JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure and Syllabi for Pre-Ph.D

BIO-TECHNOLOGY (2017-2018)

PART - I

Choose any **one** subject of the following

S. NO	PAPER	PAPER CODE
1.	Biochemistry and Cell Metabolism	17PH23101
2.	Bioprocess Engineering	17PH23102
3.	Molecular and Cell Biology	17PH23103
4.	Microbiology and Fermentation Technology	17PH23104
5.	Mathematical Methods for Biotechnology	17PH23105

PART – II

Choose any **one** subject of the following

S. NO.	SUBJECT	PAPER CODE
1.	Bioreactor Design and Analysis	17PH23201
2.	Downstream Processing	17PH23202
3.	Cancer Biology	17PH23203
4.	Animal Biotechnology	17PH23204
5.	Plant Biotechnology	17PH23205
6.	Food Biotechnology	17PH23206
7.	Metabolic Engineering	17PH23207
8.	Phtochemistry	17PH23208
9.	Nanobiotechnology	17PH23209
10.	Bioinformatics and Computational Biology	17PH23210
11.	Environmental Biotechnology and Biosafety	17PH23211
12.	Pharmaceutical Biotechnology	17PH23212
13.	Systems Biology	17PH23213
14.	Advanced Immunology	17PH23214
15.	Biofuels and Renewable Energy Systems	17PH23215

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23101) BIOCHEMISTRY AND CELL METABOLISM.

UNIT I

Carbohydrates: Classification of carbohydrates – configuration & conformations of carbohydrates – structural and biological functions of mono, di, oligo & polysaccharides (homo & hetero) – sugar derivatives – glycol conjugates – proteoglycans – glycoproteins & glycolipids – lectins. **Lipids:** Classification of lipids – structural & biological functions of lipids.

UNIT II

Amino acids and Proteins: Structure & functions of amino acids – classification of amino acids – amino acid derivatives - stereochemistry of amino acids. **Proteins:** Classification & biological functions of proteins - physico-chemical properties of proteins – primary, secondary, tertiary and quaternary structures of proteins. **Nucleic acids:** Classification & functions of nucleic acids – Watson & Crick proposed DNA – different forms of DNA – organization of DNA – different types of RNA – structural elucidation & biological functions of different RNA molecules.

UNIT III

Regulation of glycolysis: Fermentation. Metabolism of maltose, lactose, sucrose, fructose, mannose and galactose. Pentose phosphate pathway and its significance. Glucuronic acid pathway and ascorbic acid pathway.TCA cycle: pyruvate dehydrogenase complex, Reactions of the TCA cycle and Regulation. Amphibolic pathway. Anapleortic reaction. The glyoxylate cycle. Gluconeogenesis and regulation. Futile cycles in carbohydrate metabolism. Glycogen metabolism and regulation. Biosynthesis of Starch, Biosynthesis of glycoproteins.CO_2 Fixation, C3 and C4 pathways (Hatch- Slack pathway). Disorders of carbohydrate metabolism- glycogen, lactose, galactose and fructose.

UNIT IV

Lipid digestion, absorption and transport. Fatty acid oxidation - Fatty acid activation, Transport across the mitochondrial membrane. Oxidation: oxidation of unsaturated, odd-chain fatty acid, peroxisomal β-oxidation. Regulation of fatty acid oxidation ά, -oxidation and ω-oxidation. Degradation of triacylglycerol and phospholipids, ketone bodies-formation and utilization. Biosynthesis of Fatty acids- Transfer of Mitochondrial Acetyl Co-A to cytosol, formation of malonyl Co-A, Fatty acid synthase complex, biosynthesis and regulation of fatty acid synthesis. (Long chain fatty acids and unsaturated fatty acids) Biosynthesis of prostaglandins, Thrombaxanes and Leukotrienes. Biosynthesis of Triacylglycerols and its regulation. Biosynthesis of glycerophospholipid sphingophospholipids and sphingoglycolipids. Sphingolipid storage disease Biosynthesis of cholesterol and its regulation, entry of cholesterol esters into cells. Fat of cholesterol.

UNIT V

Nitrogen cycle. General metabolic reactions of amino acids. Amino acid transamination, deamination, oxidative de-amination, non-oxidative deamination (amino acid oxidases and deaminases), amino acid decarboxylation, role of folic acid, vitamin B1, B6, and B12 in amino acid metabolism. Krebs urea cycle, regulation of urea cycle. Metabolic breakdown of individual amino acids. Ketogenic and glucogenic amino acids, Biosynthesis and regulation of aspartate family amino acids (Aspartate kinase), branched chain amino acids, histidine, tryptophan,

phenylalanine. Metabolic defects of amino acid metabolism. Biosynthesis of nucleotide coenzymes-nicotinamide coenzymes, Flavin coenzymes and coenzyme- A.

Books:

- Albert L. Lehninger, David L. Nelson, and Michael M. Cox "Principles of Biochemistry" (CBS Publishers), 2013.
- Jeremy M. Berg and Lubert Stryer "Biochemistry" (W.H.Freeman & Co Ltd) 5th & 6th, Edition, 2013.
- Emil L, Et Al; Smith "Principles of Biochemistry: General Aspects", (McGraw Hill) 8th Edition, 2001.
- Martin et al., "Harper's Review of Biochemistry" (LANGE Medical Publications) (Lange) 19th Edition, 2001.
- Thomas M.Devlin "Text Book of Biochemistry with clinical correlation" (John Wiley) 2nd & 4th Edition , 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23102) BIOPROCESS ENGINEERING

UNIT I

Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.

UNIT II

Immobilized biocatalysts: formulation and characterization of immobilized cell biocatalysts, applications of immobilized cell biocatalysts. Internal and external mass transfer limitations, Industrial applications of enzymes.

UNIT III

Microbial Stoichiometry, bio-energitics, microbial growth, yield.

UNIT IV

Specific growth rate, logistic equation, microbial growth kinetics, inhibition kinetics, microbial community. Kinetics of balanced growth: monod growth kinetics, kinetic implications of endogenous and maintenance metabolism, other forms of growth kinetics, other environmental effects on growth kinetics. - Transient growth kinetics: growth-cycle phases for batch cultivation, unstructured batch growth models, growth of filamentous organisms.

UNIT V

Cellular growth in reactors- batch, chemostat, PFR. Immobilized cells in reactors. Structured kinetic models: compartmental models, metabolic models, modeling cell growth as an optimum process- Product formation kinetics: unstructured models, chemically structured product formation kinetics models, product formation kinetics based on molecular mechanisms-genetically structure models, product formation kinetics by filamentous organisms-Segregated kinetic models of growth and product formation, thermal-death kinetics of cells and spores.

BOOKS:

- Blakebrough, N., T. K. Ghose, and A. Fiechter, eds. “Advances in biochemical engineering”, (Springer-Verlag), Volume 3, 2013.
- Dunn, I.J., Heinzle E., Ingham, J. and Prenosil, J.E., “Biological Reaction Engineering:Dynamic Modelling Fundamentals with simulation examples”, (WILEYVCH publications) , 3rd Revised Edition, 2016.
- Moser, Anton, “Bioprocess technology: kinetics and reactors”, (Springer Science & Business Media), 2012.
- Najafpour, G.D., “Biochemical Engineering & Biotechnology”, (Elsevier), 2nd Edition, 2015.
- Truskey, G.A., Yuan, F. and Katz, D.F., “Transport Phenomena in Biological Systems”, (Pearson Prentice Hall), 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23103) MOLECULAR AND CELL BIOLOGY

UNIT I

Cell and Cell Cycle: First cell in the world – cell theory – diversity of cell size & shape – macro & micro compounds in cell – basic properties of cell - Chromosomes – genes – enzymes – identification of DNA as genetic material – structure of DNA. **Cell Cycle**: Phases of cell cycle – mitosis – meiosis – regulation of cell cycle – cell cycle check points – coupling of S phase to M phase – regulators of cell cycle progression – inhibitors of cell cycle progression – proliferation of differentiated cells – stem cells.

UNIT II

Cell Structure & Organelles functions: Structure & functions of nuclear envelope – nuclearpore complex – nucleolus – nucleus during mitosis – Endoplasmic reticulum – golgi apparatus – mechanism of vesicular transport – lysosomes – mitochondrial structure & mechanism of oxidative phosphorylation – structure & functions of chloroplast - electron flow through photosystem I & II – cyclic electron flow – ATP synthesis – peroxisomes. **Cytoskeleton Cell Movement:** Microtubules – microtubule motors & movements – cilia – flagella – micro filaments - structure of plasma membrane – membrane proteins – glycocalyx – passive diffusion – facilitated diffusion – carrier proteins – ion channels – active transport driven by ATP hydrolysis – active transport driven by ion gradients – phagocytosis – receptor mediated endocytosis – protein trafficking endocytosis – bacterial cell walls – plant cell wall – extra cellular matrix – cell adhesion proteins – tight junction – gap junction – plant cell adhesion & plasma desmata.

UNIT III

DNA Replication and Repair: Semi-conservative mode of replication, experimental evidence of Meselson- Stahl and Cairns autoradiography experiments. Replication fork, continuous and discontinuous DNA synthesis. Evidence for Okazaki fragments- RNA primers, Enzymes and protein in replication, Single Strand DNA binding proteins (SSB), Helicases, Topoisomerases, DNA ligases, DNA polymerases. E.Coli DNA polymerase I, II and III, Eukaryotic DNA polymerases. Rolling circle replication. Replication of ϕ×174 and E. coli DNA. Eukaryotic DNA replication. Autonomous replication sequences (ARS) and regulation of plasmid DNA replication. Mitochondrial DNA replication. Termination and fidelity of DNA replication. Nearest neighbour base pair analysis. Replicons and termination signals. Inhibitors of DNA replication. Reserve transcriptase. DNA damage and repair: Photo reactivation, direct reversal of damage, excision repair, Recombination repair. The SOS response.

UNIT IV

Transcription: Polynucleotide phosphorylase - RNA polymerases, structure of E.coli –RNA Polymerase, eukaryotic RNA polymerases- Template binding, promoters and enhancer sequences.

Initiation, elongation and termination of RNA synthesis. Monocistronic and polycistronic RNAs. Post-transcriptional modifications of different RNA molecules -Eukaryotic mRNA -capping, methylation and poly adenylation. RNA splicing. Splicing mechanisms. Splicing of nuclear pre-tRNA, Introns, group I and group II and pre- mRNA splicing. Excision of multiple Introns, catalytic RNA. Translation (Protein synthesis): The genetic code elucidation, experimental studies of Nirenburg and Khorona. General features of genetic code, codon degeneracy and universality. Mitochondrial genetic code, tRNA role in protein synthesis. Amino acyl-tRNA synthetases wobble hypothesis. Mechanism of initiation, elongation and termination of protein synthesis. Translational factors. Inhibitors of protein synthesis, antibiotics and other inhibitors. Post translational modifications. Protein sorting and targeting. The signal hypothesis, signal sequences and signal recognition particle, molecular chaperones, protein degradation, Lysosomal degradation. The ubiquitin pathway-protein stability and N-end rule. Mutations: Mutagens, transitions, transversions, frame shift mutations, deletion, transposon, Mutagensis, suppressor mutations.

UNIT V

Gene expression and Regulation: Housekeeping genes, constitutive genes, induction and repression. Regulatory proteins -DNA binding motif of regulatory proteins, role of Zinc fingers, leucine zippers, helix- turn -helix. Regulation of gene expression in prokaryotes operons, fine structure of lac operon, Regulatory protein. Repressors and the catabolic activator proteins, Negative regulation, Positive regulation, Dual functions of the repressor, the arabinose operon. Transcriptional control by attenuation, the trp and his operons. Regulation of gene expression in Eukaryotes - Eukaryotic promoters, positive regulation, gene amplification, gene rearrangement, translational control, hormonal regulation - Homeotic genes and their regulation.

BOOKS:

- B. Albert's, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D.Watson , "Molecular Biology of the Cell" (Garland Publishing, New York and London)
- D. Freifelder , "Molecular Biology A Comprehensive Introduction to Prokaryotes and Eukaryotes" (Jones and Bartlett, USA)
- J.D. Watson, J. Tooze and D.T.Kurtz "Recombinant DNA: A Short Course" (Scietific American Book, W.A.Preemon).
- Maniatis, E.F. Fritsch and J. Sambrook "Molecular cloning: Laboratory Manual" (Cold Spring Harber Laboratory, New York).
- A.J. Ayala and W. Castra "Modern Genetics" (Goom Helns, London), 2nd Edition, 1984.
- Ed., J. Walker and W. Castra "Techniques in Molecular Biology" (Geom Helns, London), 1992.
- R.F. Schecleif and P.C. Wensik "Practical Methods in Molecular Biology" (Springer Verlag) , 1991.
- Benjamin Lewin "Genes V" - (Oxford University Press) , 1994.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23104) MICROBIOLOGY AND FERMENTATION TECHNOLOGY

UNIT I

Taxonomy– Principle and its types (Classical approach – Numerical, Chemical, Serological and Genetic). Bacterial taxonomy– Bergey's manual of Systematic Bacteriology (Eubacteria and Archaebacterium). Characterization, Classification and Identification of microorganisms, Microscopic examination of Microorganisms morphology and fine structure of bacteria, cultivation of bacteria, reproduction & growth, pure cultures and cultural characteristics.

UNIT II

Screening, Isolation and Identification of bacteria

UNIT III

Strain Improvement: Natural mutation, Induced mutation, r-DNA technology. Isolation of industrially important microbial strains, strain improvement, maintenance and preservation of industrial microbes.

UNIT IV

Microbiological media, composition and types: selective and differential media. Sterilization and disinfection- Definitions, Principles. Methods of sterilization- Physical methods (Heat, Filtration), Radiation and Chemical methods. Control of sterilization and Testing of sterility.

UNIT V

Industrially important products: Primary metabolites, Secondary metabolites and recombinant DNA products. Batch, fed-batch and continuous fermentations; solid state and submerged fermentations. Feed-stocks for industrial fermentation: Molasses, corn steep liquor, whey, malt, yeast extract and antifoams

BOOKS:

- Prescott, L.M J.P. Harley and C.A. Klein "Microbiology" (C. Brown publishers), 2nd edition, 1995.
- Michael J, Pelczar, Jr. E.C.S. Chan, Moel "Microbiology" (McGraw Hill Book), 1986
- Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. "The Microbial World", (Eagle Works Cliffs N.J. Prentice Hall), 5th edition ,1986.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23105) MATHEMATICAL METHODS FOR BIOTECHNOLOGISTS

UNIT I

Review of Matrix Algebra; Solvability conditions for systems of linear algebraic equations. Applications to solution of systems of linear algebraic equations and systems of first order ordinary differential equations (ODEs). Stability analysis; Examples from reaction engineering, process control etc.

UNIT II

Vector Algebra; Linear independence, Norm and Inner Product; Linear Operators, Adjoint of an operator, Self-adjoint operators. Transformations under change of basis, eigen values and eigen vectors.

UNIT III

Second order linear ODEs, Sturm Liouville Operators, Spectral expansion, Special functions. Inverse of second order operators and Green's function.

UNIT IV

Second order linear partial differential equations (PDEs): Classification, canonical forms. Solution methods for hyperbolic, elliptic and parabolic equations: Eigen function expansion, separation of variables, transform methods. Applications from heat and mass transfer, reaction engineering.

UNIT V

Numerical solution of linear and nonlinear algebraic equations, Gauss elimination methods, LU decomposition, Newton-Raphson method; Finite difference method for solving ODEs and PDEs. Chemical engineering applications from separation processes, reaction engineering, fluid mechanics etc...

BOOKS:

- Schneider, Barker, G.P. "Matrices and Linear Algebra", (Dover), NY, 1972.
- Ray, A. K., Gupta, S. K. "Mathematical Methods in Chemical and Environmental Engineering", (International Thomson Learning), Singapore, 2004.
- Pushpavanam, S. "Mathematical Methods in Chemical Engineering", (Prentice-Hall of India), New Delhi, 2004.
- Ramkrishna, D., Amundson, N. "Linear Operator Methods in Chemical Engineering" (Prentice-Hall: Englewood Cliffs), New Jersey, 1985.
- Chapra, S. C., Canale, R. P. "Numerical Methods for Engineers", (Tata McGraw-Hill, New Delhi), 2006.
- Hoffman, J. D. "Numerical Methods for Engineers and Scientists", (Taylor and Francis), Boca Raton, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23201) BIOREACTOR DESIGN AND ANALYSIS

UNIT I

Bio-reactor characteristics for industrial products. Microbial cultivation, plant cells cultivation, mammalian cells cultivation and recombinant cells cultivation.

UNIT II

Hydrodynamics in bioreactors: Types of Impeller, Mixing, power input, factors effecting viscosity of the broth. Ideal bioreactors: fed-batch reactors, enzyme-catalyzed reaction in CSTRs, CSTR reactors with recycle and wall growth, the ideal plug-flow tubular reactor. -Reactors with non-ideal mixing: mixing times in agitated tanks, residence time distribution, models for non-ideal reactors, mixing-bio-reaction interactions.

UNIT III

Heat transfer in bioreactors: Sterilization and pasteurization. Heating/cooling requirement in bioreactors. Types of heat exchangers.

UNIT IV

Gas-liquid mass transfer in cellular systems: basic mass transfer concepts, rates of metabolic oxygen utilization. Determination of oxygen transfer rates: measurement of kLa' using gas-liquid reactions. Overall kLa estimates and power requirements for sparged and agitated vessels

Analogy between mass, heat and momentum transfer: role of diffusion in bio-processing, film theory, convective mass transfer, oxygen uptake in cell cultures, oxygen transfer in fermenters: measuring dissolved-oxygen concentration, estimating oxygen solubility, mass transfer correlation, measurement of kLa, oxygen transfer in large vessels

UNIT V

Multiphase bioreactors: conversion of heterogeneous substrates, packed-bed reactors, bubble-column bioreactors, fluidized-bed bioreactors, trickle-bed reactors. Scale up and stability analysis: Methods of scale-up studies. Stability analysis of reactors.

BOOKS:

- Impre, J.F.M.V., Vanrolleghem, P.A. and Iserentant, D.M., "Advanced Instrumentation, Data Interpretation and Control of Biotechnological Processes", (Kluwer Academic Publishers), 2010.
- Mann, U., "Principles of Chemical Reactors Analysis & Design: New tools for Industrial Chemical Reactor Operations", (Willey–VCH), 2009.
- Mansi, E.M.T.EL., Bryce, C.F.A., Demain, A.L. and Allman, A.R., "Fermentation Microbiology and Biotechnology", (Taylor and Francis), 3rd edition, 2012.
- Towler, G. and Sinnott, R., "Chemical Engineering Design: Principles, Practice, Economics of Plant and Process Design", (Butterworth – Heinemann Ltd. Elsevier), 2nd edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23202) DOWNSTREAM PROCESSING

UNIT I

INTRODUCTION TO BIOPRODUCTS:

Regular characteristics of Biomolecules, Problems and requirements of bio-product purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological fluids.

UNIT II

CELL DISRUPTION METHODS

Various cell disruption methods, need for cell disruption for intracellular products, cell disruption equipment. Applications in bio-processing.

UNIT III

SOLID- LIQUID SEPARATION

Centrifugation: Principles of centrifugation, centrifuge effect, various centrifuges viz; basket centrifuge, tabular centrifuge, disc-bowl centrifuge, scale –up of centrifuges. Extraction methods.

UNIT IV

CONCENTRATION OF PRODUCTS

Membrane separation processes: Basic principles of membrane separation, membrane characteristics, different types of membranes, criteria for selection of membranes.

UNIT V

CHROMATOGRAPHIC SEPARATION AND ELECTROPHORESIS METHODS

Principles of chromatographic separation methods, different types of chromatographic methods, viz; adsorption chromatography, ion – exchange chromatography, gel chromatography, affinity chromatography etc. Applications in bio-processing. Principles of electrophoresis and electrophoresis mobility, Applications Drying**:** Various types of drying methods, Freeze drying technique and its advantages over other methods. Applications in bio-processing.

BOOKS

- Ir.J.Krijgsman , "Product Recovery in Bioprocess technology ", BIOTOL series, (Butterworth Heinemann), 2006
- Peter F Stan bury, Allan Whitaker and Stephen J Hall "Principles of fermentation technology", (Pergamon Publications),2007
- Murray Moo-Young, "Comprehensive Biotechnology", (Pergamon Publications), Vol 2nd edition, 2003
- Ronald & J.Lee, "Principles of Downstream processing", (Wiley Publications), 2nd edition,2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23203) CANCER BIOLOGY

UNIT - I

Introduction, growth characteristics of cancers cells; Morphological and ultrastructural properties of cancer cells. Types of growth: hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Epidemiology of cancer.

UNIT - II

Cancer biology and biochemistry – Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors – EGF, TNF and TGF and growth factor receptors. Signal transduction in cancer. Role of transcription factors.

UNIT - III

Carcinogenesis – Radiation and chemical carcinogenesis. Stages in chemical carcinogenesis – Initiation, promotion and progression. Free radicals, antioxidants in cancer. Viral carcinogenesis – DNA and RNA viruses. Hormone-mediated carcinogenesis in humans.

UNIT - IV

Cell cycle regulation – Tumour suppressor genes p53, p21, Rb, BRACA1 and BRACA2. Telomeres, Telomerase, and Immortality. Cell–cell interactions, cell adhesion, invasion and metastasis. VEGF signalling, angiogenesis. Epigenetics – Role of DNA methylation in gene silencing, epigenetic silencing of tumour-suppressor genes. Apoptosis in cancer – Cell death by apoptosis, role of caspases. Death signalling pathways – Mitochondrial and death receptor pathways.

UNIT - V

Detection of cancers, Prediction of aggressiveness of cancer. Different forms of therapy – Chemotherapy, Radiation therapy and Immuno-therapy. Advantages and limitations. Resistance to chemotherapy and radiotherapy and the signalling mechanisms involved in this Process.

BOOKS:

- King R.J.B., "Cancer Biology", (Addison Wesley Longmann Ltd), U.K., 1996.
- Ruddon.R.W,"Cancer Biology", (Oxford University Press), Oxford, 2007.
- Robert Allan Weinberg, "The Biology of Cancer", (Garland Science), Volume 2, 2007.
- C Athena Aktipis, Randolph M Nesse. "Evolutionary foundations for cancer biology". (Evol Appl. 6(1): 144–159), 2013 January.
- Sandra Demaria, Eli Pikarsky, Michael Karin, Lisa M. Coussens, Yen- Ching Chen,Emad M. El-Omar, Giorgio Trinchieri, Steven M. Dubinett,Jenny T. Mao, Eva Szabo, "Cancer and Inflammation: Promise for Biological Therapy",(US National Library of Medicine), 1st May 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23204) ANIMAL BIOTECHNOLOGY

UNIT - I

Biology of Cultured Cells:

Historical background of animal cell culture – advantages of animal tissue culture – types of tissue cultures – cell adhesion – cell proliferation – differentiation - cell signaling –initiation of cell culture – evaluation of cell lines – cell banks.

UNIT - II

Facilities for Animal Cell Culture:

Equipments – culture vessels – minimal requirements of cell cultures – sterilization techniques – advantages & disadvantages of animal cell culture – biohazards – bioethics– validations.

UNIT - III

Cultural Media:

Physico-chemical properties of media – balanced salt solution – media constituents – selection of medium & serum – other supplements – serum free media – disadvantages of serum – advantages of serum free media – protein free media. **Cultured Cells:** Characterization of cultured cells – measurement of growth parameters of cultured cells– cell synchronization – senescence – apoptosis – types of primary cell culture – isolation of tissue – primary culture – cell lines – subculture – stem cell cultures. **Scale-up Cell Culture:** Cell quantification – equipment – types of culture process – scale-up in suspension – scale-up in monolayer – cell growth in scale-up – cell viability – cell cytotoxicity.

UNIT – IV

Cloning & Selection:

Transformation of cells – cell cloning – suspension cloning – Isolation of clones. **Transgenic Animals:** Transgenic mice and their applications – gene knockout – YAC in transgenesis – transgenesis in large animals – animal bioreactors – Dolly- a transgenic clone.

UNIT – V

Organ & Histotypic Cultures and Tissue Engineering:

Organ cultures – techniques for organ cultures – Histotypic cultures – organotypic cultures – 2-dimentional cultures – tissue engineering – embryogenic stem cell engineering – human embryogenic stem cell.

BOOKS:

- Freshney R.I. “Cultures of Animal cells: A manual of Basic Techniques and specialized applications”, (John Wiley and Sons), 6th edition, 2010.
- Glick, B.R. and Pasternack, J.J. and Pattern, C. “Molecular Biotechnology”, (ASM Press), 4th Edition ,2003
- Lewin, B. “Genes VIII”, (Pearson Prentice Hall), 2004
- Portner, R, Animal Cell Biotechnology, Methods and Protocol, (Humana Press), 2nd Edition, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23205) PLANT BIOTECHNOLOGY

UNIT - I

Conventional Plant Breeding:

Introduction to cell and Tissue Culture - tissue culture as a technique to produce novel plants and hybrids - Tissue culture media (composition and preparation) - Initiation and maintenance of callus and suspension culture - single cell clones – Organogenesis -somatic embryogenesis - transfer and establishment of whole plants in soil - Shoot-tip culture - rapid colonal propagation and production of virus-free plants - Embryo culture and embryo rescue.

UNIT - II

Hybridization:

Protoplast isolation - culture and fusion - selection of hybrid cells and regeneration of hybrid plants - symmetric and asymmetric hybrids – cybrids - Anther, pollen and ovary culture for production of haploid plants and homozygous lines – Cryopreservation – slow growth and DNA banking for germplasm conservation - Basic Techniques in rDNA Technology.

UNIT –III

Plant Transformation Technology:

Basis of tumor formation - hairy root - features of TI and RI plasmids - mechanisms of DNA transfer - role of virulence genes - use of TI and RI as vectors - binary vectors – use of 35S and other promoters - genetic markers - use of reporter genes - reporter gene with introns - use of scaffold attachment regions - methods of nuclear transformation – viral vectors and their applications - multiple gene transfers - Vectors- less or direct DNA transfer - particle bombardment – electroporation – microinjection - transformation of monocots - Transgene stability and gene silencing.

UNIT – IV

Applications of Plant Transformation for productivity & Performance:

Herbicide resistance – phosphoinothricin – glyphosate - sufonyl urea – atrazine – insect resistance - Bt genes - Non-Bt like protease inhibitors - alpha amylase inhibitor – virus resistance - coat protein mediated - nucleocapsid gene - disease resistance – chitinase – 13

beta glucanase – RIP - antifungal proteins – thionins - PR proteins – nematode resistance - abiotic stress - post- harvest losses - long shelf life of fruits and flowers – use of ACC synthase - polygalacturanase - ACC oxidase - male sterile lines - bar and barnase systems - carbohydrate composition and storage - ADP glucose pyrophosphatase.

UNIT – V

Metabolic Engineering & Industrial Products:

Plant secondary metabolites - control mechanisms and manipulation of phenylpropanoid pathway - shikimate pathway – alkaloids - industrial enzymes - biodegradable plastics – polyhydroxy butyrate - therapeutic proteins - lysosomal enzymes – antibodies – edible vaccines - purification strategies - oleosin partitioning technology. **Molecular Marker-aided Breeding:** RFLP maps - linkage analysis - RAPD markers – STS – microsatellites – SCAR (sequence characterized amplified regions) - SSCP (single strand conformational polymorphism) – AFLP - QTL - map based cloning - molecular marker assisted selection.

BOOKS:

- Adrian, Scott, Nigel W., Fowler, Mark R. "Plant Biotechnology: The Genetic Manipulation of Plants by Slater" Oxford University Press, 2nd edition, 2008
- Chawla, H.S, "Introduction to Plant Biotechnology", (Science Publishers),2nd edition, 2007
- Gamburg, O.L., and Philips G.C. "Plant Tissue & Organ Culture: Fundamental Methods", (Narosa Publishing House) ,2005
- Grierson D. and Covey, S.N. "Plant Molecular Biology", (Springer Netherlands) ,2nd edition, Blackie,1988
- Heldt, Hans-Walter, "Plant Biochemistry & Molecular Biology", (Oxford University Press), 1st edition ,1997

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23206) FOOD BIOTECHNOLOGY

UNIT I

PRESERVATION TECHNOLOGIES

Role and significance of microorganisms in foods. Intrinsic and Extrinsic Parameters of Foods that affect microbial growth, Role of microorganisms in manufacture and spoilage of fermented products, Cereals, Pulses, Nuts and Oil seeds, Fruits and Fruit products, Vegetables and Vegetable Products, Fish and Meat products, Probiotics, prebiotics and synbiotics.

UNIT II

PRODUCTION TECHNOLOGIES

Mechanism of enzyme functions and reactions in process techniques: Enzyme in bakery and cereal products, Enzymes in fat/oil industries, Cold active enzymes in Food processing, Starch and sugar conversion process or baking by amylases, cheese making by proteases, Utilization of food waste for production of valuables: whey, molasses, starch substances and other food wastes for bioconversion to useful products.

UNIT III

TECHNOLOGIES FOR IMPROVED PROCESSES

Technologies used for microbial production of food ingredients, production of carotenoids by gene combination, microbial biotechnology of natural food flavor and color production and polysaccharides in foods, Biotechnology of non-nutritive sweeteners, Biotechnological approach to improve nutritional quality and shelf life of fruits and vegetables, Biotechnological approaches (enzymes/ proteins & effective processing parameters) towards reducing / modifying anti-nutritional factors in foods and food ingredients, Anti-nutritional factors in cereals and legumes.

UNIT IV

APPLICATIONS OF BIOTECHNOLOGY IN TESTING

Testing Application of microbial molecular techniques to food system, Impact of biotechnology on microbial testing of food, current/traditional methodology and new approaches -use of gene probes, RDT, Bioluminescence.

UNIT V

QUALITY AND SAFETY ASPECTS OF FOODS DERIVED FROM BIOTECHNOLOGY

Safety and applicability of modified foods and food ingredients, Safety evaluation of genetically engineered enzyme/novel food products, International Aspects of the quality and safety assessment of foods derived by modern biotechnology.

BOOKS:

- Angold, Beech and Taggart, Food Biotechnology, 1st edition, Cambridge University Press New York, 1989.
- Kalidas.S., Gopinadhan.P., Anthony P., RobertE.L, "Food Biotechnology",2nd edition,(CRC Press),2006.
- Roger, A., Gordon, B. and John, T, "Food Biotechnology", (Cambridge University) Press, 1st edition, New York, 1989.
- W.C. Frazier, "Food Microbiology", (McGraw Hill Book Company),2nd edition,1968.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23207) METABOLIC ENGINEERING

UNIT I

INTRODUCTION

Basic concepts of Metabolic Engineering, Overview of cellular metabolism, Different models for cellular reactions, induction, Jacob Monod model and its regulation, Differential regulation by enzymes, Feedback regulation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities. metabolic pathway manipulations to improve fermentation, The modification of existing or the introduction of entirely new metabolic pathways.

UNIT II

PRIMARY METABOLITES

Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products. Engineering for L-Lysine Production by *Corynebacteriumglutamicum* Metabolic Engineering of Pentose pathway for Ethanol Production.

UNIT III

SECONDARY METABOLITES

Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, Catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

UNIT IV

MATERIAL BALANCES AND DATA CONSISTENCY

Material Balances and Data Consistency: Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems, identification of gross measurement errors

UNIT V

METABOLIC FLUX

Metabolic Flux Analysis: Theory and applications - metabolic flux analysis of citric acid fermentation, Experimental determination method of flux distribution, optimization and control of metabolic flux, Integrating Methodologies of Molecular Breeding and bioprocess systems engineering, Fundamentals of Metabolic control analysis: Control coefficients and the Summation Theorems, Elasticity Coefficients and the Connectivity Theorems, Generalization of MCA Theorems.

BOOKS:

- Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, 1st edition John Wiley and sons 2000.
- Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, 2nd edition,Butterworth-heinemann, 2003.
- Yu Matsuoka and Kazuyuki Shimizu 13C-Metabolic Flux Analysis and Metabolic Regulation, Chemical Biology, 1st Ed, Woodhead Publishing 2013.
- David T. Dennis, David B. Layzell, Daniel D. Lefebvre, David H. Turpin, Plant Metabolism 2nd edition Prentice Hall College.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23208) PHYTOCHEMISTRY

UNIT - I

HERBAL DRUGS

Phytochemicals and their classification–Phytochemical screening –Physiochemical tests — Macroscopic and microscopic techniques –Traditional plant and Herbal remedies — Herbal drugs WHO guidelines–Standardization of Herbal Drugs Derivatives with Special Reference to Brazilian Regulations.

UNIT - II

PHYTOCOMPOUNDS

Plant extract used to Bacterial, Fungal and Parasitic infection – Biological and Toxicology Properties of plant extract –Anti-MRSA and Anti-VRE activities of Phytoalexins and Phytoncides–Anti microbial and targeted screening of Plant extract – Plant derived compound against drug resistant microorganisms –Antioxidant and antitumor Plant metabolites (fruits and vegetables)– Bioactive compounds as food.

UNIT - III

PHYTOMEDICINE

Medicinal Plants for Development of Phytomedicine and Use in Primary Health Care– Immuno-stimulants and adaptogen from Plants –Polyphenols for Atherosclerosis and Ischemic Heart disease – Cancer Chemo preventive agents –Lipid oxidation nitrogen Radicals– Phytochemicals in oilseeds – Flavonoids in Cardiovascular disease – Bioengineering and Breeding approaches in improving phytochemical content of plants.

UNIT - IV

SEPARATION TECHNIQUES AND STRUCTURE ELUCIDATION

Thin layer chromatography– HPTLC– Column chromatography – GC-MS – LC-MS –HPLC – Partition chromatography – Gas chromatography – FT-IR – UV- NMR (1D&2D) – X-ray diffraction – QSAR and Molecular Modeling.

UNIT - V

SECONDARY METABOLITES

Secondary metabolite production through cell culture system–Hairy root induction–Methods of gene transfer–Chemical methods– PEG – dextran–Physical method– Electroporation–Microinjection– Lipofection delivery for herbal therapeutics–Quality Control –Germplasm Improvement.

BOOKS:

- Ahamed, I., Aqil, F. and Owais, M., "Modern Phytomedicine: Turning medicinal Plants into Drugs", (WILEY VCH, Verlag GmbH & Co), 2006.
- Arnason, J.T., Arnason, J.E. and Arnason, J.T., "Phyto chemistry of Medicinal Plants", (Kluwer Academic Publishers), 1995.
- Bidlack, W.R., Omaye, S.T., Meskin, M.S. and Topham, D.K.W.," Phytochemicals as Bioactive Agents", (CRC Press), 1st edition, 2000.
- Meskin, M.S., Bidlack, W.R., Davies, A.J. and Omaye, S.T., "Phytochemicals in Nutrition and Health", (CRC Press), 2002.

Rasooli, I, "Bioactive compounds in Phytomedicine", (Intech Open access Publishers), 1st Edition, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23209) NANOBIOTECHNOLOGY

UNIT I

Nanomaterial in biotechnology -Nanoparticles, quantum dots, nanotubes and nanowires etc. Development of nanobiotechnology – timelines and progress, overview. Synthesis, characterization, and properties of smart nanomaterials, Nanocarriers (e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, micro emulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles) for drug delivery applications. Biological nanoparticles production - plants and microbial.

UNIT II

Properties and Characterizations: Optical (UV-Vis/Fluorescence) –X-ray diffraction – Imaging and size (Electron microscopy, light scattering, Zeta potential)- Surface and composition (ECSA (Electro chemical surface area), EDAX, AFM/STM etc.) – Vibrational (FTIR and RAMAN), SERS (Surface-Enhanced Raman Spectroscopy), Magnetic, Electrical and Electrochemical.

UNIT III

Biosensors: different classes-molecular recognition elements, transducing elements. Applications of molecular recognition elements in Nano sensing of different analytes. Application of various transducing elements as part of Nano biosensors. Miniaturized devices in Nano biotechnology - types and applications, Bio MEMS, lab on a chip concept.

UNIT IV

Nano biotechnological applications in health and disease - infectious and chronic. Nano biotechnological applications in Environment and food - detection and mitigation.

Nanomedicine: Introduction to nanomedicine- Overview of nanotechnology from medical perceptive, different types of Nano biomaterials and their biomedical applications, and cell nanostructure interactions.

UNIT V

Nano nephrology, Nano neurology and molecular imaging -Drug delivery (modes and example applications), Nanomedicine and cancer (diagnostic and imaging), Regenerative medicine, including tissue engineering, cell and gene therapy, DNA-based nanostructures, Cellular nanomachines. Nanomaterials and Toxicity Evaluation: Cyto-toxicity, Geno-toxicity In vivo tests/assays etc. Assessing nanotoxicity at the single cell level, encoding information into nanomedical systems. Other emerging ethical issues in Nanobiotechnology and Nanomedicine.

BOOKS:

- Gazit, E., and Mitraki, A., "Plenty of Room for Biology at the Bottom: An Introduction to Bio Nanotechnology", (Imperial College Press), 2013.
- Goodsell, D.S., "Bio Nanotechnology", (John Wiley and Sons), 2004.
- Jesus M. de la Fuente and Grazu, V., "Nanobiotechnology: Inorganic Nanoparticles Vs Organic Nanoparticles", (Elsevier), 2012.
- Niemeyer, C.M. and Mirkin, C.A., "Nanobiotechnology: Concepts, Applications and Perspectives", (Wiley- VCH), 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23210) BIOINFORMATICS AND COMPUTATIONAL MOLECULAR BIOLOGY

UNIT I

Introduction to Bioinformatics

Scope of Bioinformatics, Introduction to Homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace). DNA mapping and sequencing, Map alignment, Large scale sequencing methods Shotgun and Sanger method.

UNIT II

Sequencing Alignment and Dynamic Programming

Heuristic Alignment algorithms. Global sequence alignments-Neddleman-Wunsch Algorithm Smith-Waterman Algorithm-Local sequence alignments (Amino acid substitution Matrices (PAM, BLOSUM). **Evolutionary Trees and Phylogeny** Multiple sequence alignment and phylogenetic analysis. CLUSTAL, W. Basic concepts in systematics, Molecular evolution, Definition and description of Phylogenetic trees and types of trees Dendrograms and its interpretation.

UNIT III

Biological Database

Introduction to Biological databases, Organization and management of databases. Searching and retrieval of information from the World Wide Web. Structure databases - PDB (Protein Data Bank), Molecular Modeling Databases (MMDB). Primary Databases NCBL, EMBL, DDBJ. Introduction to Secondary Databases Organization and management of databases Swissprot, PIR, KEGG. Introduction to Biochemical databases-organization and Management of databases. KEGG, EXGESCY, BRENDA, WIT.

UNIT IV

Introduction to Computational Molecular Biology

Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics, Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements.

UNIT V

Genomics

DNA Sequence assembly and gene identification. Homology based gene prediction. SNPs and applications. Methods of studying gene expression, EST approach, Basics of Micro array

Proteomics : Introduction to proteins. Protein identification, structure and function determination. Structure comparison methods. Prediction of secondary structure from sequence. Protein homology modeling, Protein threading. Protein ab initio structure prediction. Protein design emphasis on structural Bioinformatics. **Drug Design** Drug discovery cycle, Role of Bioinformatics in Drug discovery.

BOOKS:

- Hooman H. Rashidi and Lukas K.Buehler , "Bioinformatics Basics. Applications in Biological Science and Medicine", (CAC Press), 2000.
- Dan Gusfield, "Algorithms on Strings Trees and Sequences", (Cambridge University Press) ,1997.
- David W Mount, "Bioinformatics - Sequence and genome analysis", (CSHL Press),2004.
- Moody P C E and A J Wilkinson, "Protein Engineering", (IRL Press),1990.
- Creighton T E, Proteins. Freeman W H. "Journal Bioinformatics", (Oxford University), 2nd edition ,1993.
- Brandon D Tooze, P. Baldi. S. Brunak, "Proteomics Bioinformatics: A Machine Learning Approach", (MIT Press), 1988.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23211) ENVIRONMENTAL BIOTECHNOLOGY AND BIOSAFETY

UNIT I

Environmental Pollution microbial diversity: Atmosphere – hydrosphere – lithosphere – biosphere – source of pollutions – nature of pollutants – pollution monitoring & measurements – ecosystem – global environmental problems. Structural & Functional dynamics of Microbial life: Microbial diversity – microbial activity & growth – microbial community profiling – molecular basis of microbial community profiling – limitations of genetic fingerprinting techniques – biosensors – bioreporter - microchips – microscopy in environmental applications.

UNIT II

Air & Water Pollution: Indoor air pollution control – out door air pollution control – particulate emission control – control of gaseous emissions – control of pollutants from vehicles – primary water treatment – secondary water treatment – alternative water treatment – management of solid waste – treatment of disposal of non-hazardous solid waste – medical solid waste management – processing & disposal of medical wastes – hazardous waste treatment process – soil pollution – soil erosion – soil conservation – potential emergency control methods.

UNIT III

Lignocellulose Degradation: Microorganisms of lignocellulose degradation – degradation of lignocellulose – modular structure of celluloses & xylanases – directed evaluation of enzyme catalysts – prospects of bioconversions – Bio-utilization of effluent – prospects of genetic engineering in bioconversion. Degradation of Xenobiotic Compounds**:** Xenobiotic compounds in environment persistent compounds – chemical properties of influencing biodegradability – microorganisms for biodegradation mechanism – genetics & evaluation for biodegradation – characteristics of aerobic microorganisms for degradation of organic pollutants.

UNIT IV

Bio absorption of metals & Bioremediation: Microorganisms & metal absorption – mechanisms of bacterial metal resistance – factors effecting bio absorption – bioreactors – phytoremediation – mechanisms of bio absorption & bioaccumulation in specific metals – bioremediation by microorganisms –bioremediation technologies – measuring bioremediation in the field – efficiency of bioremediation.

UNIT V

Biosafety Introduction; Historical Back ground; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

BOOKS:

- U. Satyanarayana, "Biotechnology", (Books and Allied (P) Ltd), Kolkata, 2011.
- Indu Shekhar Thakur, "Environmental Biotechnology", (IK International Pvt. Ltd.),2011.
- A.K. De, "Environmental Chemistry", (Wiley Eastern Ltd),2011.
- D. Allsopp and K.J. Seal. ELBS/Edward Arnold, "Introduction to Biodeterioration", (Wiley Eastern Ltd),1986
- V. Sree Krishna "Bioethics & Biosafety in Biotechnology", (New age International(P) Ltd), 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23212) PHARMACEUTICAL BIOTECHNOLOGY

UNIT I

Introduction to Pharmaceutical Biotechnology: Introduction to pharmaceutical biotechnology, pharmacokinetic and pharmacodynamic concepts, current research trends, new advances and approved biologicals for pharmaceutical use and manufacturing principles. Quality assurance and control; Concept of GMP, GLP. Nutraceuticals: Antioxidants, flavonoids, carotenoids, cholesterol lowering chemicals, nutritional importance and their functions

UNIT II

Therapeutics based on biotechnology: Hematopoietic growth factor and coagulation factors, interferons and cytokines; Preparation and standardization of hormones-thyroid, insulin and growth hormones; Enzymes-Enzymatic therapy and monographs; antibiotics and their derivatives-penicillin, streptomycin, tetracycline, cephalosporins, macrolides, peptide antibiotics (any two); vaccines -BCG, DPT, Poliomyelitis, Typhus, toxoids-diphtheria and tetanus; antitoxins-diphtheria and gas gangrene(any two); others-whole human blood, dried human plasma, gamma globulins, clinical dextran and absorbable haemostats, uses, and storage.

UNIT III

DRUG METABOLISM

Biotransformation of drugs – Microsomal and non-microsomal mechanisms and the enzymes involved. Mode of excretion – Biliary/ fecal excretion, Factors affecting drug metabolism. Drug metabolism in fetus and new born. Models to study drug metabolism, Dose effect relationships, Adverse drug reactions – Toxic reactions, Allergic reactions, Idiosyncrasy, Acute poisoning and treatment.

UNIT IV

QSAR AND DRUG DESIGN

Drug Action – physicochemical properties and stereochemistry of compound. Isosterism and bio isosterism – metabolite, antagonist and structural variations. Methods for variation – Fibonacci search, Topliss tree, Craigsplot, Simplex methods, and Cluster analysis. Hansch's Liner method, Free and Wilson methods, mixed approached principal component analysis. **COMPUTER ASSISTED COMBINATORIAL DESIGN** Combinatorial chemistry – Introduction, Principles, methodology, purification and analytical tools in solid phase synthesis with case studies. Compound library, interactive graphics program – with examples.

UNIT V

NEW DRUG REGULATION AND DDS

Rational drug design – phases of preclinical and clinical trials. Role of regulatory authorities. Drug delivery system – Basic concepts and Novel advances. Cell specific drug delivery, Brain specific drug targeting strategies and Pulmonary delivery systems.

BOOKS:

- N. Evers and D. Caldwell, "Chemistry of Synthetic Drugs", (Ernest Benn Ltd), London,1966.
- KS Patrick, "Burger's Medicinal Chemistry & Drug Discovery", Vol. I & II, (Oxford University Press), 2001
- A. Kotolkavas and J.H. Burckhalter, Essentials of Medicinal Chemistry, (Wiley Interscience),1988.
- Ashutosh Kar, "Medicinal Chemistry", (New Age International Ltd),2015
- D. Dasarath, "Synthetic Drugs and Polymers", (Sri Vani Publishers),2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23213) SYSTEMS BIOLOGY

Unit-I

System Biology: Fundamentals of mathematical modeling; Representations of biological networks, basics of network biology; Systems Biology Markup Language (SBML), databases and tools for systems biology. Strategies relating to in silico Modelling of biological processes.

Unit-II

Introduction to metabolic network; Signal Transduction Pathways, Measuring and Quantifying Microarray Variability-Analysis of Differentially Expressed Genes, Markup language (SMBL), E-cell and V- cell Simulations and Applications modeling: stoichiometric analysis, flux balance analysis, minimization of metabolic adjustment, gene essentiality; Protein–protein interaction networks: prediction of interactions and functional associations, analysis of huge complex networks.

Unit-III

Introduction to modeling of signaling and gene regulatory networks: basics of kinetic modeling, parameter estimation, robustness/sensitivity analysis; Introduction to discrete models: Boolean network modeling. **Networks and graph theory:** Basic properties of Network: Degree, average degree and degree distribution. Adjacency matrix, weighted and unweighted networks, Bipartite network, Paths and distances**. Random Networks:** Erdos-Renyi model, Small-world effect, clustering coefficient.

Unit-IV

Modularity: Motifs and sub-graphs, Feed-forward loops, Single-input modules: LIFO, FIFO. Dense overlapping regulons (DORs). Optimal gene design circuits: fitness function and optimal expression of a protein in bacteria, Robustness.

Unit-V

Constraint-based modelling – Metabolic reconstruction, Flux Balance Analysis (FBA): Translating biochemical networks into linear algebra, Stoichiometric matrix, Elementary mode, Extreme pathways, Objective function, Optimization using linear programming. Genome-scale cellular models: Virtual Erythrocytes, Global human metabolic model (Recon 1). **Applications** of systems biology: metabolic engineering, drug target identification; Perspectives and challenges: Sloppy nature of biological systems, synthetic biology

Books:

1. S. Choi, "Introduction to Systems Biology", (Humana Press), 2007.
2. Uri Alon, Chapman & Hall, "Introduction to Systems Biology: Design Principles of Biological Circuits", (CRC), 2007.
3. Rob Desalle, Gonzalo Giribet, Ward Wheeler, "Techniques in molecular systematics and evolution", (Springer),2002
4. Edda Klipp, Ralf Herwig, Axel Kowald, Christoph Wierling, Hans Lehrach, "Systems Biology in Practice: Concepts, Implementation and Application", (John Wiley and Sons),2005.
5. Bernhard O. Palsson, "Systems Biology: Properties of Reconstructed Networks", Cambridge University, 2006.
6. M.E.J. Newman, "Networks: An Introduction", (Oxford University Press), 2010.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23214) ADVANCED IMMUNOLOGY

UNIT I

Introduction:

Origin of immune system – innate immunity – acquired immunity – cells and organs of immune system. Lymphocytes – plasma cells – macrophages – mast cells – T-cells – Bcells MHC – CD4 – CD8 - CD28 – TNF – receptor family domains – cytokines – chemokines. **Immunochemistry:** Types of antigens – properties of antigens – immunogenicity – adjuvant – epitopes – haptens – super antigens. **Antibodies: -** Immunoglobulin structure – Immunoglobulin. functions – antigenic determinants on Immunoglobulin – Immunoglobulin classes –studies on IgG, IgM, IgA, IgE and IgD.

UNIT II

Antigen-Antibody interactions:

Types of antigen-antibody interactions – determination of antigen-antibody interactions by various techniques. **Hypersensitivity:** Cells & Coomb's classification – types of hypersensitivity – immune deficiencies – primary & secondary deficiencies – T-cell, B-cell & combined immuno deficiencies – complement system deficiencies – AIDS – SCID.

UNIT III

Complement system:

Functions of complement – components of complements – complement activation – regulation of complement system – biological consequences of complement activation – complement deficiencies – organization & inheritance of the MHC – MHC molecules & genes – genomic map of MHC genes – cellular expression of MHC molecules – regulation of MHC expression – MHC & disease susceptibility – MHC & immune responsiveness – role of antigen-presenting cells.

UNIT IV

Immuno Techniques:

Phages display libraries for antibody V-region production – immuno fluorescence microscopy – immuno electron microscopy – immuno histochemistry – immune precipitin – co-immuno precipitation – immuno blotting – use of antibody in the isolation & identification of genes & their products.

UNITV

Immune response to infectious diseases:

Viral infections – bacterial infections – parasitic diseases – fungal diseases – emerging infectious diseases rDNA vaccine technology.

Vaccine Technology:

properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, Live, Killed, Attenuated, sub unit vaccines, conjugate vaccines; Antibody genes and antibody engineering, chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

Transplantation Immunology: Types of grafts – immunologic basis of graft rejection – genetics of transplantation antigens – mechanism & types of rejection – clinical manifestation of graft rejection – immuno suppressive therapy – immuno tolerance to allograft – clinical transplantation.

BOOKS:

- Thomas J. Kindt, A. Osbarne, R.A. Goldsby, and Barbara, "Kuby Immunology", (Freeman and company), 6th edition,2006.
- David Male, Jonathan Brostoff, David B Roth and Ivan Roitt., "Immunology", (Mosby Elsevier), 7th edition,2006.
- Janeway, Travers, Walport and Shlomchik., "Immunobiology", (Garland Science publishing), 6th edition,2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

(17PH23215) BIOFUELS AND RENEWABLE ENERGY

UNIT I

Introduction to Bioethanol Production

Historical Development of Bioethanol as a Fuel, Starch as a Carbon Substrate for Bioethanol Production, The Promise of Lignocellulosic Biomass, Thermodynamic and Environmental Aspects of Ethanol as a Biofuel, Effects on emissions of greenhouse gases and other pollutants, Ethanol as a First-Generation Biofuel: Present Status and Future Prospects Chemistry, Biochemistry, and Microbiology of Lignocellulosic Biomass, Biomass as an Energy Source: Traditional and Modern Views, Structural and Industrial Chemistry of Lignocellulosic Biomass, Lignocellulose as a chemical resource, Physical and chemical pretreatment of lignocellulosic biomass, Biological pretreatments, Acid hydrolysis to saccharify pretreated lignocellulosic biomass.

UNIT II

Cellulases and its Role in Ethanol Production

Cellulases: Biochemistry, Molecular Biology, and Biotechnology, Enzymology of cellulose degradation by Cellulases, Cellulases in lignocellulosic feedstock processing, Molecular biology and biotechnology of cellulase production, Hemi-Cellulases: New Horizons in Energy Biotechnology, A multiplicity of hemi-Cellulases, Hemi-Cellulases in the processing of lignocellulosic biomass, Lignin-Degrading Enzymes as Aids in Saccharification, Commercial Choices of Lignocellulosic Feedstocks for Bioethanol Production, Biotechnology and Platform Technologies for Lignocellulosic Ethanols.

UNIT III

Biotechnology of Bioethanol Production from Ligno-Cellulosic Feedstocks

Traditional Ethanologenic Microbes, Yeasts, Bacteria, Metabolic Engineering of Novel Ethanologens, Comparison of industrial and laboratory yeast strains for ethanol production, Improved ethanol production by naturally pentose-utilizing yeasts, Assembling Gene Arrays in Bacteria for Ethanol Production, Metabolic routes in bacteria for sugar metabolism and ethanol formation, Genetic and metabolic engineering of bacteria for bioethanol production, Candidate bacterial strains for commercial ethanol production, Trends for Research with Yeasts and Bacteria for Bioethanol Production, "Traditional" microbial Ethanologens, "Designer" cells and synthetic organisms.

UNIT IV- GENETIC MANIPULATION OF PLANTS FOR BIOETHANOL PRODUCTION

Engineering resistance traits for biotic and abiotic stresses, Bioengineering increased crop yield, Optimizing traits for energy crops intended for biofuel production, Genetic engineering of dual-use food plants and dedicated energy crops, Vegetable oils and chemically processed biofuels, Biodiesel composition and production processes, Biodiesel economics, Energetics of biodiesel production and effects on greenhouse gas emissions, Issues of ecotoxicity and sustainability with expanding biodiesel production, Fischer-Tropsch Diesel: Chemical Biomass–to–Liquid Fuel Transformations, Radical Options for the Development of Biofuels, Biodiesel from Microalgae and Microbes, Biohydrogen, The hydrogen economy and fuel cell technologies, Bio-production of gases, Production of H2 by

photosynthetic organisms, Emergence of the hydrogen economy, Microbial Fuel Cells: Eliminating the Middlemen of Energy Carriers Biofuels as Products of Integrated Bioprocesses.

UNIT V

Principles of renewable energy: Energy & Sustainable development, fundamentals, scientific principles of renewable energy, technical implication, social implication, various renewable energy resources.

Thermodynamics and electrochemical principles - basic design, types, and applications - production methods – Bio-photolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types - construction and applications.

BOOKS:

- David M. Mousdale, "Biofuel-Biotechnology, Chemistry and sustainable Development", (CRC Press Taylor & Francis Group), 1st edition, 2008.
- AyhanDemirbas, "Green Energy and Technology, Biofuels, Securing the Planet's Future Energy Needs", (Springer), 1st edition, 2009.
- Twidell, J.W. and Weir, A., "Renewable Energy Sources", (T&F Ltd), 3rd edition, 2015.
- Sukhatme, S.P., "Solar Energy", (Tata McGraw Hill), 1984.