M. Tech. Biotechnology Syllabus Common (Revised)
(Paper codes Will be introduced latter)

Semester I

Code	Course Title	Contact Hrs/Wk	Credit
A	**Theory**	**L-T-P**	
MBT - 101	Advanced Recombinant Technology	3-1-0	4
MBT - 102	Biophysical Chemistry	3-1-0	4
MBT - 103	Advanced Plant Biotechnology	3-1-0	4
MBT - 104	Mathematics and Biostatistics	3-1-0	4
MBT – 115 A	**Advances in Bioreactor Design, Development and scale up***	3-1-0	4
		15-5-0	**20**
B	**Practical**		
MBT - 191	Genetic Engineering Lab	0-0-4	2
MBT – 192	Enzyme Technology Lab	0-0-4	2
MBT-193	Seminar I	0-0-2	1
		0-0-10	**5**
	Semester Total	**15-5-10**	**25**

*** Subject to be offered by HIT, Kolkata**

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Semester II

Code	Course Title	Contact Hrs/Wk	Credit
A	**Theory**	**L-T-P**	
MBT - 201	Advanced Bioinformatics	3-1-0	4
MBT - 202	Cell biology & Immunology	3-1-0	4
MBT - 203	Bio-processing Technology	3-1-0	4
MBT - 204	Downstream Processing	3-1-0	4
MBT – 215 A	**Proteomics and Genomics ***	3-1-0 **15-5-0**	4 **20**
B	**Practical**		
MBT - 291	Downstream Processing Lab	0-0-4	2
MBT – 292 MBT-293	Bioinformatics Lab Seminar II	0-0-4 0-0-2 **0-0-12**	2 **1**
	Semester Total	**15-5-10**	**2 5**

- *** Subject to be offered by HIT, Kolkata**

Semester III

Code	Course Title	Contact Hrs/Wk	Credit
A	**Theory**	**L-T-P**	
MBT - 301	Elective **- I**	3-1-0	4
MBT - 302	Elective - **II**	3-1-0	4
		6-2-0	**8**
MBT - 391	Comprehensive Exam(Viva-Voce)		2

C MBT - 392	Project work/thesis		**15**
	Semester Total		**25**

Semester IV

Code	Course Title	Contact Hrs/Wk	Credit
A MBT - 491 MBT - 492	Project work (Thesis) Sessional	0-0-0	20 5
	Semester Total		**25**

*** Elective I & II to be offered by HIT, Kolkata**

Elective -I	Elective - II
MBT- 301A Nanotechnology	**MBT – 302A** Bio-pharmaceuticals
MBT – 301B Modeling and Simulation in Bioprocess	**MBT – 302B** IPR, Ethics and Biosafety
	MBT 302 C Advanced Instrumentation in Biotechnology

Total Credits

1St Semester - 25
2nd Semester – 2 5
3rd Semester – 25
4th Semester – 25

Total : 100

M. Tech. Biotechnology Syllabus Common (Revised)
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MBT-101: **Advanced Recombinant Technology (Credit 4)**

1. Basic Tools of Genetic Engineering: [4 L]

Restriction endonucleases, DNA modifying enzymes, Cloning and Expression Vectors: plasmids, phage vectors, cosmids, phagemids, Yeast cloning vectors, Animal viruses, Ti plasmids and Cauliflower Mosaic Virus, Yeast artificial chromosome, Bacterial artificial chromosome and PAC.

2. Cloning, introduction of cloned gene into host cells and their expression: [6 L]

Cloning and expression techniques in *E.coli, B. subtilis*, *yeast*, Baculovirus-insect cell system, mammalian cell system. Restriction cloning, TOPO TA cloning, PCR product cloning, Yaest Two Hybrid system and GATWAY cloning technology. Construction and screening of genomic and cDNA library. Bacterial transformation (Chemical induction and electroporation, conjugation) and introduction of DNA into plant and animal cells.

3. Genetic Engineering Techniques: [8 L]

Restriction analysis (Agrose gel electrophoresis, PFGE), Sequencing of protein and DNA, DNA and RNA probes (production, labeling by radioactive and non-radioactive method, uses), PCR, RT-PCR, Real Time PCR, RACE, AFLP, RFLP, RAPD and FISH. Blotting and hybridization techniques, Directed Mutagenesis and protein engineering, mRNA isolation and cDNA synthesis, DNA fingerprinting.

4. Selection of engineered DNA clones and their expression products: [8 L]

Direct and indirect methods, Drug resistance, Gene inactivation, DNA hybridization, colony hybridization and in-situ hybridization (Southern, Northern, Dot blots, immunological assay, Western blotting). Protein synthesis in mini and maxi cells, Genetic changes for overproduction such as insulin, interferon, tPA and growth hormones.

5. Manipulation of Model plants and Animal: [8 L]

Transfer of genes in animal oocyte, invivo cloning of animals, gene transfer and transgenic animals, techniques of creating transgenic mice, homologous recombination koncout mice. Techniques of creating transgenic plants.

6. Application of Genetic Engineering: [8L]

Genetically engineered DNA in Medicine and industry, Generation of agriculturally important plants and animals, Marshalling of recombinant DNA to fight AIDS, DNA based diagnosis of genetic diseases, Mapping of human disease genes, Human gene therapy, RNAi, siRNA and ribozyme technology. DNA fingerprinting in clinical diagonosis and forensics. Biosafety measures and regulation of genetic engineering works.

References:

1. "Recombinat DNA" by J. D. Watson et al., W.H. Freeman and Company
2. "Molecular Biotecnology: Principles and Applications of Recombinant DNA" by B. R. Glick and J.J. Pasternak, ASM press
3. "Principle of Gene Manipulation: An introduction to Genetic Engineering " by R.W. Old and S. B. Primrose, Blackwell Science Inc.
4. "DNA cloning: A Practical Approach" by D. M. Glover and B.D. Hames, IRL Press.
5. Molecular cloning: A Laboratory A manual (3rd edition) by J. Sambrook and D. Russell, Cold Spring Harbor Laboratory Press.

MBT-102: Biophysical Chemistry (4 credits)

Macromolecular structure and dynamics 6L

Configurations and conformations of macromolecules; interaction of biological macromolecules with water and non-aqueous environments; non-covalent (weak) forces that stabilize protein and nucleic acid structure; simulation of the structure of biological macromolecules including energy minimization, molecular dynamics and free energy methods.

Statistical thermodynamics of biological macromolecules 6L

Partition functions, structural transitions in polypeptides and proteins including coil helix transitions, Structural transitions in polynucleic acids and DNA including melting and annealing of polynucleotide duplexes, helical transitions of double stranded DNA, prediction of helical structures in genomic DNA.

Optical spectroscopic methods/techniques and their applications to biomolecules 15 L

A.UV- Visible spectroscopy ---- 2L

Beer-Lambert's law; application of UV spectrophotometric techniques towards biomolecular structure determination

B. IR-Raman spectroscopy 4L

Principles (e.g. frequency, wavenumber, vibrational modes, factors influencing vibrational frequency) and applications of IR, FT-IR and Raman spectroscopy to biomolecules

C. Circular dichroism and optical rotatory dispersion 3L

Linear dichroism of biological polymers; Use of circular dichroism in protein analysis; e.g. electronic CD of both proteins and nucleic acids

D. Fluorescence Spectroscopy: 6L

Quantum Yield and Stokes shift, Fluorophores, steady state and time resolved protein fluorescence, Fluorescence lifetime measurements, solvent effects on emission spectra, fluorescence quenching, fluorescence anisotropy, Energy transfer, fluorescence sensing, fluorescence based DNA technology, flow cytometry

3D-structure determination, single molecule and laser excitation based methods and their applications- 13 L

A. **X-ray diffraction-3L**

Space groups; crystal symmetry; Miller Indices, Bravais lattices, X-ray diffraction and Bragg's law, X-ray structure determination of biomolecules and accuracy/refinement of x-ray crystallographic structures

B. **NMR spectroscopy-3L**

The NMR phenomenon, Chemical Shielding and Chemical Shift, ID NMR spectroscopy , NMR relaxation times, Nuclear Overhauser Effect , 2D NMR basics with NOESY, COSY pulse sequences and simple applications

C. **Single molecule/Electron microscopy methods-4**

Rationale behind single molecule methods; Basic concepts of tunneling force microscopies and electron microscopies; Atomic force microscopy (AFM); Scanning

tunneling and Scanning electron microscopies (STM and SEM); Transmission electron microscopy (TEM); simple applications

D. Laser based methods and their applications to biology and medicine-3

Basic concepts of the laser phenomenon and coherence ; types of lasers (e.g. Xe; Nd-YAG etc.); fiber optics technology; applications of lasers for biomolecular structure determination (e.g. LIF) and to medicine (e.g. surgery, ophthalmology)-

Books

1. C.R. Cantor and P.R. Schimmel; Biophysical Chemistry; Vol. 2 Freeman
2. Keith Van Holde, Chien and Ho. Principles of Physical Biochemistry 2nd Edition Pearson
3. D.M. Freifelder; Physical Biochemistry: Applications to Biochemistry and Molecular Biology (Freeman)
4. J.R. Lakowicz; Principles of Fluorescence Spectroscopy (Springer)
5. M.L. Wohlbarsht Ed. Laser Applications in Medicine and Biology (Springer)
6. Molecular Spectroscopy –by Steinfeld (John Wiley & Sons)
7. Proteins-Structure and Function- by David Whitford (John Wiley and Sons)
8. Biochemistry- By Lubert Stryer (Academic Press)

MBT - 103 Advanced Plant Biotechnology (Credit 4)

Plant Genomics and Molecular Mapping

1. Introductory lecture. (1 L)
2. Identification of candidate genes using: genetic information (positional cloning); biochemical and expression analysis (microarray analysis, proteomics, metabolomics). (2L)
3. Characterization and functional analysis of candidate genes using: transformation, mutant populations, knockout systems; Heterologous expression systems .(2L)
4. Structural and Functional genomics; application of sequence based and structure-based approaches to assignment of gene function. (2L)
5. Constructing molecular maps; Molecular tagging of genes/traits; Marker assisted selection of qualitative and quantitative traits. (2L)
6. Molecular marker technology; map-based cloning and their use in transgenics. MAS for genes of agronomic importance, e.g. insect resistance, grain quality and grain yield; (2L)
7. Construction of genetic and physical map; Gene mapping and cloning; QTL mapping and cloning. (4L)
8. Protein arrays: basic principles; analysis of proteomics data, Identification of disease genes. SNPs, Metabolic pathways: KEGG, EMP (2L)

The Gene transfer Techniques for the production of Transgenic

1. Overview of different gene transfer methods , plant vectors for transformation, transgene analysis and expression. (2L)

2. Indirect Gene transfer Methods**:** structural features of Ti plasmid, mechanism of gene transfer to plants Integration of T-DNA into plant genome, Molecular events in *Agrobacterium* mediated gene transfer. (4L)
3. Direct gene transfer methods**:** Particle bombardment mediated transformation, Mechanism, Particle gun design, parameter for effective transformation; silicon carbide fiber mediated transformation and alternative methods. (2L)
4. Reporter genes, Selectable and scorable markers, Binary and Co-integrative vectors, Removal of marker genes, Applications and limitations of *Agrobacterium* gene transfer (3L)
5. Plastid engineering: Introduction, importance, scope and technique (2L)

Crop Improvement and Agro-industrial biotechnology

1. Genetic Engineering for Herbicide resistance (2L)
2. Genetic Engineering for Biotic and Abiotic Stress Resistance/Tolerance (2L)
3. Genetic engineering for Improvement of crop yield and quality: Protein, lipids, carbohydrates, vitamins & mineral nutrients; (5L)
4. Agro-industry: (4L)

Microbes in agriculture , Production and utilization of essential amino-acids, chemicals from micro-algae. Agro-waste utilization; Mycorrhiza in agriculture and forestry.

Texts/References:

1. SS Bhojwani & MK Razdan. *Plant Tissue Culture: Theory and Practice, a Revised Edition.* 2005. Elsvier
2. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford University Press,2008
3. HS Chawla. Introduction to plant Biotechnology,2nd Edition, Oxford & IBH,2002
4. Bob B. Buchanan, Wilhelm Gruissem and Russell L. Jones. Biochemistry & Molecular Biology of Plants, ASPB Publication, 2008
5. Edited by BR Jordan, 2nd Edition, The Molecular Biology and Biotechnology of Flowering, CABI, 2006.
6. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.
7. R J Henry, Plant Genotyping: The DNA Fingerprinting of Plants, CABI Publication, 2001

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MBT-104: Numerical Analysis and Bio-statistics (4 Credits)

1. Sampling and presentation of data: (2L)

Application of statistics, variables, sampling method, Frequency distribution, Pie diagram, Bar diagram, Frequency polygon, Histogram, Frequency distribution curve, Scatterdiagram

2. Statistics of dispersion: (**3L)**

Variability, Range, Mean deviation, Standard Deviation, Variance, central moments, Coefficient of Quartile deviation, Coefficient of variation, Coefficient of dispersion.

3. Probability Distribution: (**6L)**

Probability mass function for discrete random variables and probability density function for continuous random variables; Skewness, Kurtosis, important discrete probability distributions: bernoulli, binomial, geometric, poisson, hypergeometric; important continous distributions: uniform, exponential, normal.

4. Regression: (4L)

linear, logistic, and multiple regression; correlation model—Application to biological science.

5. Testing Hypothesis: (**5L)**

Concepts and importance in experimental research, type of errors; testing means, Significance of difference between means using Z score; Large sample tests based on normal distribution – Test based on t and F distributions, Chi square test for goodness of fit, independence of attribute, homogeneity, and variance of a normal population.

6. Non-parametric and distribution-free statistics (3L)

introduction; some important nonparametric tests; Sign test, Wilcoxon's rank test and Spearman's rank correlation.

7. Analysis Of Variance: (**3L)**

One way and two way classifications of Anova – Applications from Biological Sciences – Case studies.

8. Solution Of Equations And Eigen Value Problems (4L)

Iterative method, Newton – Raphson method for single variable and for simultaneous equations with two variables. Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss – Seidel methods.

9. Interpolation (3L)

Newton's divided difference formulae, Lagrange's and Hermite's polynomials. Newton forward and backward difference formulae.

10. Numerical Differentiation And Integration (4L)

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules. Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule.

11. Initial Value Problems For Ordinary Differential Equations (3L)

Single step Methods – Taylor Series, Euler and Modified Euler, Runge – Kutta method of order four for first and second order differential equations.

Text Book:

1. Debajyoti Das, Arati Das, Statistics in Biology and Pshychology, Academic Publisher
2. P.N. Arora, P.K. Malhan, Biosttistics, Himalaya Publishing House
   Sastry, S.S., "Introductory Methods of Numerical Analysis (Third Edition)", Prentice Hall of India, New Delhi, 1998.
3. Kandasamy, P.,Thilakavthy, K. and Gunavathy, K. "Numerical Methods", S.Chand and Co., New Delhi ,1999.
4. Grewal B.S., Grewal J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, 1999.
5. Jain M.K., Iyengar S.R.K and Jain R.K., "Numerical Methods for Engineering and Scientific Computation (Third Edition)", New Age International (P) Ltd., New Delhi, 1995.
6. Gerald C.F., Wheatley P.O., Applied Numerical Analysis (Fifth Edition), Addison – Wesley, Singapore, 1998.
7. Narayanan S., Manickavachakam Pillai K. and Ramanaiah G., "Advanced Mathematics for Engineering Students-Vol.-III", S.Viswanathan Pvt. Ltd., Chennai, 1993.

MBT-115 A*: Advances in Bioreactor design, Development and Design Scale up (Credit 4)

1. Inoculums development: (3L)

Introduction to fermentation process, Microbial growth kinetics and media for Industrial fermentation, design of industrial nutrient media. Sterilization: Thermal death kinetics of micro – organisms – Batch and continuous Heat sterilization of liquid media – filter sterilization of liquid Media and Air. Inocula Development: Introduction – criteria for the transfer of inoculums – Development of inocula for: Yeast processes, Bacterial processes and mycelial processes – The Aseptic inoculation of plant fermenters.

2. Batch and continuous culture: (**10L)**

Chemostat: General principle, Balance equations critical dilution rate, Biomass productivity, comparison with batch cultures, residence time distribution, Test of validity, imperfect mixing, wall growth Transient state analysis, Turbidostat, Chemostat in series Applications. Fed batch operation, Perfusion system, Bioreactor consideration in immobilized cell system.

3. Advanced Bioreactor (5L)

Stirred vessel reactors, Bubble column reactors, biochemical loop reactors and its applications, Biological wastewater treatment in reciprocating jet bioreactors, tower-shaped reactors for aerobic biological wastewater treatment. Membrane bioreactors.

4. Product Formation in Microbial Cultures (4L)

Growth associated and nongrowth associated Kinetics, Energy Requirements:
Electron transfer concept; Maintenance energy, magnitude and control of maintenance energy, Effect of maintenance.

5. Effect of Inhibition and Activation of Growth (3L)

Competitive and noncompetitive inhibition, Product and substrate inhibition, activators, Effect on batch and continuous systems.

6. Transport Phenomenon in Bioreactor: (5L)

)Oxygen demand, solubility, measurement of D.O.T. Redox potential, oxygen transfer, measurement of K_La (different methods). Agitation and mixing, Baffled, vortex and airlift systems, Effect of stirring, sparging and other parameters, Power requirements for gassed and ungassed system, Rheology, O_2 Transfer.

7. Modeling and Scale Up of Bioreactor: (5L)

Introduction, Modeling of bioreactors, the model cycles, kind of models, complexity of the model, solving equations, parameter sensitivity, experimental design / parameter optimization / testing of the model.

Scale up of bioreactors: Introduction, scale up methods in use, fundamental methods, semi-fundamental methods, dimensional analysis, Rules of thumb, trial and error, Mechanistic background of dimentional analysis, the use of dimensionless groups for scaling up, heterogeneous systems, generation of dimensionless groups and some examples, regime analysis, method of regime analysis. Power input requirement, scale translation, types of fermenter, scale up of CSTR, design correlations, bulk mixing, scale up methods.

8. Bioreactor Instrumentation and Control: (3L)

Measurement of physical and chemical parameters in bioreactors – monitoring and control of dissolved oxygen, pH, impeller speed and temperature in stirred tank fermenter.

9. Plant and Animal Cell Bioreactor: (4L)

Plant cell bioreactors, characteristics of plant cell suspensions, plant cell bioreactor requirements, plant cell bioreactor design, plant cell bioreactor operation, alternative cultures for plant cells. Animal cells: Animal cell bioreactors, animal cell bioreactor operation, and animal cell bioreactor design.

Reference:

1.James E. Bailey and David F. Ollis, "Biochemical Engineering Fundamentals", 2nd Edn., McGraw Hill International Edition, New York, 1986.
2. "Comprehensive Biotechnology" Vol.2 Ed.: M. Moo-Young (1985)
3. Schuler & Kargi, Bio-process Eng. PHI
4. Aiba S. and Nancy F. Millis, "Biochemical Engineering", 2nd Edn., Academic Press, New York, 1973.
5. Web F.C, "Biochemical Engineering", Van Nostrand, London, 1964
6. Pauling M. Doran, Bioprocess engineering principles
7. Biotechnology Series edited by H. Bauer,
8. Biochemical Engineering, S.Aiba
9.Animal Cell Culture edited by Johr R.W. Master.

MBT-191: Recombinant DNA Technology lab (2credits)

1. **Cloning of a gene using plasmid /phage vector:**

Isolation of plasmid,
Restriction enzyme analysis of plasmid DNA by agrose gel elctrophoresis,
Ligation,
Bacterial transformation,
Selection of recombinant colonies,

2. Isolation of genomic DNA from bacteria, plant and tissue.

3. DNA amplification and cloning of a gene by PCR.

4. Sitedirected mutagenesis using PCR.

5. Southern blotting, Northern blotting, Western blotting and ELISA

5. Isolation of RNA and Isolation of poly A mRNA

6. Overexpression of proteins Protein electrophoresis-1D+2D.

7. Reporter gene assay (Gus/CAT/β-Gal)

References:
1. "Molecular cloning. A laboratory manual" 3rd edn. by J Sambrook et al. Cold spring harbor laboratory press,.
2. "Current Protocols in Molecular Biology"
3. "Gene cloning and analysis - A laboratory guide" by GJ Boulnois; Blackwell scientific publications, 1987

MBT-192: Enzyme Technology Lab (2 Credits)

Experiments:

1. Production of alkaline protease in bioreactor, isolation of the enzyme and optimization of its activity.
2. Determination of kinetic coefficients for amylase, with and without inhibition (competitive, uncompetitive, noncompetitive).
3. Determination of specific growth rate, yield coefficient of microbial growth in bioreactor.
4. Development and operation of immobilized enzyme bioreactor.
5. Determination of K_La (volumetric mass transfer coefficient) using gassing out method.

MBT 201: Applied Bioinformatics (4 Credits)

Sequence-alignment methodologies. [8 lectures]

Sequence databases; Similarity matrices; Pairwise alignment: Features of dynamic Programming, alignment by Bayesian Statistical Methods, multiple sequence alignment: local multiple sequence alignment: MEME, PSSM, HMM(algorithms and applications) Progressive methods for global multiple sequence alignment: CLUSTALW, PILEUP, T-COFFEE; Statistical significance of alignment results;

Pattern analysis in sequences and Phylogenetic tree construction methods [8 lectures]

Motif representation, Markov models; .Distance Based methods: clustering based methods,optimality based methods: Fitsch -Margoliash and Minimum evolution methods, Neighbor joining and related neighbor methods Character Based methods: Maximum parsimony methods, Maximum likely hood method, , genetic algorithm, Phylogenetic tree evaluation: Boot strap analysis; dendrogram and applications

Structure-Prediction of Biomolecules with applications in Bioinformatics [8 lectures]-

Structure classification of proteins (SCOP, CATH); Secondary structure prediction of various protein categories (e.g transmembrane proteins and helical proteins), RNA secondary structure prediction methods.
Patterns, motifs and Profiles in sequences: Derivation and search methods;Derived Databases of patterns, motifs and profiles e.g Prosite, Blocks, Prints-S, Pfam
Overview of tertiary structure prediction methods; algorithms for modeling protein folding; algorithms for 3D structure prediction with representative examples
Protein structure prediction by comparative modelling approaches (homology modeling and fold recognition); ab initio structure prediction methods

Molecular Modelling and drug design (16 L)
Force fields and their evaluation (e.g MM2, AMBER) Monte Carlo and molecular dynamics simulations (e.g. GROMACS); simulation approaches towards protein and nucleic acid conformation determination; Energy minimization techniques; Structure comparison using database formalisms(DALI, VAST etc.); CASP for dry-wet structure comparisons
Classification of drug targets, Target discovery and validation methodologies Types of drug targets and characterization of drugs, Structure based drug design methods including computer-aided drug design (pharmacophore development) and recent technology developments; Target selection, Ligand(lead compound) design ,optimization and analysis; Protein-ligand docking; QSAR; physico-chemical molecular descriptors; ADME parameters and their optimization; drug deliverability, metabolism, toxicity and pharmacokinetics; molecular diversity and Combichem; discussion of drug design to drug discovery to drug development with pharmaceutical/biotech drug case studies.

References:

1. "Principles of Drug Action" by W.B. Pratt and P. Taylor, Churchill Livingston
2. "Introduction to Bioinformatics", 2nd Edition, Arthur M. Lesk
3. "Molecular Biotechnology" Therapeutic Applications and Strategies. Sunil Maulik and Salil D. Patel, Wiley-Liss
4. "Principles of Medicinal Chemistry" by W.O. Foye, T.J. Lemke and D.A. Williams, Williams and Williams
5. "Side Effects and Drug Design", by E.J. Lien, Marcel Dekker
6. "Molecular Modelling: Principles and Applications", by Andrew Leach, Pearson Education
7. "Drug Discovery and Design" by Scolnick.J.(2001),Academic Press, London
8. Bioinformatics. (A.D.Baxevanis & B.F.F.Ouellette, eds.) Wiley Interscience, 1998.
9. *"Guidebook on Molecular Modeling in Drug Design"* N. R. Cohen, Editor. Academic Press, San Diego, 1996

10. Bioinformatics Sequences and Genome Analysis,2nd edition 2004 by David W. Mount, CBS Publishers and Distributors .
11. Introduction to Bioinformatics computer Skills, 2001, by Cynthia Gibas and Per Jambeck, SPD
12. "Introduction to Bioinformatics" by Atwood, Person Education
13. "Beginning Perl for Bioinformatics", James Tisdall, SPD
14. "Biocomputing : informatics and Genome Project",.,1994, by Smith, D.W Academic Press, NY.
15. "Computational Chemistry", Guy H. Grant and W. G. Richards OUP.

MBT 202 Cell Biology and Immunology (Credit 4)

Fundamental concepts of Cell Biology [5L]

General principles of signal transduction; signaling through G-protein-linked cell-surface receptors and second messengers; signaling through enzyme-linked cell-surface receptors; signaling through intercellular receptors.

Cell Cycle: [3L]

Components of the cell cycle control system, cytoskeleton filaments; molecular motors, intracellular control of cell cycle events; Extracellular control of cell division and cell growth, apoptosis; caspases.

Fundamental concepts of Immune system [4L]

Overview of immunology; components of innate and acquired immunity; phagocytosis; complement system; MHC – structure, genetic organization; HLA typing; graft versus host reaction; Antigens – immunogens, hapten, adjuvant, carrier.

Molecular basis of immune responses [7L]

Primary and secondary immune response; kinetics of immune response; Immunoglobulins – class, subclass and structure, Ig superfamily; affinity, avidity, allotype, isotype, idiotype; Antibody genes and antibody diversity.

Immunological techniques [5L]

RIA, ELISA, Western blotting, ELISPOT assay, Immunoflourescence, flow cytometry and immunoelectron microscopy, lymphoprofileration assay, mixed lymphocyte reaction, cell cytotoxicity assays, microarrays, transgenic mice, gene knock outs.

Vaccinology [7L]

Active and passive immunization; live, killed, attenuated, subunit vaccines; recombinant and protein-based vaccines, plant-based vaccines; reverse vaccinology; peptide vaccines; conjugate vaccines; antibody engineering –chimeric and hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries.

Immune system in health and disease [4L]

Primary and secondary immunodeficiency; pathogeensis of different diseases – Graves' disease; Rheumatoid arthritis, Myasthania Gravis, Multiple sclerosis, animal models of autoimmunity.

Cancer and immune system [5L]

Types of tumour; special properties of cancer cells; metastatic cascades, retroviral and cellular oncogenes; proto-oncogenes; activation pathways of proto-oncogenes; tumour suppressor genes; tumour antigens; tumour evasion of the immune system; immunotherapy of cancer.

MBT 203 Bioprocess Technology (Credit 4)

Principles of Enzyme catalysis and large scale purification of enzymes(10 L)

*Fundamentals of Enzyme Kinetics***:** Enzyme nomenclature, Units of Enzyme, Mechanism of Enzyme reaction, Reversible reactions, Enzyme kinetics, Enzyme inhibition, determinations of kinetic constants (2L)

Large Scale Production of Enzyme: Sources of Enzyme, Preparation of Enzyme, Centrifugation, Filtration, Aqueous Two-Phase system, Cell breakage - Ultrasonic, High pressure homogeniser, Bead mills, Freeze-press, Lytic enzyme, Ultrafiltration and Reverse osmosis, Concentration of enzyme, Stabilization of enzyme, Commercial preparations (5L)

Purification of Enzymes**:** Heat treatment, Chromatography – Adoption, Ion exchange, Hydrophobic, Affinity, Gel-exclusion, (3 L)

Application of Enzyme in Large Scale Industries (10 L)

Food Processing- Dairy, Bakery, Fats & oil, Brewing , Cheese Production ,Corn and High Fructose Syrup (5L)

Enzyme Processing of Industrial Products – Detergent , Leather & Wool , Textile & Cotton, , Paper & Pulp (5L)

Bioprocessing of Food (10L)

Bioprocessing of food for nutraceuticals –Lipid based nutraceuticals , polar lipid, PUFA, protein. Polysaccharide,nucleotide, other small molecular weight compounds (5L)

Functional Food production - Dietary fibre, Food Gum,Emulsifier & Surfactant, Artificial Butter, Favoring agent , Alternative Sweetener , Antioxidant , Preservatives (5L)

Microbial Bioprocess (!0L)

Bioremediation of Heavy metal and Polynucleated hydrocarbons (3L)
Biohydrogen and Bioethanol (3L)
Bioleaching of metal Ores (2L)
Biopesticide Production (2L)

Reference;

1. "Enzyme Technology" by A. Pandey, C. R. Socol, C. Webb, (2006), Springer.
2. "Enzyme Technology" by W.L. Goldstein, (1979), Academic Press
3. "Enzymes in Industry:Procedure and Application" (1990) By W. Aehie, Wiley-WeH Pub.**:**
4, "Fundamentals of food biotechnology" (1996) by H. Lee, Wiley IEEE
5. "Functional Foods & biotechnology" (2006) by K. Shelly, CRC Press.
6."Biotechnology and Food Ingredients" (1991) G. Richard, Springer.
7."Fundamental Food and Nutraceuticals" (2006) by J. Shi, CRC Press.

MBT-204: DOWNSTREAM PROCESSING (4 Credits)

1. Requirement of Downstream Processing: **2L**

Importance of downstream processing in biotechnology, problems, requirement of purification, characteristics of biological molecules, classes of bio-products, physicochemical basis of separation Overview of a bioprocess including upstream and downstream processing, Characteristics of fermentation broth & its pretreatment.

2. Product Isolation Method: **2L**

Liquid - liquid extractions, Distillation, Precipitation (Ammonium sulphate, organic solvent, high molecular weight polymer).

3. Overview of cell disruption : **2L**

Chemical method (detergent, alkali), physical (Osmotic shock, grinding with abrasive, solid shear, liquid shear and enzymatic methods.

4. Principles, operation, design and scale-up of the following: **6L**

Separation of particulate by filtration, Rotary Vacuum Filtration centrifugation (Batch, continuous, basket), settling, sedimentation, decanting, Material balance and numerical examples of that process.

5. Membrane based separation methods: **8L**

UF, RO, Dialysis, biotechnological application, Structure and characteristics of membranes; Design consideration for reverse osmosis, ultrafiltration and electrodialysis; Gaseous separations; Liquid membranes; Supported liquid membrane; Membrane reactors

6. Adsorptive separation: **3L**

Definition; Types of adsorption; Types adsorbents types, their preparation and properties; Types of adsorption isotherms and their importance; Mathematical modeling with suitable initial and boundary conditions for different cases such as thermal swing, pressure swing, and moving bed adsorption

7. Mechanism and modes of chromatographic separation: **5L**

Reverse Phase, Hydrophobic interaction, Size exclusion, Affinity, Ion exchange, Gel filtration, Role of HPLC in protein characterization.

8. Polishing of Bioproducts: **1L**

Crystallization of small and large molecules, Real life example, Drying and Formulations

9. New and Emerging techniques: **3L**

Pervaporation, Supercritical fluid extraction, Concept, modeling and design aspects and applications

10 Case studies: **12 L**

Baker's yeast, Ethanol, Power alcohol, Citric acid, Gluconic acid, Intracellular proteins, Penicillin, Streptomycin, Insulin, Casein, interferon, Tissue Plasminogen activator. Large scale separation and purification of *E.coli*, yeast and mammalian proteins, Recombinant products.

Reference:

1. Biochemical Engineering Fundamentals" by J.E. Bailey and D.F. Ollis, McGraw-Hill

2. Bioseparations" by P.A. Belter, E.L. Cussler and W.S. Hu, John Wiley and Sons Inc.
3. Seperation, Recovery and Purification in Biotechnology, Aenjo J.A. and J.Hong
4. Priniciples of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984)
5. Comprehensive Biotechnology" Vol.2 Ed.: M. Moo-Young (1985)
6. Biotreatment, Downstream Processing and Modeling" (Advances in Biochemical Engineering /Biotechnology, Vol 56) by T. Schepler et al, Springer Verlag
7. Chromatographic and Membrane Processes in Biotechnology" by C.A. Costa and J.S. Cabral, Kluwer, Academic Publisher
8. Downstream Processing" by J.P. Hamel, J.B. Hunter and S.K. Sikdar, American Chemical Society
9. Protein Purification" by M.R. Ladisch, R.C. Wilson, C.C. Painton and S.E. Builder, American Chemical society ,Verlag

MBT-205 * : Proteomics and Genomics (Credits 4)

Genomics:

1. Genome Evolution and overview of genomic anatomis: **[2 L]**

Origin of Genomes, Eukaryotic nuclear genomes, Eukarytotic organelle genomes, anatomy of prokaryotic genomes. Overview of genome database.

2. Approaches for Gene Identification and Gene Prediction: [4 L]

Prediction of genes, promoters, Splice sites, regulatory regions, Basic principles application of methods to prokaryotic and eeukaryotic genomes and interpretation of results.

3. Structural Genomics: [3 L]

Basic principles, Technology, Data Bases (NCBI and Plant Databases), Sequences Comparison techniques (BLAST etc.).

4. Functional Genomics: [5 L]

ESTs, Digital Northern, SAGE, molecular markers in genome analysis, RFLP and AFLP anlysis, Microarray (Basic principles and technology of cDNA microarrys, oligonucletide microarray chips, Cancer and genomic microarrays) Examples for application of microarrays, Microarray data analysis. Transcriptomics, Use of various databases in function assignment.

5. Molecular Phylogenetics and comparative Genomics: [4 L]

Gene duplication and phylogeny, Gene order, Horizontal gene transfer, Transposable element clusters of orthologous genes, DNA based phylogenetic trees, Application of molecular phylogenetics.

6. Genomic Variation: [3 L]

SNPs, AFLP and RFLP analysis, Arabidopsis KO Strategies, Pharmacogenomics, Ethical consideration of genetic testing.

Proteomics:

1. Introduction and Tools for Proteome Analysis: **[9 L]**

What is proteome? 2D gel electrophoresis, High-throughput proteome analysis with 2D-IEF, Current concepts of co-immunoprecipitation for protein interaction analysis, chromatography, amino acid sequencing, Current concepts of peptide sequencing with MS-MS methods, MALDI-TOF mass spectrometry and ESI-TOF MS, phage display, protein chips, Yeast Two-Hybrid (Y2H) methods, Synthetic lethal screen, Proteome-wide interaction maps, TAP tags, GFP tags, inteins and protein splicing for interaction analysis, protein array (Microarray-affimatrics and spotted array concepts).

2. Protein Structure and function Relationship: [6 L]

Protein-protein interactions for large molecular complexes (RNA polymerase II, ribosome), Databases for analysis for protein-protein interaction, Unstructured proteins (Current concepts and examples, the fly-casting mechanism). Current degradation concepts, the N-end rule and PEST sequences, control of ubiquitination, proteosome, SUMO Protein-protein interaction in health and disease.

3. Nuclear Magnetic Resonance Spectroscopy (NMR): **[3 L]**

Basic principles, chemical shift, spin-spin interaction, NOE, 2D-NMR, NOESY, COSEY.

4. X-ray Crystallography: **[3 L]**

Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor.

References:

1) "Genome II" by T. A. Brown.
2) "Human Molecular Genetics 3" by T. strachan and A. P. Read, Garland Science Pub.
3) "Principles of Genome analysis" by S.B. Primrose and R. M. Twyman,
4) "Genomics: Application in Human Biology" by S.B. Primrose and R. M. Twyman.
5) "Functional Genomics: Apracticqal Approach" by S. P. hunt and R. Livesey, Oxford University Press.
6) "DNA Microarry: Apractical approach" by M. Schlena, Oxford University Press
7) "Discovering Genomics, proteomics and Bioinformatics" by A. M. Campbell and L. J. Heyer.
8) Essentials of Genomics and Bioinformatics by C. W. Sensen, mJohn wiley ans sons Inc.
9) "Proteomics" by T. Palzkil, Kluwer Academic pub.
10) "Protein and Proteomics" by Richard J Simson, I K publisher
11) "Principles of Proteomics" by M. Twyman ; Bioscientific Publishers
12) "Introduction to Proteomics: by D. C. Liebler, Tools for the New Biology", Humana Press
13) Molecular Biology of the Cell, by B.Alberts,D.Bray, J.Lewis et al, Garland Pub. N.Y 1983
14) Genomics, by Cantor & Smith John Wiley & Sons

MBT-291: Downstream Processing Lab (2 Credits)

Experiments:

1. To produce potable water from seawater using Reverse Osmosis system.
2. Enzyme purification using ultrafiltration membranes.
3. a) Determination of alcohol percent composition in alcohol water mixture using Gas Chromatography.

b) To determine CO_2 / CH_4 percent composition in standard air sample using Gas Chromatography.

4. Gel Filtration study of enzyme mixtures.
5. Citric Acid production and purification by chemical method.
6. Downstream Processing of immunoglobulin.

MBT 292: Bio-informatics Lab (2 Credits)

1. **I**ntroduction to Bioinformatics lab and some useful terminologies. **H**andling of different primary databases and retrieval of primary data of both protein and nucleotide (Expasy, Entrez) of a particular group or type of an enzyme. Handling of different specialized databases: Pathway-KEGG, Disease databases (cancer and other disease databases), protein folding classification databases-FSSP, different genomic databases.
2. **D**ifferent approaches of Prediction of Genes: Promoters, splice sites, regulatory regions (Basic principles) application of methods to prokaryotic and eukaryotic genomes and interpretation of results.
3. **S**equence based and structure-based approaches to assignment of gene functions, e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc.
4. **D**ifferent approaches of Identification of Disease Genes: Based on some specialized general databases and specific disease databases.
5. **U**se of various derived databases in structure and function assignment, gene expression profiling.
6. **D**ifferent approaches for analysis of ligand-protein and protein- protein interactions.
7. **S**tudy to find out potential drug targets for cardio vascular, neurological diseases etc. using proprietary and public domain softwares (eg. VEGAZZ) (ligand design, optimization and improvement)

MBT - 301 A – Nanotechnology (Credit 4)

1. Nanotechnology –Introduction, Concepts and origin

Introduction and definition of nanotechnology, importance and role of nanoscale science and technology in the current context-pros and cons; history and development of nanotechnology –contribution of scientists and technologists. **[4L]**

2. Latest developments and future of nanotechnology: Intoduction**,** Silicon based technology and molecular manufacturing; introduction to nanotechnology applications in diverse fields (e.g. nanobiotechnology, nanomaterials); nanotech device developments (e.g. nanotubes, biosensors, solar cells). **[6 L]**

3. Properties of nanomaterials: Introduction, nanochemistry including self-assembly of materials; nanoparticles, carbon nanotubes, **nanocomposites**; **synthesis and characterization of such materials** **[8 L]**

4. Nanobiology: Introduction to nanobiology, bionanotechnology, nanobiochemistry, molecular nanotechnology, Nanosomes, Benefits of molecular nanotechnology). **[10 L]**

5.Nanotechnology in biomedical and Life Sciences: Introduction, nanomedicine, drug delivery, nanocapsule; nanorobots; nanopharmacology, other nanotechnology products and applications in other areas. **[10L]**

6. Research & development and career opportunities in nanotechnology (Indian and global perspective). **[4 L]**

Text book:

1) **"**Nanotechnology-principaes and applications" by S.K. Kulkarni, Capital pub. Com.
2) "Nanotechnology: A gentle introduction to the next big" by Mark and Daniel Ratner, perason low price.

Reference book:

1) "Nano: The Essentials" by T.Pradeep. Tata McGraw Hill, New Delhi (2007)
2) "Introduction to Nanotechnology" by Charles P Poole Jr and Frank J Ownes, John Wiley Sons, Inc(2003)
3) "Nanocomposite Science and Technology" by Pulickel m.Ajayan, Linda S.Schadler, Paul V.Braun, Wiley – VCH Verlag, weiheim (2003)
4) "Nanotechnology: Basic sciences and emerging technologies" by Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkar Raguse, Overseas Press (2005).
5) "Instrumental Methods of Analysis" by Willard, 2000.
6) "Instrumental Methods for Chemical Analysis" by Ewing. Etal 2000.
7) "Handbook of nanotechnology" by Bhushan
8) "Nanostructures & Nano Materials" by Ghuzang Cao.
9) "Nanoscale Technology in Biological Systems" by Cooper, Springer Verlag
10) "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" by Guozhong Cao
11) "Surface Science : Foundations of Catalysis and Nanoscience" by Kurt W. Kolasinski
12) "Self-Assembled Nanostructures" by G. Carotenuto
13) Integrated Chemical Systems : A Chemical Approach to Nanotechnology" (Baker Lecture Series) by Allen J. Bard

MBT –301 B Modeling and simulation in bioprocesses. (Credit 4)

1) Significance of modeling and simulation, kinetic models on different approaches; deterministic and stochastic, structured and unstructured, segregated and unsegregated; examples of each class. **[5 L]**

2) Compartmental models (two and four); product formation model; genetically structured models, modeling of extra cellular enzyme production. **[5L]**

3) Modeling of continuous sterilization of medium; modeling of activated sludge process with a control system; model for anaerobic digestion, model for SCP production form spent sulfite liquor. **[5 L]**

4) Models for external mass transfer, internal diffusion and reaction within biocatalysts, model for antibiotic formation; modeling of therapeutic protein production with recombinant cells. **[5 L]**

5) Simulation techniques; continuous system simulators (CSMP, INT, LEANS, MIDAS, MIMIC);dynamic process simulators (DYFLO, DYNSIS, PRODYC, REMUS); steady state material and energy balance programs(PACER, FLOWTRAN, CHESS);some aspects of INT and DYFLO programs; General arrangement of main program using INT subroutines. **[5 L]**

6) Programs based on numerical methods like algebraic equations, Newton_Raphson method for algebraic convergence, interpolation, arbitrary function generation (FUN1, FUN2 subroutines). **[5L]**

7) Programs based on solution of differential equations: Eular method for 1^{st} and 2^{nd} order integration, subroutines INT and INTI; Fourth order Runga –Kutta method: stability of numerical integration variable slip size method. **[5 L]**
8) Case studies, Numerical problems. **[5 L]**

References:

1. Bailey, J.E and D.F ollis , Biochemical Engineering fundamentals , 2^{nd} ed. McGraw Hill Book Co. , 1988
2. Blanch, H.W and I.J. Dunn ,
"Modeling and Simulation in Biochemical Engg" in advances in biochemical engg. Vol-3 edited by T.K. Ghosh, A.Fiechler and N. Blakebrngh.
3. R.G.E Franks, " Modeling and Simulation in chemical engineering ", Wiley International 1972.
4. Kleinstreur ,C. and T. Powegha,
" Modeling and Simulation of Bioreactor Process Dynamics " in Advances in Biochemical Engg./ Biotechnology , vol.30 , edited by A. Fiechler springer verlag , Berlin , Heidelberg,1984.

MBT – 302 A- Bio-pharmaceuticals (Credit 4)

1) Drug development, Manufacturing, Formulation and Drug delivery processes:(7L)

Introduction, Drug discovery and development; steps of drug discovery**;** Patenting, Drug manufacturing processes, biochemical Product formulation processes; Delivery of biopharmaceuticals as drugs: Parenteral delivery systems, Oral delivery systems, Pulmonary delivery, Nasal delivery, Ophthalmic delivery, transmucosal and transdermal delivery systems**.** Current status and future development trends of biopharmaceuticals.

2) Cytokines-Interferon family as biopharmaceuticals: **(5L)**

Introduction, Cytokines, cytokine receptors and Interferons; Types of interferons and function; signal transduction in interferon's, JAK-STAT pathway in interferon's and biological effects, eIF-2a protein kinase system, Interferon biotechnology, production and medical uses/applications of IFN-α, IFN-β, Medical a IFN-γ, Additional isolated interferons.

3) Interleukins, Tumour necrosis factor and Growth factor family as biopharmaceutical: (10L)

Introduction, Interleukin: Interleukin-2 (IL-2), Interleukin-1 (IL-1), Other Interleukins; Tumour necrosis factors (TNFs); Growth factors: Insulin-like growth factors (IGFs), Epidermal growth factor (EGF), Platelet-derived growth factor (PDGF), Fibroblast growth factors (FGFs), Transforming growth factors (TGFs), Neurotrophic factors, neurotrophins, Ciliary neurotrophic factor and glial cell line-derived neurotrophic factor, Neurotrophic factors and neurodegenerative diseases.

5) Hormones, thrombolytic agents, vaccines, and nucleic acids as biopharmaceuticals: **(10L)**

Introduction, Therapeutic protein hormones; proteins as thrombolytic agents, Vaccines: for Hepatitis B and tetanus immunoglobulin, Snake and spider antivenins for AIDS and Cancer; Peptide vaccines; AIDS and Cancer; monoclonal antibodies for Cardiovascular disease, Infectious diseases, Autoimmune disease, Transplantation and Anti-tumour antibodies; Nucleic acids as a therapeutic biopharmaceutical.

6) Blood factors, Haemapoietic growth factors and Therapeutic enzymes as biopharmaceuticals: (10 L)

Introduction, Blood and Blood substitutes; Haemostasis: coagulation pathway, Clotting disorders, Production of factor VIII, Factors IX, VIIa and XIII; Anticoagulants, Haemopoietic growth factors: Granulocyte colony stimulating factor (G-CSF), Macrophage colony-stimulating factor (M-CSF) Granulocyte-macrophage colony stimulating factor (GM-CSF), Leukaemia inhibitory factor (LIF), Erythropoietin (EPO), Thrombopoietin; Enzymes of therapeutic value: Asparaginase, Dnase, Glucocerebrosidase, a-Galactosidase and urate oxidase, Superoxide dismutase, Lactase.

Text Book:

1) "Biopharmaceuticals Biochemistry and biotechnology" (2nd Edition) by Gary Walsh, Pub: Wiley

Reference books:

1) "Drug Delivery and Targeting" by A.M. Hillery, A.W. Lloyd and J. Swarbrick, Harwood Academic
Publisher
2) "Pharmaceutical Biotechnology" by S. P. Vyas, V. Dixit, CBS Publishers
3) "Pharmaceutical Biotechnology" by Sambhamurthy & Kar , NewAge Publishers
4)" Monoclonal antibodies: applications in clinical oncology" by Epenetos A.A.(ed), Chapman and Hall Medical, London
5) Biopharmaceutics and Pharmacokinetics by V.Venkatesharalu , Pharma Books Syndicate

MBT 302 B- BIOSAFETY, ETHICS AND IPR (Credit 4)

Concept and implications of Bioethics (L 6)

Introduction to ethics and bioethics, roots of honours and integrity in science, The responsible conducts of biotechnological research, Research with human beings; societal obligation of a biotechnologist. Research with human beings; societal obligation of a biotechnologist: Introduction to Biosafety, Classification and Description of Biosafety Levels, Design of Clean rooms and and Biosafety Labs, Biosafety regulations to protect Nature , Growers and Consumers

Overview of general principles of Law (L 6)

Jurisprudential, definition and concept of property rights, duties and their correlations, History and evaluation of IPR – like patent design and copy right, Introduction to the need of intellectual Property rights, Distinction among the various forms of IPR, IPR in India and Abroad., Requirements of a patentable invention like novelty, inventive step, Prior art and state of art.

Unit III International and national interest of Biosafety (L-8)

Development and consequences on usage of GMOs: Risk for animal/human/agriculture owing to GMOs, risk of environment owing to GMOs, Introduction and need for Ethics, Ethical Issues involving GMOs, Ethical Issues in India and Abroad. Regulations on ethical principles in biomedical/ biotechnological practice: The Nuremberg code, declaration of Helsinki, The Belmont report, co-operational guidelines, WHO, guidelines of DBT, Guidelines of an informed consent, Rights/ protection, infringement or violation, Remedies against infringement, civil and criminal,

Concepts of Patenting: Indian patent act 1970 (L-10)

TRIPS major changes in Indian patent system, post-TRIPS effects, Contents of patent specification and procedure for patents, Obtaining patents, geographical indication, WTO, Detailed information on patenting biological products: Biodiversity Budapest, Appropriate Case Studies Biotechnology/ biomedicine application, Ethical consideration; ethics and the natural world, Environmental ethics (protecting public health and environment, Genetically modified foods – the ethical and social issue. Ethical issues in genetic engg, Biomedical science, eugenic enhancement, eugenic genetic engg. Genetic information – use and abuse, Patenting human genes, Ethical and policy issue

Ethics in cloning, genetic, Testing and screening (L –10)

Human gene therapy and genetic modification, Ethical and public consideration, Legal implication of somatic cell, gene therapy- germ line gene therapy. Ethics in Research design, Plagiarism in Research and publication implication --South Korea stem cell model. Copyright piracy and current global trends China model of infringement cases Trademark, Business mark, service mark and geographical indication national and international case studies. IPR and Business ethics case studies in at least five major biopharmaceutical companies.(Monsanto, Millennium, Genezyme, TGN biotech, Sciona etc)

Texts/References:

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3.T. M. Murray and m.J.Mehlman. Encyclopedia of ethical, Legal and Policy Issues in Biotechnology. John Wiley & Sons 2000.

Important Links:

http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/ - 31k - Cached - Similar page
http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section

M. Tech. Biotechnology Syllabus Common (Revised)

(Paper codes Will be introduced latter)

MBT 302 C - Advanced instrumentation in Biotechnology (Credits 4)

1. High Performance Liquid chromatography ----------5 Lectures

Basic principles, Instrumentation, quantification, reverse phase, Macromolecular separation,(gel filtration/ion exchange)

2. Luminescence Biotechnology----------5Lectures

Basic principle, instrumentation, measurement, chemoluminescence immunoassay, bioluminescence assay, molecular biological application of luminescence.

3. Chemical synthesis of peptides----------3Lectures

Background, solid phase peptide synthesis, limitations

4. Microscopic techniques in biotechnology ----------10 Lectures

Light microscopy, phase contrast, dark field, and fluorescence microscopy
Application of confocal microscopy
Electron microscopy:
Basic principles, instrumentation, Transmission Electron microscopy, Scanning electron Microscopy. Atomic force microscopy.

5. Capillary electrophoresis for biotechnology.....5 Lectures

Basic principles, instrumentation, application in biotechnology

6. Flow cytometry for Biotechnology.....5 Lectures

Tools---- High throughput flow cytometry---fluorescence activated cell sorter--application in biotechnology

7. Mass spectrometry in Protein and Proteomics----------5 Lectures

Basic principles of MALDI-Mass spectrometry
MALD – TOF Analyzer

8. Microarray Technology ---------- 4 Lectures

Basic Principles, Slide printing.