- Heterogenous nano structure and composites, nanoscale bio structures, Nano wire, Micelles and liposomes.

UNIT II: Synthesis and Characterization

Molecular synthesis, Self assembly, Polymerisation, Scanning probe instrument, spectroscopy and imaging techniques, electron microscopy, , Nanoscale lithography, e-beam lithography.

UNIT III: Molecular Nanobiology

Molecular biology of biosynthesis and molecular design, microarrays (DNA and Protein), Genetic code and protein synthesis, Hybrid Computers- Protein-hybrid computers, role of genetically engineered polymer proteins.

UNIT IV: Applications-Drug Delivery

Nanotechnology for immune system., Drugs-Photodynamic therapy, molecular motors, neuro electronic interphases, development of nanoluminiscent tags,

UNIT V: **Applications-Polymers**

Designer biopolymers, Procollagen, DNA Polynode, RNA topoisomerase, Protein –magnetic materials, nanofibers and tissue engineering.

UNIT VI: Applications of Bionanotechnology

Applications of nanotechnology in agriculture, environment and food industry.

TEXTBOOKS:

1) M. Ratner and D.Ratner, Nanotechnology –a gentle introduction to the next big idea, Pearson Education , 2007.
2) R. R. Birge, Proetin based computers, Scientific American , 1995.
3) Bionanotechnology by GoodSell-Wiley Liss.
4) Biomedical applications of nanotechnology by-Labhasetwar-Wiley Interscience.

REFERENCES:

1. L.E.Foster, Nanotechnology-Science, Innovation and opportunity , Person eduction inc, 2007.

Nanoelectronics and nanosystems-Karl Goser-Springer Engineerng Series.

I year - I semester M. Tech(BT)

122BT71 MOLECULAR BIOLOGY AND IMMUNOLOGY LAB

L	T	P	C
-	-	6	2

Molecular biology

1. Extraction and purification of genomic DNA
2. Extraction and purification of plasmids
3. Restriction digestion and Ligation of DNA
4. Transformation
5. Southern blotting

Immunology

1. Differential leukocyte count
2. Immunodiffusion techniques
3. Enzyme-linked immunosorbent assay (ELISA)
4. Immunoprecipitation
5. SDS – polyacrylamide electrophoresis
6. Western blotting
7. Immunoflluorescence
8. Fluorescence-activated cell sorting

I year - I semester M. Tech(BT)

122BT72 Technical Paper Writing and Seminar

L	T	P	C
-	-	3	2

There shall be two seminar presentations during I year I semester and I year II Semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful

In the First semester the report must be in the form of the review paper with a format used by IEEE /ASME

Etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high

Quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

A Student has to concentrate on the following sections while writing technical paper or presenting seminar.

Contents:

- Identification of specific topic
- Analysis
- Organization of content
- Writing style
- Figures
- Tables
- References

I year – II semester M. Tech(BT)

122BT10 BIOREACTOR ENGINEERING

L	T	P	C
3	1	-	3

UNIT I: Bioreactors
Bioreactor function .Utility, types of bioreactors. Modes of bioreactor operations, Main components of the bioreactor and their function. Introduction methods of Aeration, surface aeration, Mechanical stirred bioreactors.

UNIT II :Reactor Kinetics
Immobilized biocatalysts , methods of immobilization, kinetics of immobilized enzymes, Enzyme catalysis in CSTR. Cell death in batch reactor, endogenous metabolism, maintenance, product and substrate inhibition on chemostat.

UNIT III: Bioreactors and design features
Batch reactor, Chemostat CSTR, Plug Flow Reactor, Fed batch reactor, Bubble column, bubble generation at an orifice, bubble coalescence and breakup, gas holdup interfacial area, immobile and mobile gas liquid interface, regimes of bubbles, design of bubble columns, Cascade reactor, air lift reactor, Fluidized bed bioreactors, trickle bed reactors Immobilized bioreactors, recycle bioreactors.

UNIT IV: Gas- liquid mass transfer
Gas-liquid mass transfer in cellular systems, basic mass transfer concepts, solubility of gases (O,CO_2) in biological media, mass balances for two-phase bioreactor. Mass transfer – introduction to mass transfer between phases, mass transfer in porous solids, quantifying mass transfer. Oxygen transfer-introduction, oxygen transfer process, factors effecting k_La, interfacial area and oxygen transfer, factors effecting the saturation concentration of oxygen, oxygen uptake.

UNIT V: Mass transfer in agitated tanks
Correlations with k_La , Newtonian and Non Newtonian liquid, Power number. Experimental determination of k_La, static method, dynamic method, chemical method. Power requirement for mixing in aerated and non aerated tanks, agitated and non-agitated tanks for Newtonian and non Newtonian fluid. Mixing time in agitated reactor, residence time distribution. Non ideal reactor and multiphase bioreactor.

UNIT VI: Aeration and Agitation in Animal cell bioreactors
Introduction. Cell damage in animal cell bioreactors , shear damage , bubble damage. Method of minimizing cell damage. Laminar & Turbulent flow in stirred tank bioreactors, turbulent eddies, kolmogrov eddy size. Preventing vortex formation, Off - centre impellers,baffles Control of bioreactor, strategy, online and offline monitoring of bioreactors: computerized bioprocess control. Scale up and scale down of mass transfer equipment and bioprocess control of bioreactor, sensor used in the bioreactor, pH, O_2,CO_2 electrode, Online sensors for cell properties. Direct regulatory control and cascade control mechanism.

TEXT BOOKS:

1. Bailey JE, Ollis DF; Biochemical Engineering fundamentals Year of Publication 1986
2. Blanch HW and clark Ds: Biochemical Engineering Marcel Decker Year of Publication 1987
3. Introduction to Biochemical Engineering by D G Rao Tata Mc Graw Hill, New Delhi.

REFERENCE BOOKS:

1. Wiseman A: Handbook of Enzyme Biotechnology, 3rd Edition, Ellis Horwood Publication, Year of Pub l 1988.
2. Moser, A:Bioprocess technology, Kinetics and reators: Springer Verlag., Year of Publication 1988
3. Schugerl K: Bellgart K H (Eds): Bioreaction Engineering, Modeling and control, Springer – verlog, berlin Year of Publication 200G.
4. Biochemical Engg Principles and functions by Syed Tmveer Ahmed Inamdar,PHI Learning Private Limited.

I year – II semester M. Tech(BT)

122BT11 RECOMBINANT DNA TECHNOLOGY

L	T	P	C
3	1	-	3

UNIT I: Nucleic Acid Isolation and Sequencing
Nucleic Acid Purification, Yield Analysis. Sequencing methods – Sanger's, Maxam-Gilbert's method. Automated sequencing. Full genome sequencing, Nucleic Acid Amplification and its Applications

UNIT II: Molecular Tools in Genetic Engineering
Molecular Tools in genetic engineering: Restriction enzymes, ligases, Linkers, adaptors and their chemical synthesis, s1 nuclease, terminal deoxy nucleotides, transferases, Poly A polymerases. , Alkaline Phosphatase etc., Modification enzymes, DNA, and RNA markers.

UNIT III: Cloning Vectors
Nucleic Acid Sequencing. Gene Cloning Vectors: Plasmids bacteriophages, phagemids cosmids, viral vectors, Artficial chromosomes. Cloning mRNA enrichment, reverse transcription. Restriction Mapping of DNA Fragments and Map Construction

UNIT IV: Cloning Strategies
Strategies of Gene cloning Cloning, reverse transcriptase, interacting genes, library construction and screening. Genomic libraries (complete sequencing projects).. Two-and three hybrid systems, cloning differentially expressed genes Site-directed Mutagenesis and Protein Engineering.

UNIT V: Gene Expression
Gene Regulation, DNA transfection, Northern blot, Primer extension. S1 mapping, RNase protection assay. Reporter assays. Nucleic acid microarrays. Expression Strategies for Heterologous Genes, Vector engineering and codon optimization. Host engineering, In vitro transcription and translation, expression in bacteria expression in prokaryotic and eukaryotic cells, expression in plants.

UNIT VI: Applications

Phage Display T-DNA and Transposon Tagging Role of gene tagging in gene analysis, Transgenic and Gene Knockout Technologies. Targeted gene replacement. Gene Therapy Vector Engineering of gene delivery, gene replacement augmentation, gene correction gene editing, gene regulation and silencing.

TEXT BOOKS:

1. Molecular and cloning : a laboratory Manual J Sambrook EF Fritsch and T.maniatis cold Spring Harbor laboratory Press, New York 2000
2. DNA Cloning a Practical Approach M.Glover and B.D.Hames, IRL Press, Oxford 1995.

REFERENCE BOOKS:

1. Molecular and Cellular Methods in Biology and Medicine, P.B.Kaufman, W.Wu D.Kim and 1.j: Cseke, Cre Press, Florida, 1995.
2. Methods in Enzymology vol.152 Guide to Molecular Cloning Techniques. S.I. Berger and a.R.Kimmel, Academic press Inc San diego, 1998.
3. Methods in Enzymology vol 185. Gene expression technology, D.V. Goeddel, Acdemic Press Inc.San Diego 1990.

I year – II semester M. Tech (BT)

122BT12 DOWNSTREAM PROCESSING

L	T	P	C
3	1	-	3

UNIT-I : **Down Stream Processing** of Bioproducts
Down Stream Processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Role of DSP methods in bioprocess economics.
Cell disruption methods: Various cell disruption methods, need for cell disruption for intracellular products cell disruption equipment. Applications in bio-processing.

UNIT-II : Sedimentation, Filtration and Centrifugation
Solid –Liquid Separation: Filtration: Principles filter aids, constant volume filtration, constant pressure filtration, specific cake resistance equivalent cake thickness. Filtration equipment viz. plate and frame filter press, vacuum filters, leaf filters.
Sedimentation: Principles of particle setting, batch sedimentation equipment via: thickener.
Centrifugation: Principles of centrifugation, centrifuge effect, g-number, sigma factor, various centrifuges via basket centrifuge, tabular centrifuge disc-bowl centrifuge, scale-up of centrifuges.

UNIT-III : Adsorption and Drying
Adsorption: Adsorption and adsorption processes, adsorption equilibrium and isotherms, principles of adsorption and equipment, applications
Foaming, Flocculation and Coagulation: Principle and applications in bioprocessing

Freeze drying technique and its advantages over other methods, Applications in bio-processing.

UNIT-IV: Purification Techniques I
Membrane separations processes: Basic principles of membrane separation, membrane characteristics, different types of membranes, criteria for selection of membranes.
Precipitation:
Precipitation: Principles of precipitation, precipitation equipment, applications in bio-processing.

UNIT V: Purification Techniques II
Chromatography
Chromatographic separation and electrophoresis methods: Principles of chromatographic separation methods, different types of chromatographic methods, via adsorption chromatography, ion-exchange chromatography, gel chromatography, affinity chromatography etc. Applications in bio processing.

UNIT VI:
Liquid Liquid Extraction: Extraction process and principles phase equalitarian and distribution, batch and continuous extraction, co-current and counter current extraction processes, LLE equipment. Applications in bio-technology.

TEXT BOOKS:

1. Bioseparations (Principles and Techniques) By Sivasanker, Prentice Hall of India Private Limited
2. Principles of fermentation technology by Peter F Stan bury, Allan Whitaker and Stephen J Hall, Pergamon Pulications.

REFERENCE BOOKS:

1. Separation Process in Biotechnology edited by juan A.Asenjo,Taylor & Francis Group
2. Comprehensive Biotechnology Vol 2 Ed:M Moo-young(1985)
3. Product Recovery in Bioproces technology,Biotol series,Butterworth-Heinemann

I year – II semester M. Tech (BT)

122BT13 BIOINFORMATICS

L	T	P	C
3	1	-	3

UNIT I : SCOPE OF BIOINFORMATICS AND BIOLOGICAL DATABASES

History, definition,, importance and uses of bioinformatics, Organization and management of databases, Nucleotide databases(NCBI), Protein Databases(PDB,SCOP,CATH)

UNIT II: SEQUENCE ALIGNMENT

Basic concepts of homology,. Dynamic Programming, Smith-Waterman Algorithm ,Neddleman-Wunsch Algorithm BLAST and FASTA algorithms

UNIT III: MULTIPLE SEQUENCE ALIGNMENT AND PHYLOGENETIC ANALYSIS

Basic concepts of various approaches for MSA (progressive, hierarchical). Algorithm of CLUSTALW and its application for sequence analysis .Taxonomy and phylogeny: Basic concepts in taxonomy and phylogeny; molecular evolution; Definition and description of phylogenetic trees and various types of trees

UNIT IV : GENOMICS

Prediction of Genes, Promoters, splice sites, regulatory regions, , Homology based gene prediction. SNPs and applications. EST approach.

UNIT V: PROTEOMICS

Secondary structure prediction methods, Algorithms of Chou Fasman and GOR methods; Protein homology modeling, Protein threading. Protein ab initio structure prediction

UNIT VI: DRUG DESIGN

Drug discovery cycle, Role of Bioinformatics in Drug discovery. Molecular Docking - Protein-ligand interactions, Protein-protein interactions

TEXT BOOKS:

1. Bioinformatics : Genome and sequence analysis by David W Mount.

REFERENCE BOOKS:

1. Bioinformatics : A practical guide to analysis of genes and proteins by Baxevanis,Andreas D Wiley Interscience publishers
2. An introduction to bioinformatics algorithms by Neil C Jones,Pavel A Pevzner

I year - II semester M. Tech(BT)

(Professional Elective-II)

122BT14 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
3	1	-	3

UNIT I: Industrial Pollution and Control Issues and scope of Environmental biotechnology, Industrial pollution –effluent characteristics of dairy, distillery, tannery, paper and pulp industries, wastewater treatment, Biotechnology in reduction of CO_2 emission, Bioscrubbers, Biobeds, Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., cyanide, fluoride, heavy metals

UNIT II: Bioremediation and Biodegradation Concept of bioremediation, types of bioremediation, Biodegradation of hazardous wastes-hydrocarbons, pesticides, toxic organics

UNIT III: Bio energy Production of biofuels-methane, hydrogen, alcohols, biodiesel from biomass and microalgae, bioaugmentation of petroleum recovery

UNIT IV: Environmental Toxicology Introduction, Definition, classification, origin and general nature of toxicants in environment, factors affecting toxicity, Effects of toxicants on ecosystem, Types of bioassays (median lethal concentration,Ames test, bioluminescence, algal toxicity, gene induction etc.), biomarkers, bioaccumulation, mesocosm and microcosm studies.

UNIT V: Metal Biotechnology Microbial transformation, accumulation and concentration of metals-bioleaching of copper, uranium, gold and silica, future prospects, Abatement of heavy metals by microorganisms, heavy metal tolerance in microbes, mechanism of heavy metal resistance, microbial remediation of metal contaminated habitats, phytoremediation of heavy metals

UNIT VI: Environmental Management System Definitions , Concept, Scope and Objectives, Types of Environmental Impact Assessment(EIA), Environmental auditing, Environmental audit statement, Environmental Management Plan (EMP), Role of Remote sensing and GIS in environmental management

TEXT BOOKS:

1. Waste Water Treatment- M.N.Rao
2. Bioremediation and Biodegradation- Martin Alexander
3. Microbial Biotechnology : A. N. Glazer and H. Nikaids.
4. Modern Toxicology by Gupta and Salunkhe.
5. A Text book of Biotechnology- R. C. Dubey, S.Chand Publishers, 2009.
6. Environmental Impact Assessment – Canter.

REFERENCE BOOKS

1. Water and Wastewater Treatment-Metcalf and Eddie

I year - II semester M. Tech(BT)

(Professional Elective-II)

122BT15 ADVANCED IMMUNOLOGY AND IMMUNO-TECHNOLOGY

L	T	P	C
3	1	-	3

UNIT-I: ANTIGEN PRESENTATION AND MHC MOLECULES

Functioning of different APCs. MHC-restricted antigen recognition by T cells. Pathways of antigen processing. Significance of MHC-associated antigen presentation. Cross-presentation.

UNIT II : LYMPHOCYTE SUBSETS

Th1, Th2, Th17 subsets, regulatory T cells, alpha beta and gamma delta T cells. B lymphocyte subsets – B1 and B2 cells.

UNIT III: IMMUNOLOGICAL MEMORY

T cells memory, B cells memory,Central & Peripheral memory. Relationship between memory and vaccines & infection.

UNIT IV: IMMUNOTECHNOLOGY

Hybridoma technology: Generation, significance and approaches of monoclonal antibody production. Immunotoxin, chemeric antibodies, humanized antibodies and bispecific antibodies. T cell cloning. Transgenics and knock-out mice.

UNIT V: IMMUNOTHERAPY

.Cytokines,Cytoimmunotherapy, Immunomodulators in therapy, Immunotherapy of HIV infection. Natural antibodies, anti-idiotypes.

UNIT VI :ADJUVANTS: Function of adjuvants. Mechanism of action, New generation adjuvants, Plant based adjuvants.

TEXT BOOKS:

1. “Essential Immunology” by Ivan M.Roitt(1980). (Blackwell Scientific Publications, Oxford, London) fourth edition./
2. Essential Immunology – W.E.Paul

REFERENCE BOOKS:

1. Infection and immunity by John Playfair and Gregory Bancroft, third edition, Oxford University press 2008.
2. “Monoclonal antibodies: Principles and practice “ by J.W.Goding. Academic Press.
3. “Hybridoma Techniques: A Laboratory course” by VR. Muthukkaruppan , S.Bhaskar and F.Sinigagalia,Macmilan India Ltd.

I year - II semester M. Tech (BT)

(Professional Elective-II)

122BT16 BIOTECHNOLOGY FOR CROP IMPROVEMENT

L	T	P	C
3	1	-	3

UNIT I: Plant Biotechnology for crop improvement: Conventional plant breeding strategies, Hybridization, Inbred lines, Pure lines, Heterosis. Genetic Engineering of crops for useful agronomic traits for male sterility, food quality, improved crop productivity and molecular farming.

UNIT II: Molecular markers : Random amplified polymorphic DNA (RAPD), Restriction fragment length polymorphism (RFLP), Amplified fragment length polymorphism (AFLP), Simple sequence repeats (SSR), Inter Simple sequence repeats (ISSR), Single strand conformation polymorphism (SSCP) and Quantitative trait loci (QTLs)

UNIT III: Molecular markers for crop improvement Marker assisted selection (MAS), Construction of molecular maps in plants, Map based Cloning, Molecular maps and their utility in plant genomics, Advantages and limitations of molecular markers.

UNIT IV: Molecular Biology of Plant Processes Discovery / Cloning of Plant Genes: Probe based screening, Genomic and proteomic approaches, Expressed Sequenced Tags, Developmentally regulated genes

UNIT V: Transgenic Crops I Secondary metabolites, increase in productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency, Metabolomics, post harvest technology, strategies for enhancing nutritive value of crops, introduction to male sterility for hybrid seed production

UNIT VI: Transgenic Crops II Plants as bioreactors, chloroplast transformation transgenic plants for quality improvement of protein, lipid & carbohydrate content, phytoremediation of contaminated soils, Risks and benefits of release of GM crops. Regulation of research and development of transgenic plants.

TEXT BOOKS:

1. Biochemistry and Molecular Biology of Plants (Buchanan, B.B., Gruissem, W. and Jones, R.L eds.) 2000
2. Molecular Plant Breeding, Yunbi Xu, CABI Publishers, I edition, 2010 (ISBN-13: **978-1845933920)**

REFERENCES

1. Principles of Plant Genetics and Breeding, George Acquaah, Blackwell-Wiley Publishers, I Edition, 2006 (ISBN-13: **978-1405136464)**
2. Plant Molecular Breeding- Sheffield Biological Series, H. John Newbury, Blackwell Publishers, 2003 (ISBN-13: **978-0849328138)**

I year - II semester M. Tech (BT)

(Professional Elective-II)

122BT17 BIOREACTOR AND PLANT DESIGN

L	T	P	C
3	1	-	3

UNIT-I: Fundamental Concepts

Introduction, Production requirement, Biological system identification, Stoichiometry and medium design.

UNIT-II: Stirred Tank Bioreactor Design

Introduction, Important Transport Phenomena: Power consumption, structured model of stirred tank bioreactor.

UNIT-III: Membrane Bioreactors

Immobilized Bioreactor Design, membrane bioreactor Design.

UNIT-IV: Bioreactor operation modes

Introduction, classification of operation modes, basic equation of operation of stirred tank bioreactors, Fed batch operation, utility of fed batch culture, basic equation of fed batch operation, classification of fed batch operation, basic equation of Chemostat.

UNIT V: Plant design-I

Technical feasibility survey, process development, land and utilities, site characteristics, plant location, plant layout, plant operation and control, flow diagrams, equipment design and specifications, Marketability of the product, availability of technology, raw materials, equipments, human resources.

UNIT VI: Plant design-II

Waste disposal, govt. regulations and other legal restrictions, community factors and other factors affecting investment and production costs , Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc.

TEXT BOOKS:

1. Bioreactor System Design by Juen A.Asenjo, Jose C.Merchuk, Published by CRC Press 1995.
2. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 4th Edition, 1989.

I year - II semester M. Tech (BT)

(Open Elective)

122BT18 BIOETHICS, BIO SAFETY & IPR

L	T	P	C
3	1	-	3

UNIT I: Bioethics

Principles of Bioethics. Bioethics in Microbial (Bioterrorism), Plant (GMO) & Animal (Stem Cells & Cloning) Biotechnology

UNIT II: Biosafety Concepts and Issues

Definition of Biosafety, Biosafety for human health and environment, Assessment of Biological hazard, Levels of biosafety for microbes, plants & animals, Cartagena protocol

UNIT III: Biosafety Regulations

Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products. International dimensions in Biosafety. Biotechnology and food safety. Case study – Bt Cotton, Bt Brinjal

UNIT IV: Intellectual Property Rights I

Discovery & Innovation, Types of IPR, Patents and methods of application of patents, Case study on Patents (Basmati rice, Turmeric, Neem). Trade Secrets, Copyrights, Trade Marks, Industrial designs, Overview of WTO, GATT, TRIPS, WIPO and Indian Patent Act

UNIT V: Intellectual Property Rights II

Patent search – databases, Patent drafting, Patent Cooperation Treaty (PCT) for filing patents, Plant breeder's rights, Integrated circuits,

UNIT VI: Ethics in Preclinical and Clinical Trials

Institutional Animal Ethics Committee; Guidelines for laboratory animal facility-CPCSEA; Preclinical safety evaluation of biotechnology derived pharmaceuticals, Issues of ethics of clinical trials, Good Clinical Practice (GCP).

TEXT BOOKS:

1. Bioethics – Shaleesha A Stanley, Wisdom Educational Service, Chennai, 2008
2. V Sree Krishna. Bioethics & Biosafety in Biotechnology. New age International Publications, 2007

REFERENCES:

1. Borem, A., Santos, F., & Bowen, D. (2003). *Understanding Biotechnology.* Prentice Hall. Upper Saddle River, NJ.
2. Singer, Peter A.; Viens, A.M. (2008), Cambridge Textbook of Bioethics, Cambridge: Cambridge University Press, ISBN 978-0-521-69443-8
3. Anitha Rao R & Bhanoji Rao "Intellectual Property Rights – A Primer", Eastern Book Company, 2008.
4. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.

I year - II semester M. Tech (BT)

(Open Elective)

122 MB47 ENTREPRENEURSHIP AND INNOVATION

L	T	P	C
3	1	-	3

The objective of the course is to make students understand the nature of entrepreneurship, and to motivate the student to start his/her own enterprise with innovative skills.

UNIT 1: Nature of Entrepreneurship; Characteristics, Qualities and skills of an Entrepreneur, functions of entrepreneur, Entrepreneur scenario in India and Abroad. Forms of Entrepreneurship: Small Business, Importance in Indian Economy, Types of ownership, sole trading, partnership, Joint Stock Company and other forms. First-Mover disadvantages, Risk Reduction strategies, Market scope strategy, Imitation strategies, and Managing Newness.

UNIT 2: Aspects of Promotion: Generation of new entry opportunity, SWOT Analysis, Technological Competitiveness, legal regulatory systems, patents and trademarks, Intellectual Property Rights- Project Planning and Feasibility Studies- Major steps in product development.

UNIT 3: Management of Small Business

Pre feasibility study - Ownership - budgeting - project profile preparation - Feasibility Report preparation - Evaluation Criteria- Market and channel selection- Product launching - Monitoring and Evaluation of Business- Effective Management of Small business.

UNIT 4: Support Systems For Entrepreneurs

Institutional Support, Training institution, Financial Institutions and Aspects: Sources of raising Capital, Debt-Equity, Financing by Commercial Banks, Government Grants and Subsidies, Entrepreneurship Promotion Schemes of Department of Industries (DIC), KVIC, SIDBI, NABARD, NSIC, APSFC, IFCI and IDBI. New Financial Instruments. Research and Development – Marketing and legal aspects, Taxation benefits, Global aspects of Entrepreneurship.

UNIT 5: Introduction to Innovation

Meaning of innovation, sources of innovative opportunity, 7 sources of innovative opportunity, Principles of innovation, the enablers of innovation, business insights, insights for innovation, technical architecture for innovation, focus on the essence of innovation.

UNIT 6: Process And Strategies For Innovation

Process of innovation, the need for a conceptual approach, Factors contributing to successful technological innovation, Strategies that aim at innovation, impediments to value creation and innovation.

TEXT BOOKS:

1. Robert D Hisrich, Michael P Peters, Dean A Shepherd: Entrepreneurship, TMH, 2009
2. Peter Drucker (1993), “Innovation and Entrepreneurship”, Hyper Business Book.

I year - II semester M. Tech (BT)

(Open Elective)

122SE22 OBJECT- ORIENTED PROGRAMMING THROUGH JAVA

L	T	P	C
3	1	-	3

UNIT-I

History of Java, Java buzzwords, datatypes, variables, simple java program,scope and life time of variables,operators, expressions, control statements, type conversion and costing, arrays,, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, recursion, string handling, StringTokenizer.

UNIT-II

Inheritance –Definition ,single inheritance , benefits of inheritance, Member access rules, super class, polymorphism- method overriding, Dynamic method dispatch, using final with inheritance, abstract classes,Base class object.

UNIT-III

Interfaces :definition, variables and methods in interfaces , differences between classes and interfaces, usage of implements and extends keyword, an application using interfaces, uses of interfaces.

Packages: Definition, types of packages, Creating and importing a user defined package.

Introduction to i/o programming: DataInputStream, DataOutputStream, FileInputStream, FileOutputStream, BufferedReader.

UNIT-IV

Exception handling -exception definition, benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes.

Multi-Threading:-Thread definition, types of multitasking, uses of multitasking, ,thread life cycle, creating threads using Thread class and Runnable interface, synchronizing threads, daemon thread.

UNIT-V

Advantages of GUI over CUI ,The AWT class hierarchy,Component,Frame,
user interface components- labels, button, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, menubar, graphics, layout, managers –boarder, grid, flow, card and grid bag.

Event handling: Delegation event model,closing a Frame,mouse and keyboard events, Adapter classes.

UNIT-VI

Applets – Concepts of Applets, differences between applets and applications,life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Networking – Basics of network programming, addresses, ports, sockets, simple client server program, multiple clients, sending file from server to client.

TEXT BOOKS

1. Java; the complete reference, 6th editon, Herbert schildt, TMH.
2. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

REFERENCES

1. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, seventh Edition, Pearson Education.
2. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell,Seventh Edition, Pearson Education

I year - I semester M. Tech(BT)

122BT73 BIOPROCESS ENGINEERING LAB

L	T	P	C
-	-	6	2

1. Immobilization of whole cells (Yeast)
2. Immobilization of enzymes (amylase) and determination of specific activity.
3. Various bioprocesses followed by product recovery e.g.
   (i) Citric acid production from *A. niger*
   (ii) Ethanol production from *S. cereviceae*
4. Enzyme kinetic studies: Determination of Michaelis Menten constant
5. Microbial kinetic studies: determination of Monod's model constants
6. Determination of volumetric mass transfer coefficient sodium sulphite oxidation method
7. Experiments on Bioreactor operation
   a. Screening
   b. Media preparation for fermentation
   c. Fermenter testing
   d. pH probe calibration
   e. Pump calibration
   f. Fermenter sterilization
   g. Fermenter charging
   h. Media sterilization
   i. Inoculation methods for fermenter
   j. Fermentation-Batch, Fed Batch
   k. Addition bottles: solution preparation
   l. Sampling
   m. Harvest the culture from the fermentor
8. Gel filtration chromatography
9. Adsorption isotherms
10. Drying technique
11. Cell disruption using Homogenizer
12. Precipitation of proteins using Ammonium sulphate

I year - II semester M. Tech(BT)

122BT74 Technical Seminar
(Independent Review Paper)

L	T	P	C
-	-	3	2

There shall be two seminar presentations during I year I semester and I year II Semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

II year – I semester M. Tech(BT)

122BT75 Comprehensive Viva-Voce

L	T	P	C
-	-	-	2

There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studied during the M.Tech course of study. The Comprehensive Viva-Voce is valued for 50 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce. A candidate has to secure a minimum of 50% to be declared successful.

II year – I semester M. Tech(BT)

122BT76 Project seminar -I

L	T	P	C
-	-	-	2

In II year I semester and II semester, a project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation) in each of the semester. The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 25 marks and the end semester seminar evaluation shall carry 25 marks. The report for the project seminar will carry 10 marks and the remaining marks (15) shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

II year – I semester M. Tech(BT)

122BT77 PROJECT WORK (PART I)

PROJECT STATUS REPORT

L	T	P	C
-	-	-	**18**

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

A Project Review Committee (PRC) shall be constituted comprising of Heads of all the Departments which are offering the M.Tech programs and three other senior faculty members concerned with the M.Tech. Programme.

Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the PRC.

After satisfying attendance requirement, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Project work. This process is to be completed within four weeks of commencement of II year I semester.

The student shall submit a project report at the end of II year I semester, and the same shall be evaluated at the end of that semester by the PRC as Excellent/Good/Satisfactory/Unsatisfactory. In the case of unsatisfactory declaration, the student shall re-submit the Project report after carrying out the necessary modifications / additions in the Project work, within the specified time as suggested by the PRC.

II year – II semester M. Tech(BT)

122BT78	**Project seminar-II**	**L**	**T**	**P**	**C**
		-	**-**	**-**	**2**

In II year I semester and II semester, a project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation) in each of the semester. The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 25 marks and the end semester seminar evaluation shall carry 25 marks. The report for the project seminar will carry 10 marks and the remaining marks (15) shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

II year – II semester M. Tech(BT)

122BT79 Project work and Dissertation

L	T	P	C
-	-	-	20

A candidate is permitted to submit Project Dissertation only after successful completion of PG subjects (theory and practical), seminars, Comprehensive viva-voce, PG Project Part–I, and after the approval of PRC, not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and shall make an oral presentation before the PRC. Along with the draft thesis the candidate shall submit draft copy of a paper in standard format fit for publication in Journal / Conference, based on the project thesis, to the Head of the Department with due recommendation of the supervisor.

- Four copies of the Project Dissertation certified by the Supervisor and Head of the Department shall be submitted to the College.

- The dissertation shall be adjudicated by one examiner selected by the College. For this, Head of Department shall submit a panel of 3 examiners, who are eminent in that field, with the help of the PRC. The Chief Superintendent of the college in consultation with the college academic committee shall nominate the examiner.

- If the report of the examiner is not favourable, the candidate shall revise and resubmit the Dissertation, in the time frame as prescribed by PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected. The candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.

- If the report of the examiner is favourable, viva-voce examination shall be conducted by a Board consisting of the Head of the Department, Supervisor and the Examiner who adjudicated the Dissertation. The Board shall jointly report the student's performance in the project work as – (a) Excellent, or (b) Good, or (c) Satisfactory, or (d) Unsatisfactory, as the case may be. In case, the student fails in the viva-voce examination, or gets the Unsatisfactory grade, he can re-appear only once for the viva-voce examination, as per the recommendations of the Board. If he fails at the second viva-voce examination, the candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.