KALASALINGAM UNIVERSITY

Anand Nagar, Krishnankoil - 626 190

Department of Biotechnology

M.TECH. BIOTECHNOLOGY CURRICULUM

Semester I

Code No.	Subject	L	T	P	C
MAT1001	*Biomathematics*	3	0	0	3
BIT1001	*Immunotechnology*	3	0	0	3
BIT1002	*Downstream Processing*	3	0	0	3
BIT1003	*Bioprocess Plant and Equipment Design*	3	0	0	3
BIT1004	*Recombinant DNA Technology*	3	0	0	3
BIT1081	Genetic Engineering Laboratory	0	0	6	2
	Total	15	0	6	17

Semester II

Code No.	Subject	L	T	P	C
BIT1005	Genomics and Proteomics	3	0	0	3
BIT1006	Transgenic Engineering	3	0	0	3
BIT1007	*Bioprocess Modeling and Simulation*	3	0	0	3
BIT1008	*Bioinformatics and Drug Design*	3	0	0	3
BIT1009	*Molecular Biology*	3	0	0	3
BIT1082	Bioprocess Engineering Laboratory	0	0	6	2
	Total	15	0	6	17

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M.TECH. BIOTECHNOLOGY CURRICULUM

Summer Course

Code No.	Subject	L	T	P	C
BIT****	Elective I	3	0	0	3
BIT****	Elective II	3	0	0	3
BIT****	Total	6	0	0	6

Semester III

Code No.	Subject	L	T	P	C
BIT****	Elective III	3	0	0	3
BIT****	Elective IV	3	0	0	3
BIT****	Elective V	3	0	0	3
BIT1098	M.Tech Thesis Part I	0	0	12	6
	Total	9	0	12	15

Semester IV

Code No.	Subject	L	T	P	C
BIT1099	M. Tech Thesis Part II	0	0	24	12
	Total	0	0	24	12

Total Credits - 67

KALASALINGAM UNIVERSITY

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M.TECH. BIOTECHNOLOGY CURRICULUM

List of Electives

Code No.	Subject	L	T	P	C
BIT1010	Immobilization Technology	3	0	0	3
BIT1011	Enzyme Technology	3	0	0	3
BIT1012	Bioremediation	3	0	0	3
BIT1013	Drug Design and Targeting	3	0	0	3
BIT1014	Industrial Microbiology	3	0	0	3
BIT1015	Metabolism and Bioenergetics	3	0	0	3
BIT1016	Statistical Techniques and Computer Programming	3	0	0	3
BIT1017	Biomolecular Spectroscopy	3	0	0	3
BIT1018	Industrial Waste Treatment and Management	3	0	0	3
BIT1019	Bioelectricity	3	0	0	3
BIT1020	Modeling and Analysis of Bioprocesses	3	0	0	3
BIT1021	Membranes: Structure and Dynamics	3	0	0	3
BIT1022	Clinical Physiology	3	0	0	3
BIT1023	Biological Enquiry: History & Philosophy	3	0	0	3
BIT1024	Plant Biotechnology	3	0	0	3

SEMESTER I

MAT1001	BIO – MATHEMATICS	L	T	P	C
		3	0	0	3

ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER

Exactness and integrating factors - variation of parameters - Ordinary linear differential equations of n-th order - solution of homogeneous and non- homogeneous equations, operator method, method of undetermined coefficients and variation of parameters - Sequence and series - Power series methods for linear ordinary differential equations - Laplace transform and its applications - Fourier series and Fourier transform - applications in biotechnology

PARTIAL DIFFERENTIAL EQUATIONS

Models in physiology - introduction to solution techniques such as variable separation, product method and Laplace Transform method

BIOSTATISTICS

Basic probability concepts - objective and subjective - sets and random events - axiomatic definition, counting, permutation, and combination - probability of random events by counting - Basic laws of probability - conditional and joint probabilities - independence of events - definition and examples of random variable, Baye's theorem - Moments of Random Variables - expected values, mean, variance - covariance between to or more random variables - derivation and specialization for important random variables - independence of random variables

SAMPLING THOERY

Sampling - random sampling, standard notations - distributions of statistics such as sample means, difference between two sample means, sample proportions - Estimation - expectation, variance and other moments from sample data - properties of estimators - unbiasedness, efficiency and consistency - implications of each property

REGRESSION ANALYSIS

Regression - linear, logistic, and multiple regression - correlation model Testing Hypothesis - concepts and importance in experimental research - type of errors - testing means - Chi square test for goodness of fit, independence of attribute, homogeneity

TEXTBOOK

1. Eason, G., Coles, C.W., Gittinby, G., Mathematics and Statistics for the Biosciences, Pearson Higher education, New York, 3rd Edition, 1992

REFERENCES

1. Murray J.D., Mathematical Biology, Springer-Verlag, Berlin, 3rd Edition, 2005
2. Kreyszig, E., Advanced Engineering Mathematics, John Wiley, Brisbane, 9th Edition, 2006

BIT1001	IMMUNOTECHNOLOGY	L	T	P	C
		3	0	0	3

CYTOKINES

Cytokines regulating immune inflammation - interleukin-4, interleukin-10, interleukin-12 – Interferons - basic biology and therapeutic potential, treatment of inflammatory diseases

MACROMOLECULES

Intravenous immunoglobulin therapy - Treatment of angioedema resulting from Cl inhibitor deficiency

ANTIBODIES AND ANTIBODY BASED THERAPY

Characteristics of animal cells and their implication on process design - Nutritional requirements and serum free culture of mammalian cells - Kinetics of growth and product formation - Reactor systems for large-scale production using animal cells - Production of Polyclonal antibodies with different types of antigens - antigen preparation and modification, adjuvant, dose and route of antigen administration, collection of sera, purification of antibodies - Inhibitors of tumor necrosis factor - Targeting the IL2 receptor with antibodies or chimeric toxins, monoclonal antibodies to CD3

HYBRIDOMA TECHNOLOGY

Production and applications of monoclonal antibodies for diagnosis and therapy

IMMUNOTHERAPY FOR ALLERGIC DISEASES

Specific and nonspecific immunotherapy for Asthma and allergic diseases, insect stings etc. Renal, pancreas, cardiac, lung, liver transplantation, xenotransplantation. Tumor Immunology, AIDS and other Immunodeficiencies

TEXTBOOK

1. Frank Austen, K., Burakoff, S.J., Fred Rosen, Terry B. Strom, Therapeutic Immunology, Blackwell Science, Boston, 3rd Edition, 2006

REFERENCES

1. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby Immunology, W.H., Freeman & Co, San Francisco, 6th Rev. Edition, 2006
2. Ivan M. Roitt, Seamus J. Martin, Peter J. Delves, Roitt's Essentials of Immunology, Blackweel Publishing, 11th Edition, 2006

BIT1002	DOWNSTREAM PROCESSING	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction to fermentation process - Microbial Growth Kinetics - Media for industrial fermentations – Sterilization - Development of inocula for industrial fermentations - Design

of a fermenter - Instrumentation and control - recovery and purification of fermentation products

BIOSEPARATION

An overview of bioseparation - Separation of cells and other insolubles from fermented broth - filtration and microfiltration, centrifugation (batch, continuous, basket)

CELL DISRUPTION

Physical methods - osmotic shock, grinding with abrasives, solid shear, liquid shear - Chemical methods - alkali, detergents - Enzymatic methods

PRODUCT ISOLATION

Extraction and absorption method - precipitation - ammonium sulphate, organic solvents, high molecular weight polymers - ultrafiltration

CHROMATOGRAPHY

Method of selection - selection of matrix - gel filtration - ion-exchange chromatography - affinity chromatography - hydrophobic interaction chromatography – HPLC - Co-valent chromatography - IMAC chromatography. Crystallisation and drying - Effluent Treatment - Fermentation economics

TEXT BOOKS

1. Belter, P.A., Cussler, E.L., Wei-Houhu, Bioseparations – Downstream Processing for Biotechnology, Wiley Interscience , London, 5th Edition, 1988
2. Jenkins, R.O. (Ed.), Product Recovery in Bioprocess Technology – Biotechnology by Open Learning Series, Butterworth-Heinemann, Sydney, 3rd Edition, 1992

REFERENCES

1. Bailey, J.E., Ollis, D.F., Biochemical Engineering Fundamentals, McGraw-Hill, London, 3rd Edition, 1990
2. Micheal L. Shuler, Fikret Kargi, Bioprocess Engineering – Basic Concepts, Printice Hall of India, New Delhi, 2nd Edition, 2004
3. Mukhopadhyay, S.N., Process Biotechnology Fundamentals, Viva Books Pvt. Ltd, New Delhi, 2nd Edition, 2004

BIT1003	BIOPROCESS PLANT AND EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

BASIC PRINCIPLES

Principles of kinetics for chemical and biochemical reactions - Fundamentals of homogeneous reactions for batch, plug flow, semi-batch, stirred tank/ mixed reactors

NON-IDEAL REACTOR ANALYSIS

Concept of ideal and non-ideal reactor - residence time distribution - models of non-ideal reactors – plug flow reactor for microbial processes

REACTOR DESIGN

Types of reactors – batch, plug low reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor bubble column, air lift fermenter etc. - Mass transfer in biochemical processes - Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells - three phase fuidized bed trickling bed reactor - Design and analysis of the reactor systems - Gas liquid reactors

UNCONVENTIONAL BIOREACTORS

Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture

ADVANCED CONCEPTS

Scale up concepts - Bioprocess control and computer coupled bioreactors - Growth and product formation by recombinant cells - Design, scale up and optimization of various equipment and biosystems used for biotechnological process industries

TEXTBOOKS

1. Anton Moser, Bioprocess Technology - Kinetics and Reactors, Springer Verlag, London, 2nd Edition,1988
2. Levenspiel, O., Chemical Reaction Engineering, John Wiley Eastern Ltd, San Francisco,3rd Edition, 1998

REFERENCES

1. Bailey, J.E., Ollis, D.F., Biochemical Engineering Fundamentals, McGraw-Hill, London, 3rd Edition, 1990
2. Atkinson, B., Biological Reactors, Pion Ltd., London, 2nd Edition, 1974

BIT1004	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
		3	0	0	3

EXPRESSION OF GENES IN PROKARYOTIC AND EUKARYOTIC SYSTEMS

Use of prokaryotic and eukaryotic organisms as biological systems in molecular biotechnology - Gene structure in prokaryotic and eukaryotic cells - Genetic elements that control Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, post translational processing of mRNA, extra chromosomal DNA and its functions

TOOLS IN rDNA TECHNOLOGY

Restriction endonucleases and other enzymes used in recombinant DNA technology - Cloning vectors - Plasmid cloning vector pBR322, other plasmid vectors, Bacteriophage l vectors and other phage vectors - Cosmids, Phagemids - YAC and BAC vectors - Genetic transformation of prokaryotes - Transferring DNA into *E.coli* – Chemical induction and Electroporation - DNA labeling - radioactive and non-radioactive methods - DNA sequencing – Chemical cleavage and dideoxy methods - Polymerase Chain Reaction, RT-

PCR, RACE, Real-time quantitative PCR - Southern and Northern blotting - DNA fingerprinting

ANALYSIS OF CLONED GENES AND STUDYING GENE FUNCTION

Construction of cDNA and genomic DNA library - library screening by DNA hybridization - immunological assays - protein activity - gene isolation and cloning - Chromosome walking - in situ hybridization - site-directed mutagenesis - Expression of cloned gene in recombinant cells – production of biochemicals - DNA markers - Gene transfer to animal cells - strategies (direct transfer, transfection) - Reporter genes and promoter analysis - Selectable markers - Two-vector expression system - Cloning in bacteria other than *E. coli* / *Saccharomyces cerevisiae* and other fungi

APPLICATION OF RDNA TECHNOLOGY

DNA Diagonostic system - random amplified polymorphic DNA (RAPD), DNA finger printing, their applications

TRANSGENIC TECHNOLOGY & HUMAN GENOME PROJECT

Advances in Transgenic Technology - Antisense and ribozyme technology -Human genome project and its application - Gene therapy prospect and future, Current production of rDNA products - Bio-safety measures and regulations for rDNA work

TEXTBOOKS

1. Primrose, S.B., Twyman, R.M., Bob Old, Principles of Gene Manipulation and Genomics, Blackwell Publishing, 7th Edition, Boston, 2006
2. James Watson, Jan Witkowski, Myers Richard, Amy Caudy, Recombinant DNA: Genes and Genomics; A short course, F.H. Freeman, San Francisco, 3rd Edition, 2006

REFERENCES

1. Bernard R. Glick & Jack J. Pasternak, Molecular Biotechnology, ASM Press, Washington, 3rd Edition, 2003
2. Joseph Sambrook & David W. Russel, Molecular Cloning, Cold Spring Harbor Laboratory, New York, 3rd Edition, 2001
3. Robert F. Weaver, Molecular Biology, MGH Publication, London, 5th Edition, 2005

BIT1081	GENETIC ENGINEERING LABORATORY	L	T	P	C
		0	0	6	2

1. Studies of auxotrophs, strain improvement improvement by UV/Chemicals method
2. Selection of improved Strain/Cell line, studies of phenotypic characteristic of mutants and their comparison with wild type strain
3. Extraction and purification of plasmid DNA
4. Bacterial transformation and identification of recombinant colonies
5. Preparation and transformation of competent cells, preparation of agarose gel
6. Restriction enzyme analysis
7. Indentification of recombinant clones

SEMESTER II

BIT1005	GENOMICS AND PROTEOMICS	L	T	P	C
		3	0	0	3

GENOMICS

Large scale genome sequencing strategies - Genome assembly and annotation - Prediction of Genes - Promoters, splice sites - Regulatory regions - basic principles, application of methods to prokaryotic and eukaryotic genomes and interpretation of results

STRUCTURAL GENOMICS (SG)

Gene networks - the need for SG - basic principles, approaches for target selection - Functional genomics - application of sequence 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. - Use of various derived databases in function assignment

DNA MICROARRAYS

Basic principles - using the databases - understanding of microarray data and correlation of gene expression data to biological processes and computational analysis tools (especially clustering approaches)

PROTEOMICS - PROTEIN ARRAYS

Basic principles - bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server) - databases (such as InterPro) and analysis tools. Databases such as DIP, PPI server and tools for analysis of protein-protein interactions

IDENTIFICATION OF DISEASE GENES

Basic concepts - need for identification of disease genes, role of bioinformatics- OMIM database - reference genome sequence, integrated genomic maps - Gene expression profiling - identification of SNPs, SNPs databases (DbSNP). Databases such as KEGG and EMP

TEXTBOOK

1. Primrose, S. B., Twyman, R. M., Principles of Genome Analysis, Blackwell Publishing, Singapore, 3rd Edition, 2002

REFERENCES

1. Primrose, B., Twyman, R. M., Genomics: Applications in Human Biology, Blackwell Publishing, Singapore, 4th Edition, 2004
2. Westermeier, R., Naven, T., Proteomics in Practice (A Laboratory Manual of Proteome Analysis), Wiley-VCH, London, 3rd Edition, 2002

BIT1006	TRANSGENIC ENGINEERING	L	T	P	C
		3	0	0	3

TRANSGENESIS

Animal cell culture - Homologus recombination in mammalian cells - Classic transgenic mice - history, production and use - The cre/lox recombination system as a tool in transgenic engineering - Transgenic mice in immunology, neurobiology and oncogenesis

TRANSGENIC ANIMALS

Methods for production of animals - in production of proteins of pharmaceutical use, in understanding the basic organ and tissue-specific gene expression in the living body, for production of animal models for human or animal disease, for improving desired characteristics and productivity of domestic animals

TRANSGENIC PLANTS

Plant tissue culture - Techniques for transformation of photosynthetic organisms - Microprojectile bombardment - amplification, movement and expression of genes in plants by viral-based vectors

FLORAL MUTANTS

Mendalian and molecular studies - Aquaculture and transgenic fish - Microinjection, electroporation - Gene gun and use of DNA-incubated sperm as procedures to deliver DNA into fish eggs - Advantages of using fish over mammals in transgenic technology

ETHICAL ISSUES

The ethics, biological and environmental safety issues surrounding the production of transgenic animals, plants and humans - Intellectual property and biotechnology

TEXTBOOKS

1. Grosveld, F., Kollias, G., (Eds), Transgenic Animals, Acdemic Press, New York, 1st Edition, 1992
2. Hiatt, A., Transgenic plants: Fundamentals and applications, Marcel Dekkar, New York, 2nd Edition, 1993

REFERENCE

1. Meran, R.L., Owean, Jan Pen (Eds.), Transgenic plants: A production system for industrial and pharmaceutical proteins, John Wiley & Sons, London, 3rd Edition, 1996

BIT1007	BIOPROCESS MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

BIOPROCESS MODELING

Unstructured and structured modeling - Deterministic and stochastic models - Segregated and unsegregated models - Shu's segregated models for Lactic acid fermentation

STRUCTURED KINETIC MODELS

Compartmental models (two and three), Product formation, Unstructured and structured models, Genetically structured models.Stochastic model for thermal sterilization of the medium, Modelling for activated sludge process, Model for anaerobic digestion, Models for lactic acid fermentation and antibiotic production

BIOPROCESS STIMULATION

Process simulation techniques - Equation oriented approach, Equation oriented simulators (SPEED UP, ASCEND, FLOWSIM, QUASILIN, DYNSIM)

SIMULATION PROGRAMS

Simulation programs based on Euler's methods, Newton – Raphsen methods, Runga – Kutta methods - Simulation of biochemical system models

DESIGN AND ANALYSIS OF BIOLOGICAL REACTORS

Case studies in fermentation with reference to enzymes, antibiotics etc

TEXTBOOKS

1. Jiri E., Prenosil, Elmar Heinzle, John Ingham, Irving J. Dunn, Biological Reaction Engineering: Dynamic Modelling Fundamentals With Simulation Examples, Science, London, 2003
2. Bailey, J.E., Ollis, D.F., Biochemical Engineering Fundamentals, McGraw-Hill, London, 3rd Edition, 1990

REFERENCES

1. Fiechter, A., Ghose, T.K., N. Blakebrough, Advances in Biochemical Engineering, Springier-Verlag, Berlin, 5th Edition, 2005
2. Elmar Heinzle, Arno P. Biwer, Charles L. Cooney, Development of Sustainable Bioprocesses: Modeling and Assessment, Wiley Publishers, New York, 6th Edition, 2007
3. Selected articles by G. Francis on Modelling and Simulation of Bioprocesses

BIT1008	BIOINFORMATICS AND DRUG DESIGN	L	T	P	C
		3	0	0	3

INTRODUCTION

Databases - mapping, sequence, structure, non-redundant - Sequence alignment - pairwise and multiple – phylogenetics - Structure prediction methods - homology, threading, abinitio - Sequence analysis - class and secondary structure prediction- motifs – PROSITE - detecting functional sites in DNA – ORFinder - Computer science perspective - pattern recognition, hidden Markov models - neural networks

MOLECULAR SIMULATION TECHNIQUES

Monte Carlo Methods - Metropolis Monte Carlo Algorithm - Flow calculations in Metropolis, Monte Carlo Algorithm with examples - Ising Lattice, Gibbs Ensemble Monte Carlo Simulations

MOLECULAR DYNAMICS METHODS

Methods for the integration of Dynamical Equations - Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles - Structural information from M.D

MOLECULAR MECHANICS

Energy minimization - intra molecular interactions - Physicochemical parameters in drug design - Ionization constants, chelation, solubility and partition Co-efficient - Over view of Molecular Descriptors

DRUG DESIGN

Rational basis of drug designing - Criteria for synthesizing drugs - Drug designing approaches - Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction - Structure based drug design process - Receptor based design - drug designing using known receptor structure, design of energy inhibitors - Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools - Scoring and docking mode - QSAR principles and Methods in drug designing - Current research in drug designing- a case study

TEXTBOOKS

1. Leach, A.R., Molecular Modelling: Principles and application, Princeton Hall, London, 2nd Edition, 2001
2. Krogsgaard, L., Povl Madsen, Text Book of Drug Design and Discovery, CRC, London, 3rd Edition, 2002
3. A.D.Baxevanis & B.F.F.Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley Interscience, New York, 3rd Edition, 2004

REFERENCES

1. Walsh, G., Biopharmaceuticals-Biochemistry and Biotechnology, Wiley, London, 3rd Edition, 1998
2. Cohen, N. R., Guidebook on Molecular Modeling in Drug Design. Academic Press, San Diego, 3rd Edition, 1996

BIT1009	MOLECULAR BIOLOGY	L	T	P	C
		3	0	0	3

DNA

Double Helix (Chargaff's Rules) - Major and minor grooves etc., A, B, and Z forms of DNA, DNA topology - The chemistry of DNA synthesis - mechanism of DNA polymerase, replication fork - specialization of DNA polymerases - DNA synthesis at the replication fork,

initiation of DNA replication - binding and unwinding - Origin detection and activation by the initiator protein, finishing replication

CHROMOSOMES

Chromosome sequence and diversity - Organization in eukaryotes - Chromosome duplication and segregation - Nucleosome, higher-order chromatin structure, regulation of chromatin structure - Principles of nucleic acid hybridization - Cot curves - Laws of DNA constancy and C-value paradox - numerical and structural changes in chromosomes, Heterochromatinization - Coding and non-coding sequences - Satellite DNA

RNA

RNA–types and functions - Mechanism of transcription of prokaryotes and eukaryotes, methods for measuring nucleic acid and protein interactions - Promoters and Enhancers - Operons-*lac* and *trp* operon - Bacteriophage lambda-lysogeny and lytic cycle and M13 their molecular biology - Environmental regulation of gene expression - Capping, polyadenylation – splicing - ribo-nucleoproteins

mRNA & tRNA

Structure of mRNA, RNA editing, mRNA stability, RNA interference, rRNA processing-in prokaryotes and eukaryotes - prokaryotic and eukaryotic ribosome - tRNA processing in prokaryotes and eukaryotes - RNase P - mRNA, tRNA, attachment of amino acids to tRNA – ribosome - initiation, elongation and termination of translation – translation dependent regulation of mRNA and protein stability - Transposons and retrotransposons - Replication and functions RNA tumor viruses

MUTATION

Mutation – Recombination - Molecular basis of spontaneous and induced mutation and their role in evolution - DNA-methylation - Repair and SOS response

TEXT BOOK

1. Watson, J. D. , Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of the Gene, Benjamin Cummings, London, 3rd Edition, 2003

REFERENCES

1. Weaver, R.F., Hedrick, P.W., Molecular Biology, William C. Brown, Illinois, 5th Edition, 2003
2. Malacinski G.M., Freifelder D., Essentials of Molecular Biology, Jones & Bartlett Pub, Boston, 4th Edition, 2002

BIT1082	BIOPROCESS ENGINEERING LABORATORY	L	T	P	C
		0	0	6	2

1. Calculation of specific growth rate, yield coefficient and other kinetic parameters for different fermentation systems
2. Medium optimization for fermentation processes by using factorial designs, plackett burman design and CCD
3. Study of enzyme kinetics, Determination of V_{max}, K_m, and other kinetic parameters.
4. Study of Enzyme inhibition kinetics & immobilization kinetics
5. Analysis of bioprocesses with different bioreactor operation like batch, fed batch and continuous mode
6. Operation in Air lift bioreactors, fluidized bed reactors
7. Modeling and simulation of bioprocesses – Case studies using literatures

SYLLABUS FOR ELECTIVES

BIT1010	IMMOBILIZED ENZYME AND WHOLE CELL TECHNOLOGY	L	T	P	C
		3	0	0	3

ENZYMES

Introduction - Free and immobilized enzymes - Applications in industrial, medical, analytical, chemical, pharmaceutical and food sectors - Enzyme isolation, purification and immobilization methods - Immobilization of whole cells

ENZYME KINETICS IN FREE AND IMMOBILIZED ENZYMES

Michaelis-Menten kinetics - Kinetics for reversible reactions

EFFECT OF VARIOUS TYPES OF INHIBITION

Evaluation of kinetic parameters - Micro environmental effects on enzyme kinetics, Enzyme deactivation – Compettitive and non-compettitive inhibition kinetics

DESIGN AND ANALYSIS OF ENZYME REACTORS

Ideal reactors - Reactor dynamics - Reactors with non-ideal mixing

INTERNAL AND EXTERNAL MASS TRANSFER EFFECTS IN IMMOBILIZED-ENZYME REACTORS

Intra-particle diffusion and reaction - Operational stability and optimization - General design considerations - Enzyme reactions in organic media

TEXT BOOK

1. Martin Chaplin, Christopher Bucke , Enzyme Technology, Cambridge University Press, London, 4th Edition, 1990

REFERENCES

1. James M. Lee, Biochemical Engineering, Prentice Hall, New York, 2nd Edition, 1992
2. Trevan, M.D., Immobilized Enzymes, John Wiley & Sons, New York, 3rd Edition, 1980
3. Lehninger, A., Priciples of Biochemistry, Worth Publishers, New York, 2006

BIT1011	ENZYME KINETICS AND TECHNOLOGY	L	T	P	C
		3	0	0	3

CONCEPTS OF RATE PROCESSES IN BIOLOGICAL SYSTEMS

Factors contributing to enzyme catalytic rates - Single and multi-substrate system - Regulatory enzymes - Steady-state kinetics - Initial velocity, product inhibition enzyme

activation analysis - Effect of pH and temperature on enzyme rates - Isotope effects and their application to transition state structure

CLASSIFICATION AND NOMENCLATURE OF ENZYMES

Hydrolases and transferases - Peptidases - Esterases – Kinases – ATPases – Oxidoreductases - Lyases and some examples of isomerization, rearrangement and condensation reactions - The role of metal ions and cofactors like pyridoxal phosphate, Thiamine -pyrophosphate, folate, biotin, flavin, nicotinamide nucleotides and lipoate in enzyme catalytic mechanisms

STRUCTURAL ENZYMOLOGY

Active site characterization - Methods of active site group assignment - Chemical modifications and site directed mutagenesis - Integration of kinetic, chemical, and structural data towards enzyme mechanisms - Immobilization techniques and methods - Influence of immobilization on enzyme activity - Frontiers in enzyme technology

STABILITY OF ENZYMES

Strain selection, (thermophilic, halophilic, alkalophilic producer strain) - Cloning stable enzyme in mesophile - Protein engineering to improve enzyme stability

ENZYME APPLICATIONS

Industrial, medical and analytical appliocations of enzymes. Enzyme reaction in non-aqueous medium - Synthesis with hydrolase enzymes - Chemical modification of enzyme to improve physico-chemical properties

TEXT BOOKS

1. Fersht, A.R., Enzyme Structure and Mechanism, W.H. Freeman & Co, New York, 5th Edition, 2000
2. Segel, I.H., Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems, Wiley Interscience, New York, 6th Edition, 1994

REFERENCES

1. Plownan, K.M., Enzyme Kinetics, McGraw-Hill & Co, London, 4th Edition, 1972.
2. Walsh, C.S., Enzymatic Reaction Mechanisms, W.H. Freeman & Co, New York, 4th Edition, 1978
3. Trevan, M.D., Immobilized Enzymes, John Wiley & Sons, New York, 3rd Edition, 1980

BIT1012	BIOREMEDIATION	L	T	P	C
		3	0	0	3

AN OVERVIEW OF THE CURRENT BIOREMEDIATION PRACTICE AND ITS APPLICATIONS

Microbial systems of bioremediation - Factors influencing bioremediation- environmental factors, physical factors and chemical factors

MICROBIAL TRANSFORMATION REACTIONS

Aerobic and anaerobic biotransformations - Microbial detoxification of specialty chemicals like insecticides, herbicides, fungicides, polychlorinated biphenyls, heavy metals

RESPONSES OF MICROORGANISMS TO THE PRESENCE OF POLLUTANTS

Inducible degradative enzymes and mechanisms - Application of genetically engineered microorganisms for hazardous waste management .

BIOREMEDIATION SYSTEMS AND PROCESSES

Solid and slurry phase bioremediation (land farming, composting, slurry bioreactors and lagoons - Microbial cleaning of gases (biofiltration and bioscrubbing) - Liquid phase bioremediation .

IN SITU BIOREMEDIATION

Assessment for in situ bioremediation - Microbial activity - Subsurface delivery systems - in situ oxygenation. Defining project goals - project team, review of remediation options - Developing design concept - Supportive elements of project

TEXTBOOKS

1. James J. Valdes, Bioremediation, Kluwer Academic Press, Boston, 2nd Edition, 2000.
2. Ronald L. Crawford, Don L. Crawford, Bioremediation: Principles and Applications, Cambridge Universoty Press, London, 3rd Edition, 2005

REFERENCES

1. Baker H., Herson D. S., Bioremediation, McGraw-Hill Inc., London, 3rd Edition, 1994
2. Eweis J. B., Ergas S. J., Chang D. P. Y., Schroeder E. D., Bioremediation Principles,., McGraw-Hill Inc., Boston, 2nd Edition, 1998

BIT1013	DRUG DESIGN AND TARGETING	L	T	P	C
		3	0	0	3

ORGANIZED DRUG DISCOVERY AND DEVELOPMENT

Pharmacological, Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction strategies - Alternative strategies in Lead identification - Lead optimization - Preclinical development - Clinical trials, Patenting, and clearance for

application - Receptor versus enzyme mediated drug action - SAR and its quantitative description – QSAR - Molecular principles in agonist and antagonist action

THERMODYNAMIC AND STRUCTURAL PRINCIPLES

Objectives and approaches in the native ligand modification - Molecular graphic and dynamical methods in peptide and protein mimicry - Morphinans versus Enkephalins - paradigm example of a peptido-mimetic, other illustrative examples from current literature. - Drug design by receptor site fit - Active site simulations using PDB structure data and homology modeling - Graphical and computational active site fits exploiting small structure data libraries and commercial softwares

CONCEPT OF PERTURBATION

Free Energy and its practical applications - Rational design of enzyme inhibitors - Enzyme catalytic principles - Affinity Labels - Illustrative examples - Principle of Suicide Inactivation - Design strategies, scope and limitations - Illustrative examples to cover hydrolases, PLP based enzymes, isomerases and redox enzymes

PRINCIPLES AND PRACTICE OF TRANSITION STATE MIMICRY

Illustrative examples - ACE, Renin and HIV protease inhibitors - Collected Substrate Analog Inhibitors and design strategies - illustrative examples - Combinatorial approach to compound libraries - Current status and future prospects - Synthetic Peptide libraries - Peptide libraries through Phage Display - Applications in Epitope, Agretope mapping and in synthetic vaccine design

ARTIFICIAL COMBINATORIALS

Peptides - Benzodiazepines and other current examples - Selection strategies and screening methodologies - Perspectives in Gene Therapy - Human Genome Project and its possible impact

TEXT BOOK

1. Hansch, C., (Ed.), Comprehensive Medicinal Chemistry (Vols. I-VI) , Pergamon Press, London, 3rd Edition, 1990

REFERENCES

1. Sandler, M., Smith, H. J., Design of Enzyme Inhibitors as Drugs, Oxford University Press, London, 4th Edition, 2002
2. Perun, T. J., Propst, C. L., Computer Aided Drug Design, Marcel Dekker, New York, 5th Edition, 1989

BIT1014	INDUSTRIAL MICROBIOLOGY	L	T	P	C
		3	0	0	3

THE SCOPE OF INDUSTRIAL MICROBIOLOGY

Screening strategies for new metabolite such as antibodies, enzymes, amino acids and other substances - Strain improvement methods and their applications

FERMENTATION MEDIA
Stock cultures - Inoculum preparation - Sources of raw materials for Biotechnology industry - Fermentation procedures - Purification and recovery of products - Biochemical basis of production processes

FERMENTATIVE PRODUCTION
Structure, biosynthesis, regulation and uses of organic acids - amino acids – nucleosides - nucleotides and related compounds – Vitamins - Antibiotics - Ergot alkaloids

MICROBIAL TRANSFORMATIONS
Basic principles - Immobilised enzymes and cells - Enzymes as products of fermentation - Representative examples - Penicillin acylase, glucose isomerase, invertase - Aspects of single cell proteins - Microbial leaching - Extracellular polysaccharides (EPSs)

PROCESS ECONOMICS AND PATENTS
A brief introduction to patents and secret processes - Fermentation economics and process appraisal

TEXTBOOKS

1. Crueger and A. Crueger, Biotechnology: A Textbook of Industrial Microbiology (Ed. T. D. Brook). Sinaeur Associates, 2nd Edition, 1990
2. L. E. Casida, Industrial Microbiology. Wiley Eastern Ltd., 1989

REFERENCES

1. G. Reed (Ed.), Prescott and Dunn's Industrial Microbiology (4th Ed.). CBS Publishers, 1999
2. H. J. Rehm, G. Reed, H. Pape (Eds.), Biotechnology (A Comprehensive Treatise vols. 1-8). VCH, 1986
3. Harry W.Seeley, Paul Van Denmark, Microbes in Actions: A lab Manual of Microbiology. D. B. Taraporwalla and Sons, 1997

BIT1015	METABOLISM AND BIOENERGETICS	L	T	P	C
		3	0	0	3

OVERVIEW OF METABOLISM
Concept of flow of matter and energy - Thermodynamics of coupled systems and non-equilibrium reactions - Biological energy currencies - high energy bond, reducing power and inter conversions of energy forms - Carbon, nitrogen cycles in biosphere - Classification of living system based on carbon and energy requirements - Methods to study metabolism

BIOSYNTHESIS OF CARBOHYDRATES AND LIPIDS
Photosynthesis - photosynthetic electron transport, Calvin cycle and other avenues of harvesting light energy – Gluconeogenesis - Cori cycle - Glycogen metabolism - Biogenesis of fatty acids and sterols

CARBOHYDRATE AND LIPID CATABOLISM
Glycolysis - TCA cycle - Fatty acid oxidation, other metabolic routes of carbon - Oxidative phosphorylation

NITROGEN & PROTEIN METABOLISM
Sources of organic nitrogen; flow of nitrogen into biosynthesis and catabolism of amino acids; central role of glutamine; the urea cycle and excretion of nitrogen - Digestion and absorption of proteins - Protein turnover - Catabolism of carbon skeletons of amino acids

METABOLISM OF NUCLEOTIDES
Biosynthesis of purines and pyrimidine nucleotides - Catabolosim of purines and pyrimidine nucleotides - Integration of metabolism and concepts of metabolic regulation, metabolic disorders

TEXTBOOK

1. Ochs, R.S., Hanson, R.W., Halls, J., Metabolic Regulation, Elsevier, Amsterdam, 4th Edition, 1985

REFERENCES

1. Atkins, P.W., Julio De Paula, Physical Chemistry, W.H. Freeman & Co, New York, 8th Edition, 2006
2. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Biochemistry, W.H. Freeman & Co, New York, 5th Edition, 2003.
3. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Illustrated Biochemisrty, MGH publications, Santiago, 26th Edition, 2003
4.

BIT1016	STATISTICAL TECHNIQUES AND COMPUTER PROGRAMMING	L	T	P	C
		3	0	0	3

BIOSTATISTICS
Probabilities - Conditional probability – Probability distribution function - probability mass function for discrete random variables and probability density function for continuous random variables

PROBABILITY DISTRIBUTIONS
Important discrete probability distributions - bernoulli, binomial, geometric, poisson, hypergeometric - important continous distributions - uniform, exponential, normal - Random variables – Expectation - Special distributions - Estimation, Sampling distributions - Hypotheses testing – Regression - Error propagation

EXPERIMENTAL DESIGN
Experimental design - Randomization, factorial, Latin square, and sequential cross-over design

STUDENT'S T TEST & F TEST

Student's t test - Applicability to samples from normal distributions - F Test and applications - comparison of variances of two normal distributions - Non-parametric distribution

PROGRAMMING IN A HIGH-LEVEL LANGUAGE

Algorithms - pseudocodes, examples from chemistry, biology and numerical analysis

TEXTBOOK

1. Morris H. DeGroot, Mark J. Schervish, Probability and Statistics, Addision Wisely, San Francisco, 3rd Edition, 2001

REFERENCES

1. Rajaraman, V., Fundamentals of Computers, Prentice-Hall India Private limited, New Delhi, 2004
2. Chapra, C., Canale, R.P., Numerical Methods for Engineers, Tata McGraw-Hill, London, 5th Edition, 2005

BIT1017	BIOMOLECULAR SPECTROSCOPY	L	T	P	C
		3	0	0	3

ELECTROMAGNETIC AND QUANTUM THEORY OF RADIATION

Wave-particle duality – Photons - Yukovs theory for nature of forces - Interaction of light with matter - Transition dipole moment - Group theory - Jablonsky diagram

UV-VISIBLE ABSORPTION SPECTROSCOPY

Beer-Lambert's law - Applications of UV-visible difference Spectroscopy - Circular dichroism in protein analysis

FLUORESCENCE SPECTROSCOPY OF BIOMOLECULES

Quantum yield - Static and dynamic quenching of fluorescence, energy transfer, polarization, anisotropy, time-resolved fluorescence - IR, FT-IR and Raman spectroscopy of biomolecules

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Chemical shifts - coupling constants, ring currents, paramagnetic shifts, spin-spin and spin-lattice relaxation times – NOE - Chemical exchange - Application to bimolecular structure and dynamics

ELECTRON SPIN RESONANCE SPECTROSCOPY

Hyperfine splitting - Zero field splitting, spin labels - Mass spectrometry of biomolecules. Crystal systems and space groups - Miller indices and space lattices - Diffraction of x-rays and Braggs law - Structure determination of biomolecules - Refinement and accuracy of the x-ray crystallographic structures. Scanning Tunneling Microscopy - Atomic Force Microscopy - Electron Microscopy of Biomolecules

TEXTBOOKS

1. Lalcowicz, J.R., Principles of Fluorescence Spectroscopy, Plenum Press, New York, 3rd Edition, 2006
2. Campbell, J.D., Dwek, R.A., Biological Spectroscopy, Benjamin, London, 3rd Edition, 1984

REFERENCES

1. Mathews, P.S.C., Quantum Chemistry of Atoms and Molecules, Cambridge University Press, London, 3rd Edition, 1986
2. Atkins, P.W., Julio De Paula, Physical Chemistry, W.H. Freeman & Co, New York, 8th Edition, 2006
3. Cantor, C.R., Schimmel, P.R., Biophysical Chemistry, Part-2, W.H. Freeman & Co., San Francisco, 3rd Edition, 1980

BIT1018	INDUSTRIAL WASTEWATER TREATMENT AND MANAGEMENT	L	T	P	C
		3	0	0	3

CHARACTERISTICS OF WATER

Physical, chemical and biological parameters - Standard methods of water analyses - Biodegradable waste and agricultural runoff in streams - Population forecasting - Prediction of water demand and wastewater generation - Water and wastewater quality

WATER SYSTEMS

Physical, chemical and biological systems - Primary, secondary and tertiary treatment

WASTEWATER TREATMENT PLANTS

Sedimentation, coagulation, flocculation, filtration, adsorption, ammonia removal, aeration, anaerobic and aerobic digestion - Activated sludge and trickling filter - ion exchange, lagoons, disinfection - Natural treatment systems - Sludge treatment and disposal

INDUSTRIAL WASTEWATER TREATMENT

Characteristics of industrial wastewater, treatment levels and available technologies

TEXTBOOKS

1. Metcalf & Eddy, Waste water Engineering Treatment and Disposal and Reuse, McGraw-Hill Companies, New York, 2nd Rev. Edition, 1991
2. Lepathak, Water Pollution Management Hand Book, Blackwell Publishing, San Diego, 4th Edition, 2000

REFERENCES

1. Arceivala, Waste Water treatment for pollution control, MGH, New York, 2nd Edition, 1998

2. Tchobanoglous, G., Burton, F. L., Stensel, H.D., Wastewater engineering: Treatment and reuse, TMH, London, 4th Edition, 2003
3. Mattock, G., Ellis Horwood, New Processes of Waste water treatment and recovery, Ellis Horward, New York, 4th Edition, 2000
4. Jogdand, Environmental Biotechnology, Himalaya Publishing House, New Delhi, 3rd Edition, 1995

BIT1019	BIOELECTRICITY	L	T	P	C
		3	0	0	3

PROPERTIES OF CELLS
Passive and active electrical properties of excitable cells

BIO-POTENTIALS
Cellular bio-potentials and currents and the techniques for recording them - The resting membrane potential and action potential - Origins, models and theories of explanation

ACTION POTENTIALS & IONIC PUMPS
The Hodgkin-Huxley model of the action potential - Membrane ionic pumps and exchange processes

PHYSIOLOGICAL AND CLINICAL SIGNIFICANCE OF BIO-POTENTIALS
Electrophysiology of neuroeffector transmission - Prejunctional and post junctional electrical events - Transmission processes in skeletal, smooth and cardiac muscle and synapses - Time courses of transmitter-activated postjunctional membrane potentials and currents

ELECTROPHYSIOLOGY
Electrophysiology of membrane ionic channels and neurotransmitter receptors - Chemical modification of bioelectric activity

TEXTBOOKS

1. Barr, R., Plonsey, R.L., Bioelectricity: A Quantitative Approach, Plenum press, New York, 4th Edition, 1988
2. Aidley, D.J., The physiology of excitable cells, Cambridge University press, London, 3rd Edition, 1989

REFERENCES

1. Ruch, P., Patton, R., Physiology and Biophysics, Academic press, London, 2nd Edition, 1965
2. Katz, B., Nerve, Muscle and Synapse, McGrawhill, London, 2nd Edition, 1966
3. Kandel, E., Schwartz, K., Principles of Neuroscience, Elsevier, New York, 4th Edition, 1991

BIT1020	MODELLING AND ANALYSIS OF BIOPROCESS	L	T	P	C
		3	0	0	3

BIOPROCESS KINETICS

Review of enzyme and microbial kinetics - Metabolic stoichiometry - Kinetics of substrate utilization, product formation and biomass production in cell cultures - Growth and product formation in filamentous organisms - Thermal death kinetics for cells and spores

TRANSPORT PHENOMENA IN BIOPROCESS SYSTEMS

Mass transfer - Heat transfer and power input calculations for different kinds of fermentors - Calculations for Newtonian and non-Newtonian fermentation broths

IDEAL REACTORS

Introduction to ideal reactors - Performance equations for ideal reactors and non-isothermal reactors - Rate data analysis - Multiple reactors and multiple reactions -Polymerization reactions, enzymatic reactions, microbial growth and bioreactors

NON-IDEALITY IN REACTORS

RTD studies - Dispersion effects, models for non-ideal reactors - Non-isothermal reactors - External diffusion effects on heterogeneous reactions - Diffusion and reaction in porous catalysts

ANALYSIS OF BIOLOGICAL REACTORS

Case studies in fermentation - Enzymatic and waste treatment bioprocess design - Experiments to illustrate bioprocesses

TEXTBOOKS

1. Bailey, J.E., Ollis, D.F., Biochemical Engineering Fundamentals, McGraw-Hill, London, 3rd Edition, 1990
2. Fiechter, Ghose, T.K., Blakebrough, N., Advances in Biochemical Engineering, Springier-Verlag, Berlin, 4th Edition, 1999

REFERENCES

1. Leigh, J.R., Modeling and control of fermentation processes, Technology & Industrial Arts, Cambridge, London, 3rd Edition, 1987
2. Cenk Ündey, Satish J. Parulekar, Ali Cinar, Gülnur, Batch Fermentation: Modeling, monitoring and control , Marcel Deckker, New York, 6th Edition, 2003

BIT1021	MEMBRANES: STRUCTURE & DYNAMICS	L	T	P	C
		3	0	0	3

MEMBRANE STRUCTURE

Diversity of biological membranes - lipid bilayer and membrane proteins - Membrane fluidity - Fluid mosaic model

MEMBRANE DYNAMICS
Membrane dynamics - Membrane pumps, channels and transporters - Lipid anchored proteins - Rafts

INTERACTION OF SMALL MOLECULES WITH MEMBRANES
Membranes channels and pumps - Voltage gated ion channels - Ligand-gated ion channels - ATP driven ion pumps - Partitioning and permeability - active and passive transport - Pumping of ions across membranes

MEMBRANE PROTEINS
Integral membrane proteins - ATP-binding cassette proteins (ABC) - Pore and channel forming proteins - Symporters and antiporters - Gap junctions

SURFACE RECEPTORS
The cell surface receptor - Membrane recycling and signal transduction – Membrane biogenesis – Biomimetic membranes

TEXTBOOK

1. RB Gennis; Biomembranes - Molecular structure and function. Springer verlag, 1988

REFERENCES

1. Hille, Bertil, Ion channel of excitable membrane, 3rd Edition, Sinauer associates, New York, 2001
2. Selected reading from current articles in Science and Nature

BIT1022	CLINICAL PHYSIOLOGY	L	T	P	C
		3	0	0	3

GENERAL EXAMINATION
Palpation, percussion, auscultation - Mechanism of inflammation, infection, neoplasms

DISEASES OF THE NERVOUS SYSTEM
Head injury - Stroke - Dementia, upper and lower motor neuron lesions

EYE & EAR DISEASES
Refractive errors of the eye - Cataract and retinal detachment - Otitis media – Conjunctivitis – Deafness

PANCREATIC DYSFUNCTION
Diabetes mellitus - Insulin resistance

DISORDERS OF BLOOD
Anemias - Leukemia - Vitamin K deficiency

CARDIAC DISEASES
Cardiopulmonary resuscitation - Cardiac failure - Rheumatic heart disease - Arrhythmias and myocardial infarction – Atherosclerosis - Hypertension

OVERVIEW OF RESPIRATORY DISEASES
Asthma - Chronic obstructive pulmonary disease - Tuberculosis

OVERVIEW OF GASTROINTESTINAL DISEASES
Peptic ulcers – Diarrhea - Food poisoning

OVERVIEW OF RENAL DISEASES
Urinary tract infection - Renal calculi

OVERVIEW OF RHEUMATIC DISEASES
Rheumatoid arthritis, gout arthritis

DISEASE DIAGNOSTICS
Basic investigative techniques for diagnosis like XRay, ECG, EEG, renal function tests

TEXTBOOK

1. Ross & Wilson, Anatomy and Physiology in health and illness, Churchill Livingstone, New York, 7th Edition, 2000

REFERENCES

1. Lingappa, V.R., Farey, K., Physiological Medicine: A Clinical approach to basic medical physiology, McGraw Hill, London, 1st Edition, 2001
2. Tortora and Grabowski, Principles of Anatomy and Physiology, Wiley International, 8th Edition, 2005

BIT1023	BIOLOGICAL ENQUIRY: HISTORY AND PHILOSOPHY	L	T	P	C
		3	0	0	3

INTRODUCTION TO PHILOSOPHIZING
Language - truth and logic - A review of history of philosophy of science – Scientific imagination - case studies of Mendel and Galileo

THE SCIENTIFIC METHODS IN THE PRACTICE OF BIOLOGY
The success of reductionist approach to problems in molecular biology - Contrast with holistic (higher level) biology - Resurgence of interest in global approaches like- systems biology, complexity - Richness of biology in cyclical phenomena with interdependent parallel processes - Feedback loops and networks - Emergent properties of the system - The concept of Causality in light of extant complexity

COMPLEXITY AND INDETERMINACY IN BIOLOGY

Historical contingency and evolution - History, nature and the future of Biology - Physics-biology interface during the classical period - Biology as an independent science during the 19th and 20th centuries (the major concepts and their evolution) - The nature of explanation in modern biology - Future directions

THE INTERFACE BETWEEN BIOLOGY (GENETICS) AND SOCIETY

Darwinism - Lamarckism and Creationism - Eugenics, its history and future - ELSIfication of biology - Genetic screening - Evolution of ethics and ethics in post-genomic society - some controversies

BIO-SAFETY AND ENVIRONMENTAL CONCERNS

Molecular organizing principles of living systems, Ontogenic theories based on molecular self organization, Importance of template replication and macromolecular catalysis, Protein first or DNA first conundrum - RNA world hypothesis - Present consensus and remaining challenges

TEXTBOOKS

1. Losee John, Historical Introduction to the Philosophy of Science, Oxford University Press, London, 3rd Edition, 1972
2. Losee John, Philosophy of Science and Historical Inquiry, Clarendon Press, New York, 1987

REFERENCES

1. Ruse Michael,Philosophy of Biology, Macmillan, London, 4th Edition, 1989
2. Gauch Hugh G., Scientific method in Practice; Cambridge University Press, London, 5rd Edition, 2003
3. Selected readings from Reviews and Commentaries

BIT1024	PLANT BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

INTRODUCTION TO PLANT CELLS & ORGANELLES

Plasma membrane - Cell Wall - Endoplasmic reticulum - Golgi Apparatus - Vacuoles, Nucleus – Peroxisomes – Plastids - Mitochondria and Chloroplasts - Gene structure and expression - Translation, regulation of gene expression - Implication of plant transformations - Plant promoters, terminators, reporters, selectable markers

PLANT TISSUE CULTURE

Plasticity and Totipotency - The culture environment - Plant Cell culture media - Plant growth regulators and their biosynthesis and function - Culture types - Callus, Cell suspension culture, protoplasts, root culture, shoot tip and meristem culture, embryo culture, microspore culture - Somaclonal variation - Polyploidy

SIGNAL PERCEPTION AND TRANSDUCTION

Overview - Plant receptors - G protein and phospholipids signaling - Cyclic nucleotides - Role of Calcium in signaling - Protein kinases as primary elements in signaling - Particular pathways of signal transduction associated with plant growth regulators

PLANT DISEASE RESISTANCE

Types of pathogen and their mode of action - Plant defence system - Constitutive and inducible defence - Genetic basis of plant pathogen interaction - R genes and R gene mediated resistance - Biochemistry and Molecular biology of defence reactions - Systemic acquired resistance - Control of plant pathogen by genetic engineering - Role of Salicylic acid, Jasmonic acid and ethylene in plant defence - Osmotic adjustment and its role in drought and salinity tolerance - ABA in stress tolerance - ABA dependent and independent genes - cis and trans acting factors - freezing and heat stress - Strategies for genetic engineering of stress tolerance

PLANT SECONDARY METABOLITES

Introduction to primary and secondary metabolism - Important pathway leading to the biosynthesis of secondary metabolite in plants - Metabolic products produced by in vitro culturing of plant cells - Selection of plant cells/tissues for the production of a specific product - Culture system in secondary plant product biosynthesis – Batch continuous cultures and immobilized plant cells - Biotransformation of precursors by cell culturing - Metabolic engineering for production of secondary metabolites

TEXTBOOKS

1. Bob Buchanan, Wilhelm Gruissem, Russell L. Jones, Biochemistry and Molecular Biology of Plants, Wiley, London, 6th Edition, 2002
2. Adrian Slater, Nigel Scott, Mark Fowler, Plant Biotechnology: The Genetic Manipulation of Plants**,** Oxford University Press, London, 3rd Edition, 2003

REFERENCES

1. Paul Christou, Harry Klee, Handbook of Plant Biotechnology, John Wiley & Sons, New York, 4th Edition, 2006
2. Hans-Walter Heldt, Plant Biochemistry, Academic Press, London, 5th Edition, 2004

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