

**BIOLOGICAL SCIENCE AND ENGINEERING  
DEPARTMENT**

**M.Tech. BIO-TECHNOLOGY**

**Course of Study & Scheme of Examination  
2016-17**



**Maulana Azad National Institute of Technology  
Bhopal**

**M.TECH BIOTECHNOLOGY****I- Semester**

Course No.	Subject	Scheme of Studies Periods Per week			Credits
		L	T	P	
BIO-501	Instrumentation in Biotechnology	3	-	-	3
BIO-502	Genetic Engineering & Population Genetics	3	-	-	3
BIO-503	Cell & Tissue Culture Engineering	3	-	-	3
	Internal Elective-I	3	-	-	3
	Internal Elective-II	3	-	-	3
	Open Elective-I	3	-	-	3
BIO-514	Biotechnology Lab-1	-	-	2	2
BIO-515	Seminar-1	-	2	-	2
	<b>Total</b>				<b>22</b>

**II- Semester**

Course No.	Subject	Scheme of Studies Periods Per week			Credits
		L	T	P	
BIO-551	Cheminformatics & Drug Designing	3	-	-	3
BIO-552	Molecular Biotyping	3	-	-	3
BIO-553	Bionanotechnology	3	-	-	3
	Internal Elective-III	3	-	-	3
	Internal Elective -IV	3	-	-	3
	Open Elective-II	3	-	-	3
BIO-524	Biotechnology Laboratory-2	-	-	2	2
BIO-525	Seminar-2	-	2	-	2
	<b>Total</b>				<b>22</b>

**Internal Electives**

BIO-554	Bioethics, Bio safety Regulation & IPR
BIO-555	Computational Biology
BIO-556	Microbiology & Immunology
BIO-557	Computational Phylogenetics
BIO-504	Protein Engineering & Enzyme Technology
BIO-505	Bioenergy Engineering
BIO-506	Genomics & Transcriptomics

**Open Electives**

BIO-508	System Biology
BIO- 509	Molecular & Cellular Diagnosis
BIO- 558	Computational Advancements in Biotechnology
BIO- 554	Quality Management & process Design Marketing
BIO-559	Bioprocess Engineering

**III - SEMESTER**

Course No.	Subject	Scheme of Studies Periods Per week			Credits
		L	T	P	
BIO-601	Major Project phase-I				11
	Total				

**IV - SEMESTER**

Course No.	Subject	Scheme of Studies Periods Per week			Credits
		L	T	P	
BIO-602	Major Project				25
	Total				25
					100

## **SYLLABUS**

### **SEMESTER –I**

**Code: BIO 501 Title: INSTRUMENTATION IN BIOTECHNOLOGY**

#### **UNIT-1**

**Methods of biochemical analysis**-Biochemical analytical methods of – bioassays for analysis and estimation of carbohydrates, lipids, proteins, nucleotides and nucleic acids. Principle of enzymatic assays for metabolites.

#### **UNIT - 2**

**Nucleic acid and Protein analysis**-Principle of extraction of nucleic acids and proteins from cells, PCR, protein sequencing, protein array and, principle and applications and DNA sequencing.

#### **UNIT-3**

**Immunoanalytical Technique**-Immunoanalytical Techniques, Antiserum raising including chicken IgY, Bispecific and chimeric antibody production, immunofluorescence, immunohistochemistry testing, ELISA and ELISPOT, immunohistochemistry, and microfluidics in immunoassays.

#### **UNIT - 4**

**Analysis of Bioprocesses**-Analysis of Biomass, measurement of dry weight and biomass composition, analysis of substrate uptake and product formation rates, measure of BOD and COD in waste waters, Gaseous analysis for O<sub>2</sub> and CO<sub>2</sub>.

#### **UNIT - 5**

Radiochemical Methods in Analysis - Nuclear reactions, types and principles of radioactive isotope decay and half life, physical basis of instrumentation and measurement of radioactivity: Radiation detectors and applications- radioisotope dilution methods, autoradiography and radioimmunoassay.

**REFERENCES:**

- Techniques in Analytical Chemistry by Stewart KK, Ebel REChemical Wiley-Interscience, 1<sup>st</sup> Edn. 2000.
- Douglas A. Skoog, F. James Holler, Timothy A Nieman Principles of Instrumental Analysis. Brooks Cole
- Hayat M. Microscopy, Immunohistochemistry, and Antigen Retrieval Methods: For Light and Electron
- Microscopy. Springer 1<sup>st</sup> edn. 2002, Reed R., Holmes D, Jonthan.
- Practical Skills in Biomolecular Sciences. Weyers and Allan Jones. Addison Wesley Longman Ltd. 1998.
- Willard and Merrit Instrumental Methods and Analysis. VI Edition CBS Publishers & Distributors.

## SEMESTER- I

**Code: BIO-502 Title: GENETIC ENGINEERING / POPULATION GENETICS**

### UNIT – 1

**Recombinant DNA-** Concepts, vectors (Plasmids, phage based vectors, Artificial chromosomes-(BACs, YACs), Shuttle vectors, enzymes (DNA ligase, Polymerases, Restriction enzymes, Phosphatases, Kinases), methods of gene transfer, DNA & RNA probes.

### UNIT – 2

**Screening of recombinant cells-**Immunological screening, colony & plaque hybridization, Expression vectors, In-situ hybridization, Reporter genes.

### UNIT – 3

**Applications of Genetic Engineering-**Genomic & c DNA libraries, gene cloning in medicine, agriculture, transgenic plants & animals, gene therapy.

### UNIT-4

**Population genetics-**structure, Hardy-Weinberg law, Selective, neutral and molecular evolution, natural and artificial selection: Lamarckism: mechanism of genetic variation, Speciation- allopatric & sympatric.

### UNIT-5

Human Genome Project, Eugenics, Socio - biology, genetics of behaviour, genetic variation at molecular level, extra cellular inheritance mechanism and multiple gene inheritance.

### REFERENCES:

- Molecular Biotechnology by Pasternack and Glick.
- From Genes to Genomes: Concepts & Applications of DNA Technology by J.W. Dale & M.V. Schartz.
- Gene Cloning & DNA Analysis: An Introduction (4th edition) by T.A. Brown.

**Scheme and Syllabus M.Tech. Bio-Technology (BOS dt 29.09.2016)**

- Principles of Gene manipulation: An Introduction to Genetic Engineering, Old RW, Primrose SB, Blackwell science Publication
- An introduction to Genetic engineering by D.S.T. Nicholl, Cambridge University Press. Genetics by Peter.J.Russel
- Population genetics by Matthew B Hamilton
- Population genetics by A.N Shukla
- Genetics of population by Philip W.Hedrick
- Genetics: analysis of genes and genomes by [Daniel L. Hartl](#), [Elizabeth W. Jones](#)

## SEMESTER- I

**Code: BIO-503**

**Title: CELL AND TISSUE ENGINEERING**

### Unit - 1

Tissue culture practices for animal and plant, media composition, culture conditions, micropropagation, haploid culture, apical meristem culture, callus culture, single cell culture, protoplast culture, Blood cell culture, epithelial cell culture.

### Unit - 2

Comprehensive introduction to living and man-made materials, scaffold materials and applications of tissue engineering, artificial cell, immunochemical techniques in tissue engineering and biomaterial science, Clinical applications of tissue engineering

### Unit - 3

Basics of Xenotransplantation, Potential organ donor, biological, physical & immunological barriers, Ethical issues, potential uses of Xenotransplantation, genetic modifications of xenografts, Zoonosis in xenotransplantation.

### Unit - 4

Application of biotechnological practices for paper, textile, tannery and leather industry. Bioprocessing of functional food and nutraceuticals, production of insect, pest and disease resistant crops.

### Unit - 5

Pharmacokinetics; use of liposome as drug delivery system, production of hormones and interferon by genetically engineered cells, techniques for the development of new generation antibiotics.

### REFERENCES:

- Artificial cells, cell engineering and therapy By S Prakash
- Biomaterials, artificial organs and tissue engineering By L Hench and J Jones
- Xenotransplantation By Jeffrey L. Platt
- Animal Biotechnology By R.I. Freshney
- Plant Tissue Culture By S.S. Bhojwani, M.K. Razdan



## SEMESTER-I

**Code: BIO- 504 Title: PROTEIN ENGINEERING & ENZYME TECHNOLOGY**

### UNIT-1

**Basics of protein science:** Classification and properties of proteins, denaturation and coagulation of proteins, protein hydration, isolation, extraction and purification of proteins.

### UNIT-2

**Structure of proteins:** Organizational levels in protein structure, techniques in protein structure determination, factors determining stability of proteins, determination of protein folding and unfolding pathways, types and importance of post translational modification in proteins

### UNIT-3

**Applications of Enzymes:** Classification of Enzymes, Commercial applications of enzymes in food, pharmaceutical and other industries, Enzymes for analytical and diagnostic applications, Purification and characterization of enzymes from natural sources.

### UNIT-4

**Mechanisms and Kinetics of Enzyme Action:** Mechanisms of enzyme action, kinetics of single substrate reactions, turn over number, estimation of Michaelis-Menten parameters, Types of inhibition, Allosteric regulation of enzymes.

### UNIT -5

**Enzyme Immobilisation and Enzyme Biosensors :** Physical and chemical techniques for enzyme immobilization, Overview of applications of immobilized enzyme systems. Design of enzyme electrodes and their application as biosensors in industry health care and environment.

**REFERENCES:**

- Trevor Palmer and Philip Bonner; Enzymes: Biochemistry Biotechnology, Clinical chemistry.
- Biochemical Engineering by James M. Lee, Prentice Hall (1992).
- Principles of Biochemistry BY A. Lehninger (1987)
- Enzymes in Food Processing by Gerald Reed, Academic presses.
- Ashok Pandey. Enzyme Technology. Springer-Verlag New York Inc. 2005.
- Introduction to protein structure, Branden C and Tooze R, Garland 1993.

## SEMESTER-I

**Code: BIO - 505 Title: BIOENERGY ENGINEERING**

### UNIT-1

Introduction Biodiversity, historical and geographical causes for diversity, Genetic diversity, molecular taxonomy, species and population biodiversity, quantifying biodiversity, Maintenance of ecological biodiversity, Morphological and molecular characterization of biodiversity, hotspots, and endangered species.

### UNIT-2

Microbial Diversity- distribution, abundance, ecological niche, and principles of microbial diversity. Structural, biochemical and molecular phylogenetic relationships of microorganisms.

### UNIT-3

Introduction of Bio energy, Classification and sources of energy, energy from waste..Current energy consumption, overview of biofuel/bioenergy and biorefinery concepts, Biomass preprocessing, Bio-Energy, Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion, hydrogen production

### UNIT 4

Biochemical and Photosynthetic aspects of Energy Production, Biodiesel production from oil seeds, waste oils and algae, Environmental impacts of biofuel production, Future of Bioengineering.

### UNIT 5

Uses and values of biodiversity , ,bio piracy .indigenous system knowledge .national policies ,legislation and instruments relating the theprotection of the wild and domesticated flora and fauna as well as habitats ,conservation and management.

**REFERENCE:**

- Biodiversity:vol.1–Edward O. Wilson,Frances M. Peter, National Academy of sciences(U.S.)
- Biodiversity: New leads for the pharmaceutical and agrochemical industries – S.K. Wrigley, M.A. Hayer, R.Thomas, E.J.T. Chrystal and N.Nicholson
- Microbial diversity and bioprospecting-Alan T. bull
- Textbook of biodiversity- K.V. Krishnamurthy
- Bioenergy and Green Engineering- Energy and Fuels (ACS Publications) – A.K.Dalai

## SEMESTER – I

### **Code: BIO-506 Title: GENOMICS & TRANSCRIPTOMICS**

**Overview** - Genes, Genomes, evolution of genomes, Structure & organization of Prokaryotic and eukaryotic genome, mitochondrial & chloroplast genome, gene structure, SNP's, protein coding genes, repeated sequences.

### **UNIT-2**

**Comparative genomics-** Genomes of *Escherichia coli*, *Mycoplasma genitalium*, *Saccharomyces cerevisiae*, *Caenorhabditis elegans*, *Drosophila melanogaster*, *Arabidopsis thaliana*, *Homo sapiens*, Computational Approaches in comparative genomics.

### **UNIT-3**

Genome information resources, Brief outlook of various genome projects and their outcome, Genome rearrangements, the breakpoint graph, expected reversal distance, signed permutations, interleaving graphs and hurdles, algorithm for sorting by reversals, duality theorem and genomic distance.

### **UNIT-4**

Genome analysis- sequencing and mapping-physical & high resolution maps, restriction mapping, Introduction to phylogenetic trees, relationship of Phylogenetic analysis to sequence alignment, unweighted pair group method with arithmetic mean (UPGMA), evaluation of phylogenetic methods.

### **UNIT-5**

**Transcriptomics-** importance of transcription, tools and techniques in transcriptomics, microarray technology, sequencing based approaches to study transcriptomes, applications of new generation transcriptome sequencing, gene expression profiling, non coding RNA discovery and detection.

**REFERENCES:**

- Genes and genomes by Singer.M, and Berg.P, Blackwell Scientific Publication, Oxford ,1991
- Gene Structure and Transcription by Beebe.T, and Burke.T, Oxford Univ Press.
- Bioinformatics – A practical guide to the analysis of Genes and Proteins – Baxevanis and Fancis Ouellette, Wiley Interscience, New York.
- Metagenomics: Theory, methods and applications, edited by Diana Marco , Caister Academic Press.
- Computational Molecular Biology – An algorithmic approach – Pavel A. Pevzner

## SEMESTER: I

**Code: BIO - 559 Title: BIOPROCESS ENGINEERING**

### UNIT-1

**Design and Analysis of Bioreactors-** Stirred tank reactor, Modeling of Non-Ideal Behavior, RTD–Tanks in series and Dispersion models, applications to design of continuous sterilisers; Design and operation of novel bioreactors, Air-lift loop reactors; Fluidized bed bioreactors. Stability analysis of bioreactors.

### UNIT-2

**Bioreactor Process-**Regime analysis of bioreactor processes, Correlation's for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption. On-line data analysis for measurement of important physicochemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry.

### UNIT-3

**Monitoring of Bioprocesses**Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes; Computer-based data acquisition, monitoring and control- LABVIEW Software.

### UNIT-4

**Role of Downstream Processing in Biotechnology-**Role and importance of downstream processing in biotechnological processes, Economics of downstream processing in Biotechnology, characteristics of biological mixtures.

Primary Separation and Recovery Processes : Cell disruption methods for intracellular products: Mechanical and Chemical methods, Removal of insolubles: flocculation and sedimentation, centrifugation and filtration methods.

## UNIT-5

**Bioprocess engineering of marine products** -Bioprocess engineering for Marine products, photo bioreactors – light regime, mass transfer and scale up, downstream processing of marine products, Management of Marine production, Storage and transport.

### REFERENCES:

- Pauline Doran , " Bioprocess Engineering Calculation", Blackwell Scientific Publications.
- Harvey W. Blanch, Douglas S. Clark , " Biochemical Engineering", Marcel Dekker , inc.
- Bailey And Ollis, Biochemical Engineering Fundamentals, Mcgraw Hill, 1986.
- Shuler And Kargi, Bioprocess Engineering, Prentice Hall, 1992.



## SEMESTER- I

**Code: BIO - 508 Title : SYSTEMS BIOLOGY**

### UNIT 1

Integrating biological networks, Methods of study: Micro array, Hierarchical clustering, Self-organizing maps, translation of biochemical pathways into linear algebra. Whole cell simulation, principle and levels of simulation, Virtual erythrocytes, pathological analysis, fermentation analysis, flux balance analysis, minimal gene complement.

### UNIT - 2

Relationship analysis, predicting ligand binding function, guilt by association, Use of gene cluster, comparative genome analysis, Binding surface comparisons, Detecting protein - protein interaction.

### UNIT-3

Molecular graphics, Surfaces, , An introduction to computational quantum mechanics: Polyelectronic atoms and molecules, Molecular orbital calculations, The Hartree-Fock equations, Basis sets, ab initio quantum mechanics, Approximate molecular orbital theories, molecular dynamics and free energy calculations

### UNIT – 4

Molecular dynamics using simple models , Setting up and running a molecular dynamics simulation , , Molecular dynamics at constant temperature and pressure, Incorporating solvent effects into molecular dynamics: conformational changes from molecular dynamics simulations. Evolutionary algorithms and simulated annealing, Solving protein structures using restrained molecular dynamics and simulated annealing.

### UNIT - 5

Structural databases, Molecular fitting, Clustering algorithms and pattern recognition techniques, Reducing the dimensionality of a data set, Covering conformational space:

poling, A "classic" optimization problem: predicting crystal structures. Structure dynamics of membrane, electrostatic properties of membrane, flexible and charged membrane,

**REFERENCES:**

- Foundations of system biology By Hiraoki Kitano
- System biology dynamic pathway modeling By Olaf Wolkehaner
- System biology properties and reconstructed networks By Bernhard O Palsson
- Molecular Modeling for Beginners - by Alan Hinchliffe
- Molecular Modeling and Simulation\_ by Tamar Schlick

## **SEMESTER: I**

**Code: BIO - 509 Title: MOLECULAR AND CELLULAR DIAGNOSTICS**

### **UNIT-1**

Redoxmediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals, Optoelectric biosensors. Principle of diagnostic enzymology: Liver, cardiac, skeletal enzyme and digestive enzyme.

### **UNIT-2**

Methodology of detection of mutation in DNA, Diagnosis of genetic diseases. Molecular markers and DNA polymorphism. Case studies related to bacterial, viral and parasitic infections. DNA fingerprinting.

### **UNIT-3**

Genetic pathways that protect cells from uncontrolled growth and genes: tumor suppressor genes, oncogene. Pathways that regulate tumor initiation and/or its progression. current methods of cancer screening, development new diagnostic tests, and other innovations for the future.

### **UNIT-4**

Molecular Mechanisms of Human Disease. Infectious Agents- Biological Aspects and Clinical Implications. Molecular Haematology and Oncology. Selection and Evolution: Implications for Molecular Medicine. Molecular Basis of Development of Medicine- Diagnostic and Therapeutic Potential. Human embryonic stem cells: biology and clinical implications.

### **UNIT-5**

Antibody markers, CD Markers, HLA typing, Molecular beacons. Applications and uses of biosensors, Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring.

### **REFERENCE:**

- Biosensors by Tran Minh Canh, Chapman & Hall

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- Biosensors Fundamentals and applications by Turner, A.P.F, Karube.I.,and Wilson,G.S Oxford Univ. Press.
- Molecular diagnostics: for the clinical laboratorian, by William B. Coleman, Gregory J. Tsongalis. Human Press.
- Molecular diagnostics By George P. Patrinos, Wilhelm Ansorge . Elsevier Academic Press.
- W. R. Bailey, E. G. Scott. Diagnostic microbiology. C. V. Mosby Co.
- Carl A. Burtis. Fundamentals of clinical chemistry. W.B. Saunders, 2001

## SEMESTER- II

**Code: BIO - 551 Title: CHEMINFOMATICS& DRUG DESIGNING**

### **Unit-1**

Introduction to cheminformatics, history of cheminformatics, applications of cheminformatics, evolution of cheminformatics, future scope of cheminformatics, Data and data source in chemistry, searching chemical structures.

### **Unit -2**

Representation of chemical compounds, manipulations in 2D and 3D structures of chemical compounds, representation of chemical reactions, molecular descriptors, calculations of physical and chemical data, calculations of structural desiphers.

### **Unit-3**

Development of drug, drug life cycle, drug development time lines, stages of drug discovery, strategic issues in drug discovery, emerging approaches to drug design and discovery, drug metabolism physic chemical properties, pharmacokinetic action of drug on human body.

### **Unit-4**

Computer aided drug design, methods of computer aided drug design, ligand design methods, docking algorithms and programs, drug design approaches, Strategy for target identification and validation, Lead compound identification and optimization,

### **Unit 5**

Combinatorial chemistry and library design, virtual screening , drug likeliness and compound filters. absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction, computer based tools for drug design.

### **REFERENCES:**

1. Introduction to Chemoinformatics by Andrew R. Leach, Valerie J. Gillet

2. Introduction to Computational Chemistry by Frank Jensen
3. Targeted and Controlled Drug Discovery - S.P.VYAS and R.K.Khar
4. Cheminformatics By Johann Gasteiger and Thomas Engel
5. Bioinformatics from Genome to Drug By Thomas Langauer

## SEMESTER: II

**Code: BIO - 552    Title: MOLECULAR BIOTYPING**

### UNIT-1

Polymerase chain reaction - Principle, Design of primers, methodology, RT-PCR, Multiplex PCR, Anchored PCR, Inverse PCR and PCR walking. Identification of PCR products.

### UNIT-2

Molecular markers – 16S rDNA, RFLP, RAPD, AFLP, repetitive extragenic palindromic (rep), interspersed transcribed sequences (ITS), Blotting techniques: Southern, Northern, Western.

### UNIT – 3

Applications of PCR, DNA chips, and micro array.

### UNIT-4

Metagenomics- concepts, methodology, softwares, applications.

### UNIT – 5

Stem Cell & applications - Male Germ-line Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells of Human Adult Bone Marrow, role of stem cells in organ regeneration.

### REFERENCES:

- Developmental Biology, 6th Edition, Scott F. Gilbert.
- Stem Cell Biology by Marshak, 2001, Cold Spring Harbour Symposium Publication.
- Genes to clone by T. A. Brown
- Genetic engineering by S. Mitra
- Principles of Gene Manipulation: An Introduction to Genetic Engineering Old RW, Primrose SB. Blackwell Science Publications.
- Genes by B. Lewin
- Molecular biology D. Freifelder.
- Molecular cloning by Sambrook et al.

## SEMESTER- II

**Code: BIO - 553**

**Title: - BIONANOTECHNOLOGY**

### UNIT-1

Introduction to nanotechnology ; Application and benefits of nanotechnology ; Basics tools for nanotechnology – Principals of scanning force microscopy, Scanning electron microscopy ,Transmission electron microscopy; Nanoinprint, Lithography ,Bimolecular recognition .

### UNIT-2

Types of Motor proteins: Linear and Rotary motors, Structure of Motor proteins, Motility properties of motors, ATP hydrolysis mechanism of various motor proteins, comparison of kinetics, steps and force production by motors, chemo-mechanical coupling of motors single molecule approaches. Protein based nanocrystals, microbial nanoparticle production.

### UNIT-3

Nano LC and capillary electrophoresis, interphases with mass spectroscopy, chip based separation in micro and nanosized channels, fluorescence imaging, fluorescence correlation spectroscopy, single molecule spectroscopy.

### UNIT-4

DNA as a polymer and DNA based motors basics of DNA structure, Hairpin loops and helices: reciprocal exchange and stability of DNA structure, Base pairing, motifs used in DNA nanotechnology. RNA polymerase and DNA helicase as motors, Single molecule mechanics and DNA dynamics.

### UNIT-5

Tissue engineering, Bacterial motors, Nanomechanistic devices from DNA,.Biosensors; Application of biochips, DNA –chip, Protein chip, Application of colloidal particles, bacterials motors, drug delivery system



**REFERENCE:**

- Nano-biotechnology: Concepts, Applications and Perspectives, by Christof M. Niemeyer, Chad A. Mirkin, First edition, Wiley-VCH.
- Nanotechnology: A gentle introduction to the next big idea, by Ratner, M. Ratner, D.
- Bionanotechnology: Lessons from Nature by David S. Goodsell, First Edition, John Wiley and Sons.
- Introduction to Nanotechnology by Charles P. Poole, Frank J. Owens, John Wiley and Sons, Inc.
- Nanotechnology: An introduction to nanostructuring techniques, eds by . M Kohler, W Fritzsche, Wiley-VCH Verlag GmbH & Co. KGaA, Weiheim.
- Handbook of nanotechnology, ed. by Bhushan, Springer-Verlag, Berlin, Heidelberg, Germany.
- Nanocomposite science and technology, eds. by PM Ajayan, LS Schadler, PV Braun, Wiley-VCH Verlag, GmbH & Co., KGaA, Weiheim.

## SEMESTER-II

**Code: BIO - 554**

**Titles: BIO-ETHICS; BIO-SAFETY REGULATION**

### UNIT-1

Legal issues, Socioeconomics issues and environmental impact of biotechnology, Special procedure to release GMO.

### UNIT-2

Intellectual property rights, TRIPS and international contention, Patents and methods of application of patents, Trade secret, Farmers rights, Biopiracy and Biocolonialism

### UNIT-3

Understanding patent laws and its evolution justified with case studies. Patent copy right, Trademarks, patent act (1970), Patent amendment act (2002), Patent specification, Requirements of a patentable invention; interventional and Indian patent laws.

### UNIT-4

Biosafety regulation; national and international guidelines, r-DNA guidelines, experimental protocol use of genetically modified organism.

### REFERENCE:

- Patents by N.R. Subbaram, Pharma Book Syndicate, Hyderabad, 2003.
- Sasson A, Biotechnology and Development, UNESCO Publications, 1988.
- Sasson A, Biotechnology in Developing Countries, Present and Future, UNESCO Publications, 1993.
- Biotechnology Emerging trends by J. Selvin, A.S. Ninawe, V.S. Sugunan, N.Sukumaran, A.P. Lipton Biotech Books, Delhi.
- Basic Biotechnology by S. Ignacimuthu Tata Mc Graw-Hill, Delhi.
- Genetically Yours by Hwa A Lim, World Scientific, USA.
- Biotechnology by J.E. Smith, Cambridge Univ. Press, UK.
- K. Singh, Intellectual property rights on Biotechnology, BCIL, New Delhi.

## SEMESTER-II

**Code: BIO - 555**

**Title: Computational Biology**

### **Unit - 1**

Introduction to Bioinformatics, information networks, biomolecule information resources, an overview on biological databases. Retrieval of biological data, searching sequence database by sequence similarity criteria.

### **Unit - 2**

Sequence analysis, sequence alignment, alignment with gap penalties, space efficient sequence alignment, scoring matrices for similarity search PAM, BLOSUM.

### **Unit - 3**

Pairwise Alignment ; Introduction, The Scoring Model, Alignment algorithm, Dynamic Programming with more Complex Models, Heuristic Alignment Algorithms, Linear Space Alignment. Multiple Sequence Alignment Methods ; What a Multiple Alignment Means, Scoring a Multiple Alignment, Multidimensional Dynamic Programming, Progressive alignment Methods,

### **Unit - 4**

Marcov Chains and Hidden Marcov Models; Marcov Chains, Hidden Marcov Models, Parameter Estimation for HMMs, HMM Model Structure, More Complex Marcov Chains, numerical Stability of HMM Algorithms, multiple Alignment by Profile HMM Training.

### **Unit - 5**

Structural Bioinformatics, Basic principles on protein structure prediction, Chou Fasman and GOR methods, Ab initio structure prediction. conceptual modeling of proteins, obtaining, viewing and analyzing structural data. Basic bioinformaticsTools – Genscan, Rasmol, Cn3D, Phylip, Oligo, Clustal W, ALSCRIPT, MOLSCRIPT, CATH and SCOP.

**REFERENCES:**

- Bioinformatics- A beginner's guide by Jean-Michel Claverie
- Structural Bioinformatics by Philip E. Bourne and Helge Weissing
- Essential Bioinformatics-Jin Xiong
- Bioinformatics – Sequence and Genome analysis, Mount DW
- Bioinformatics - BaxevanisAD & Quellette BFF

## SEMESTER- II

Code: BIO - 556

Titles: MICROBIOLOGY AND IMMUNOLOGY

### UNIT – 1

**History & Overview of Microbial world-** Contributions of Scientists, Bacterial classification, Numerical taxonomy, characters for classification, Characteristics of Archaea; eubacteria, Cyanobacteria. General characteristics of viruses, life cycle of viruses. General account of Fungi, Economic importance.

### UNIT – 2

**Techniques-** Isolation, Pure & Enrichment culture techniques, Staining procedure, Biochemical tests, sterilization- physical & chemical, Phenol coefficient of disinfectant.

### UNIT – 3

#### **Microbial nutrition & Growth**

Principles of microbial nutrition, mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, maintenance of cultures.

### UNIT– 4

Types of Immunity, Antigens & antigenicity, Antibody Structure & diversity, Antigen Antibody reaction, precipitation, neutralization agglutination, complement fixation & Invitro tests.

### UNIT– 5

**Immunology-** Hypersensitivity and Allergic reactions, Autoimmunity and autoimmune diseases vaccines and new vaccines strategies, Immunization and its importance.

### REFERENCES:

- Microbiology: An Introduction: Tortora, Funke & Case. 7<sup>th</sup> edition, 2001

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- Microbiology VI Edition: M.J.Pelczar, E.C.S. Chan, N.R.Krieg.Publisher: Tata McGraw.
- Principles of Microbiology: R.M.Atlas.Publisher:W. C. Brown.
- General Microbiology: R.Y.Stainier, J. L. Ingraham, M.L. Wheelis and P.R.Painter.Publisher: Macmillan.
- Essentials of Immunology: Ivan. M. Roitt, Clackwell Scientific Publications, London.

## SEMESTER-II

**Code: BIO- 557 Title: COMPUTATIONAL PHYLOGENETICS**

### UNIT-1

Introduction to trees, concept of evolutionary trees, phylogenetic trees, relationship of Phylogenetic analysis to sequence alignment, genome complexity and Phylogenetic analysis, sequence alignment based on evolutionary model.

### UNIT-2

Methods of phylogenetic analysis like distance matrix, Fitch and Margoliash method, maximum parsimony method, maximum likelihood method, unweighted pair group method with arithmetic mean (UPGMA), neighbour-joining method

### UNIT-3

Character based methods, evaluation of phylogenetic methods, Converting sequence similarity to distance scores, choosing an outgroup, correcting of distances between nucleic acid sequences for multiple changes and reversions.

### UNIT-4

Comparison of protein sequences and protein encoding genes, comparison of open reading frames by distance methods.

### UNIT-5

Reliability of Phylogenetic predictions, problems and complications from Phylogenetic analysis, automated tools for Phylogenetic analysis, bootstrapping and jack knife replicates, jumbling sequences.

### Books:

- Bioinformatics – Sequence and Genome analysis By David W. Mount
- Molecular Evolution and Phylogenetics – Nei and Kumar.

## SEMESTER-II

**Code: BIO- 558 Titles: COMPUTATIONAL ADVANCEMENTS IN BIOTECHNOLOGY**

### UNIT I

PERL, Introduction, Features, Scalar Variables, Array Variables, File Handling, Lists (Arrays), Hashes (Associative Arrays), Control Structures, String Processing, Subroutines

### Unit II

PYTHON Introduction, Features, Python Interpreter, Control Flow Tools, Data Structures, Modules, Input and output, Errors and Exceptions, classes.

### Unit III

RUBY, Introduction, Features, General syntax rules, classes, objects, variables, containers, Blocks, Iterators, Loops, Branching, Arrays, Hashes, Strings, Regular Expressions, Subroutines, Exceptions, Terminal IO, File IO

### Unit IV

XML ,Introduction, Need , The general structure of XML, XML Tags ,Elements and sub elements, XML documents, XML attributes, Well formed XML documents ,Valid XML documents, XML DTD.

### Unit V

MATLAB, Introduction, The basic features, Vectors and matrices, Built-in functions, Plotting, Programming in MATLAB, M-files: Scripts and functions, Loops ,Polynomials in MATLAB ,Numerical Methods

### REFERENCES

- 'Programming Ruby The Pragmatic Programmers' Guide Second Edition Dave Thomas with Chad Fowler and Andy Hunt, The Pragmatic Bookshelf
- Beginning Python, Peter Nortan, Wiley Publishing, Inc.



## SEMESTER-II

**Code: BIO- 554 Title: QUALITY MANGEMENT PROCESS DESIGN AND MARKETING**

### **UNIT - 1**

Quality management: Selection and specification of equipments for handling fluids and solids, selection, speciation, design of heat mass transfer equipments used in bioprocess industries, Determination of the best system for a given conversation, advantages and limitations of series combinations.

### **UNIT - 2**

Design of facility for cleaning of process equipment used in biochemical industries, utilities for biotechnology production plants, process economics, bioprocess validation, safety considerations.

### **UNIT – 3**

Marketing management: Need to commercialize biotechnology, from laboratory to land: Extension services of biotechnology, creating and marketing the image of the biotechnology company, art of recognition & effective communication.

### **UNIT - 4**

Marketing of product, availability of technology, raw materials, equipments, human resources. Workable marketing and the strength of distribution. Effective advertising and marketing.

### **UNIT – 5**

Marketing of technology, informal sector and small enterprenurs, sustainable development in biobusiness, industrial biotechnology policy for semiindustrial contries, the role of translational cooperators,.

**REFERENCES:**

- Applied Process Design for Petrochemical Plants By E.E. Ludwig Butter worth- Heinemann
- Chemical Engineering By R.K. Sinnott, J. M. Coulson and J.F. Richardsons and Butter worth- Heinemann
- Manufacturing Facilities Design and material handling By F. E. Meyers and M. P. Stephens
- Process plant layout and Piping Design By E. Bausbacher and R. Hunt
- Plant Design and Economics for Chemical Engineers By M. Peters and K. Timmerhaus