M. Tech. Bio Technology

Course structure R-15 regulation

I/II M. Tech. 1st Semester

Code No.	Subject	Periods				Sessional Marks	External Marks	Total Marks	Credits
		Theory	Tutorial	Lab	Total				
MTBT-111	Advanced Microbiology	3	1	-	4	40	60	100	4
MTBT-112	Advanced Biochemistry	3	1	-	4	40	60	100	4
MTBT-113	Advanced Biochemical Engineering	3	1	-	4	40	60	100	4
MTBT-114	Bio Separation Technology	3	1	-	4	40	60	100	4
MTBT-115	Elective-I	4	-	-	4	40	60	100	4
MTBT-116	Elective-II	4	-	-	4	40	60	100	4
MTBT-117	Biotechnology lab-I	-	-	6	6	50	50*	100	2
MTBT-118	Seminar	-	-	-	3	100	-	100	2
	Total	**20**	**4**	**6**	**33**	**390**	**410**	**800**	**28**

*Only internal evaluation

Elective-I: MTBT-115-1 Bio analytical techniques
MTBT-115-2 Bioinformatics
MTBT-115-3 IPR and Biosafety

Elective-II MTBT-116-1 Cancer biology
MTBT-116-2 Tissue Engineering
MTBT-116-3 Animal Biotechnology

I/II M. Tech. 2nd Semester

Code No.	Subject	Periods				Sessional Marks	External Marks	Total Marks	Credits
		Theory	Tutorial	Lab	Total				
MTBT-121	Genetic Engineering	3	1	-	4	40	60	100	4
MTBT-122	Enzyme Engineering	3	1	-	4	40	60	100	4
MTBT-123	Environmental Biotechnology	3	1	-	4	40	60	100	4
MTBT-124	Bio Nanotechnology	3	1	-	4	40	60	100	4
MTBT-125	Elective-III	4	-	-	4	40	60	100	4
MTBT-126	Elective-IV	4	-	-	4	40	60	100	4
MTBT-127	Biotechnology lab-II	-	-	6	6	50	50*	100	2
MTBT-128	Seminar	-	-	-	3	100	-	100	2
	Total	**20**	**4**	**6**	**33**	**390**	**410**	**800**	**28**

Elective-III: MTBT-125-1 Industrial Biotech Products
MTBT-125-2 Pharmaceutical Biotechnology
MTBT-125-3 Agricultural Biotechnology

Elective-IV: MTBT-126-1 Biotechnology in Food processing
MTBT-126-2 Bio fuels and Platform chemicals
MTBT-126-3 Bioprocess modelling and simulation

II/II M. Tech. 1st Semester

Code No.	Subject	Sessional Marks	External Marks	Total Marks	Credits
MTBT-211	Project work	100	-	100	10

II/II M. Tech. 2nd Semester

Code No.	Subject	Sessional Marks	External Marks	Total Marks	Credits
MTBT-221	Project work	50	50	100	16

- Project guide will be allotted at the beginning of first semester and the student has to give presentation on his/her project work at the end of first semester and will be evaluated by Research Committee
- At the end of second semester, the students are required to submit their thesis, and final viva-voce examination will be conducted by committee consisting of an external member from reputed institution, HOD, Chairman, BOS, and thesis guide.

M. TECH.

(BIOTECHNOLOGY)

(Effective from the admitted batch of 2015-16)

Scheme and Syllabi

DEPARTMENT OF CHEMICAL ENGINEERING
ANITS

I SEMESTER

MTBT-111 : ADVANCED MICROBIOLOGY

Course Objectives:

To enable the students

- To understand microbial diversity
- To learn about culture media, isolation methods and preservation methods of microorganisms.
- To understand about bacterial growth and methods of control of microorganisms
- To explain the antigen-antibody interactions that offers defense mechanism.

Course Outcomes : At the end of the course student will be able to:

1. Understand the Microbial Diversity and their Characteristics.
2. Isolate and culture microorganisms.
3. utilize gained knowledge in microbiology labs and bioprocess industries.
4. gain knowledge in defense mechanisms, immunity, vaccines, antibiotics.

SYLLABUS

UNIT I

Introduction to Microbiology: Origin and evolution of microorganisms, nature and scope of microbiology, major characteristics of prokaryotes and Eukaryotes, structure and functioning of bacterial cell.

Classification of microorganisms: Major characteristics of microorganisms, concepts of Classification, classification methods, principles of nomenclature and identification, Modem trends in classification.
General features and classification of some groups of microorganisms - Algae, Fungi, Chlamydiae, Rickettsiae, Mycoplasmas, Viruses and Protozoa, economic importance of Micro-organisms.

UNIT II

Methods in microbiology: Nutritional requirements, nutritional types of bacteria, Characteristics of culture medium, type of culture media and preparation of culture media, isolation of microorganisms - general and selective methods, isolation of bacteria in pure culture, enrichment - enrichment methods, staining techniques, culture characteristics, maintenance and preservation of cultures, culture collections.

UNIT III

Reproduction and growth: Reproduction in bacteria, genetic transfer in bacteria, Bacterial growth, bacterial growth curve, growth measurement techniques, factors affecting growth, control of microorganisms by physical and chemical methods.

UNIT IV

Epidemiology and infectious diseases: Epidemiological markers, role of host in infectious diseases - Air borne, water borne and food borne diseases.

UNIT V

Immunology: Natural resistance, internal defense mechanisms, non-specific defense mechanisms, immunity, types of immunity, immune systems, antibody and its diversity, Hypersensitivity, transplantation, autoimmunity, AIDS and other immune deficiencies, vaccines, types of vaccines, production of vaccines and synthetic vaccines, monoclonal anti bodies and their use, antibiotics, history of antibiotics, classification and production of antibiotics, microbial toxins, types of microbial toxins, effects of microbial toxins and their control.

TEXT BOOKS:

1. Microbiology by M. J. Pelczer, E. C. S. Chan, N. R. Kries. Tata McGrew Hill publications
2. Microbiology fundamentals and applications by S. S. Purohit. Agro botanical. Publications.

REFERNCE BOOKS:

1. Microbiology by Prescott, Harley, Klein. Mc Graw-Hill publications
2. General Microbiology by Roger Y. Stainer, Edward A. Adebery, John L. Ingraham. Published by Macmillan Press LTD.

MTBT-112: ADVANCED BIOCHEMISTRY

Course Objectives:

- To study about the biomolecules and importance of biochemistry in the advanced level.
- To study the detailed structure and function of biomolecules like carbohydrates, amino acids, proteins, lipids and nucleic acids.
- To study membrane assembling, bioenergetic principles and ATP cycle.
- To study the metabolism and biosynthesis of fatty acids, DNA, RNA, and proteins.

Course Outcomes : At the end of the course student will be able to:

1. Explain the structure and functions of biomolecules.
2. Understand the biosynthesis and degradation of biomolecules.
3. Obtain knowledge in the metabolism and bioenergetic principles.
4. Carry out independent research work to improve and to invent new biomolecules and can understand new metabolic processes.

SYLLABUS

UNIT I

Carbohydrates: classification of carbohydrates, structure and properties of monosaccharides (ribose, glucose, fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (Starch, glycogen and cellulose).
Amino acids and proteins: Classification and properties of amino acids and proteins, peptide bond, structural organization of proteins: primary, secondary, tertiary and quaternary structure of proteins. Biochemical function of proteins, denaturation of proteins.

UNIT II

Lipids: Classification, structure and physiological functions of triglycerides, fattyacids, phospholipids, cerebrosides, gangliosides and cholesterol.

Nucleic Acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides. Structure of nucleic acids-DNA and RNA.

UNIT III

Bioenergetics:
Energetics-ATP as energy currency, biologic oxidation, structural organization and electron flow of respiratory chain, chemiosmotic theory of oxidative phosphorylation. Mitochondrial membrane transporters- shuttle systems.

UNIT IV

Metabolism Of Carbohydrates And Proteins:
Carbohydrate metabolism - Glycolysis, Glucogenesis, Citric acid cycle and Glycogen metabolism. Protein metabolism - Urea cycle, degradation of amino acids.

Fatty Acid And Nucleic Acid Metabolism:

Overview of Fatty Acid Metabolism - synthesis and degradation of fatty acids. Nucleotides - De novo and salvage pathways.

UNIT V

Central Dogma:
Biosynthesis of DNA (replication).
Biosynthesis of RNA (transcription).
Biosynthesis of proteins (translation).

Text Books:

1. Textbook of Biochemistry by Albert-Lehninger, Kalyani Publishers,Ludhiana,New Delhi.
2. Principles of Biochemistry- Lehninger,Nelson and Cox-CBS Publishers and distributors,Delhi.
3. A text book of Biochemistry by A.V.S.S.RamaRao,UBS Publishers and Distributors Ltd,NewDelhi,Chennai.
4. Fundamentals of Biochemistry-J.L.Jain,S.Chand and company Ltd. New Delhi.

MTBT-113: ADVANCED BIOCHEMICAL ENGINEERING

Course Objectives:

- To introduce enzymes, enzymatic and microbial growth kinetics
- To introduce transport of materials in biological systems with respect to mass transfer and heat transfer
- To introduce different types of bio-reactors and special reactors like animal and plant cell reactors
- To introduce immobilization and sterilization techniques.

Course Outcome: At the end of the course student will be able to

1. Determine the enzyme activity, parameters affecting activity and enzyme immobilization
2. Gain knowledge in gas liquid mass transfer, determine the K_La and know inter particle and intra particle diffusion
3. Understand working and analysis of all types of rectors
4. Know thermal death kinetics and sterilization of air and medium.

SYLLABUS

UNIT I

Enzyme Kinetics: Effects on enzyme activity, deactivation, immobilized enzymes.

UNIT II

Microbial growth kinetics: Batch growth, unstructured models, growth in continuous culture, structured models, product formation kinetics, cell immobilization.

UNIT III

Transport Phenomena: Gas-liquid Mass transfer; Theoretical models for K_{La}, interfacial area and bubble oxygen transfer, gas-liquid mass transfer of components other than oxygen. Mass transfer into solid particles: External transfer, intraparticle diffusion. Heat transfer correlations.

UNIT IV

Bioreactors: Review of various types of bioreactors used in the fermentation industry.
Multiphase bioreactors: packed bed, bubble-column, fluidized bed and trickle-bedreactors.
Alternate fermenters: new bioreactor configurations used in the fermentationtechnology.
Animal and plant cell reactor technology.

UNIT V

Sterilization: Sterilization methods, thermal death kinetics, design criterion, batch and continuous sterilization, air sterilization.

TEXT BOOK:

Shuler, M. L and F. Kargi, Bioprocess Engineering: Basic concepts, 2nd ed., Prentice Hall India, New Delhi, 2003.

REFERNCES:

1. Lee, J. M., Biochemical Engineering (e Book), Prentice Hall, Englewood Cliffs, 2001.
2. Bailey, J. E., and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd edition, Mcgraw-Hill, New York, 1986.
3. Blanch, H. W., and D. S. Clark, Biochemical Engineering, Marcel Dekker, New York, 1996.
4. Swamy,A.V.N.,' Fundamentals of Biochemical Engineering' , BS publications, 2007

MTBT-114: BIOSEPARATIONTECHNOLOGY

Course Objectives:

To enable the students to

- Understand the methods to obtain pure proteins, enzymes and in general about product development R &D
- Have depth knowledge and hands on experience on Downstream processes to produce commercial therapeutically important proteins.

Course Outcomes:

Upon success completion of this course, the students will be able to:

1. Define advanced downstream processing methods for product recovery.
2. Describe the components of downstream equipment and to understand the requirements for successful operations.
3. Enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I

Downstream Processing In Biotechnology:

Role and importance of downstream processing in biotechnological processes – Problems and requirements of bio product purification – Economics of downstream processing in Biotechnology, cost-cutting strategies – Separation characteristics of proteins and enzymes – size, stability, properties – Flocculation and conditioning of broth – Process design criteria for various classes of bio products (high volume, low value products and low volume, high value products) – Upstream production methods affect downstream purification strategies.

UNIT II

Physico-Chemical Basis Of Bio-Separation Processes:

Cell disruption methods for intracellular products – Physical, chemical, mechanical – Removal of insoluble, biomass and particulate debris separation techniques – Filtration at constant pressure and at constant rate – Empirical equations for batch and continuous filtration – Types of filtration - Centrifugal and cross – flow filtration – Types of filtration equipments – Centrifugation – Basic principles, design characteristics – Types of centrifuges and applications – Sedimentation.

UNIT III

Membrane Separations And Enrichment Operations:

Theory, Design consideration and configuration of membrane separation processes – Reverse osmosis, microfiltration, ultra filtration, dialysis and pervaporation – Structure and characteristics of membranes – Membrane modules – Enrichment Operations – Extraction– equipment forextraction– Aqueous two-phase extraction process – Evaporators – Types of evaporators – Adsorption isotherms and techniques – Protein precipitation – Methods of precipitation.

UNIT IV

Mechanism And Modes Of Chromatographic Separation:

Chromatography – Classification of chromatographic techniques – General description of column chromatography – Chromatographic terms and parameters – Practice of chromatography – Partition, normal-phase, displacement, reversed-phase, size exclusion, ion exchange, hydrophobic, affinity chromatography – Scale-up of chromatography – Process considerations in Preparative liquid chromatography and HPLC.

UNIT V

Finishing Operations And Formulations:

Drying – Mechanism, methods and applications, Types of dryers – Tray, spray, rotary, belt, disc – Crystallization – Nucleation , growth – Types of crystallizers – Tank, scrapped surface, Oslo, Circulating-magma evaporator – Freeze drying – Principle, process, applications – Case studies- Citric acid, Penicillin , Cephalosporin, Recombinant Streptokinase, Interferon.

REFERENCES

1. Belter, P.A., Gussler, E.L. and Hu, W.S., “Bioseparation: Downstream Processing for Biotechnology”, John Wiley and Sons,2011.
2. Forciniti, D., “Industrial Bioseparation: Principles & Practice”, Blackwell,2008.
3. Ghosh, R., “Principles of Bioseparations Engineering”, World Scientific Publishers,2006.
4. Ladisch, M.R., “Bioseparations Engineering: Principles, Practice, and Economics”, John Wiley & Sons,2001.
5. Roger, H., “Bioseparations Science and Engineering”, Oxford University Press,2006.

MTBT-115 -ELECTIVE – I

MTBT -115-1: BIO-ANALYTICAL TECHNIQUES

Course Objectives :

The course is designed to impart the knowledge in analytical techniques in biotechnology. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics will be taught to enable the students to understand the principles involved in techniques. In addition to theoretical aspects, the basic practical knowledge relevant to the analysis will also be imparted.

- To have a fundamental knowledge about the Light spectrum, Absorption, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.
- To Understand the methods to obtain pure proteins, enzymes and in general about product development R &D

Course Outcomes: On completion of the course, students will be able to

1. Understand spectroscopy and the separation techniques used for biological products.
2. Quantify Bio molecules using spectroscopy methods
3. Purify enzymes and metabolites using Chromatography techniques
4. Gain knowledge in various assay techniques for qualitative and quantitative estimation of biomolecules

SYLLUBUS

UNIT I

Chromatographic Techniques - Affinity - Adsorption - paper - Thin layer - Column - Ion Exchange - Gel Chromatography - Applications.

UNIT II

Gas liquid chromatography - High Pressure liquid chromatography - Equipment - Applications.

UNIT III

Spectrophotometric Techniques - IR - UV - Visible - NMR - ESR - Optical density - Circular dischroism.

UNIT IV

pH - pH titrations - Determination of pKa values - Buffers - Preparation - Buffer Action - Physiological buffers - potentiometric titration - centrifugal dialysis - lyophilization - Electrophoresis - Ultra filtration - Assay techniques for proteins, lipids, sugars, amino acids and nucleic acids.

Unit – V

Microscopic Techniques

Light Microscopy; Fluorescence microscopy,Atomic force microscope,Electron microscope,Scanning electron microscopy, Transmission Electron microsope.Application of microscope in analyzing biological samples.

Text Books:

1. "Instrumental methods of Chemical Analysis - Chatwal, G & Anand, S. Himalaya Publishing House, Bombay.
2. "Instrumental methods of Chemical Analysis - Sharma, B.K. Goel Publishing House, Meerut.
3. "Instrumental Methods Analysis - Willard, Merritt, Dean & Settle, CBS Publishers & Distributors, Delhi.

MTBT-115-2-BIOINFORMATICS

Course Objectives:

- To improve the programming skills of the student in the field of Biological research
- To let the students know the recent evolution in biological databank usage

Course Outcomes:

Upon completion of this course, students will be able to

1. Develop bioinformatics tools with programming skills.
2. Apply computational based solutions for biological perspectives.

SYLLABUS

UNIT I

Introduction, Molecular Biology and Bioinformatics, Biological database,

Primary, Secondary and Structural data bases, tools for web search, data retrieval tools

UNIT II

Genome analysis and gene mapping: sequence assembly problem, genetic mapping and linkage analysis, genome sequencing, sequence assembly tools, Human genome project.

Alignment of pairs of sequences, scoring matrices, multiple sequences, phylogenetic analysis, Tree evaluation, automated tools for phylogenetic analysis, working with FASTA and BLAST.

UNIT III

Gene identification and prediction: Basis for gene prediction, pattern recognition, gene prediction methods, working with DNA, Micro arrays, Micro array analysis.

UNIT IV

Protein classification and structure visualization: structure – based protein classification, protein structure databases, visualization databases and tools, protein structure alignment, tools for plotting protein-ligand interaction.

Protein structure prediction: Analysis and prediction of primary structure and secondary structure, motifs, profiles, patterns and fingerprints search, Ab Initio approach, 2-D structure prediction, protein function prediction from DNA sequence.

UNIT V

Proteomics: Tools and techniques in proteomics, protein – protein interactions, gene family identification methods. Computational Methods for pathways and systems Biology: Analysis of

pathways, metabolic network properties, metabolic control analysis, simulation of cellular activities.

Text-book:

S.C..Rastogi, N.Mendiratta and P.Rastogic, **Bioinformatics**, Prentice- Hall of India Pvt.Ltd, New Delhi, 2004

Reference books:

1. T.K.Attwood and D.J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, Delhi, 2002
2. A.M. Lesk, Introduction to Bioinformatics, Oxford University press, New Delhi, 2004.

MTBT-115-3: IPR AND BIOSAFETY

Course Objectives:

- To create awareness about IPR and engineering ethics
- To follow professional ethics and practices in their careers
- To create awareness and responsibilities about the environment and society

Course Outcomes:

Upon completion of this course, the student would be able

1. To understand the ethics and responsibility for safety
2. To create awareness for the professional responsibilities and rights

SYLLABUS

UNIT I

Agreements, Treaties And Concept Of PriorAct:

History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties – Budapest Treaty – PCT – Indian Patent Act 1970 & recent amendments Ordinary – PCT – Conventional – Divisional and Patent of Addition – Specifications – Provisional and complete – Forms and fees Invention in context of "prior art" – Patent databases – Searching International Databases – Country-wise patent searches (USPTO,esp@cenet(EPO) – PATENT Scope(WIPO), IPO,etc.

UNIT II

IPR:

Intellectual property rights – Origin of the patent regime – Early patents act & Indian pharmaceutical industry – Types of patents – Patent Requirements – Application preparation filing and prosecution – Patentable subject matter – Industrial design, Protection of GMO's IP as a factor in R&D,IP's of relevance to biotechnology and few casestudies.

UNIT III

Patent FilingProcedures:

National & PCT filing procedure – Time frame and cost – Status of the patent applications filed – Precautions while patenting – disclosure/non-disclosure – Financial assistance for patenting – Introduction to existing schemes Patent licensing and agreement Patent infringement – Meaning, scope, litigation, case studies.

UNIT IV

Biosafety:

Introduction – Historical Backround – 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.

UNIT V

Genetically Modified Organisms:

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 Cartegana Protocol.

REFERENCES

1. Bouchoux, D.E., "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets for the Paralegal", 3rd Edition, Delmar Cengage Learning,2008.
2. Fleming, D.O. and Hunt, D.L., "Biological Safety: Principles and Practices", 4th Edition, American Society for Microbiology,2006.
3. Irish, V., "Intellectual Property Rights for Engineers", 2nd Edition, The Institution of Engineering and Technology,2005.
4. Mueller, M.J., "Patent Law", 3rd Edition, Wolters Kluwer Law & Business,2009.
5. Young, T., "Genetically Modified Organisms and Biosafety: A Background Paper for Decision-Makers and Others to Assist in Consideration of GMO Issues" 1st Edition, World Conservation Union,2004.

MTBT-116 -ELECTIVE – II

MTBT-116 -1: CANCER BIOLOGY

Course Objectives:

To enable the students to understand

- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
- Enhanced immunology based detection methods and imaging techniques
- Development of cell based and cytokine based immunotherapy against cancer

Course Outcomes:

The course would facilitate the students

1. To appreciate the role of immune system in cancer
2. To understand the cancer microenvironment and its influence on immune cells
3. To medical applications of cytokines and immune cells against cancer.

SYLLABUS

UNIT I

Principles Of Cancer Biology:

Cancer: Definition, causes, properties, classification, clonal nature – Cell Cycle: Regulation of cell cycle, cell proliferation and apoptosis – Signal transduction pathways – Apoptosis: apoptotic pathways, signal molecules, effects on receptor, signal switches – Modulation of cell cycle in cancer – Mechanism of spread.

UNIT II

Principles Of Carcinogenesis:

Cancer risk factors – Theory of carcinogenesis – Chemical carcinogenesis – Physical carcinogenesis: x-ray radiation – mechanisms of radiation carcinogenesis – Stages of cancer: initiation, promotion, progression.

UNIT III

Molecular Biology Of Cancer:

Signal targets and cancer – Growth factors – Transformation – Activation of kinases – Oncogenes: c-Myc, Ras, Bcl-2 family – Mechanism of oncogene activation – Retroviruses and oncogenes – Detection of oncogenes – Oncogenes/proto oncogene activity – Tumor suppressor genes: Rb, p53, APC, BRCA paradigms –Telomerases.

UNIT IV

Cancer Metastasis:

Clinical significances of invasion – Heterogeneity of metastatic phenotype – Metastatic cascade: basement membrane disruption, invasion – Recent approach to identify key factors controlling metastasis – Angiogenesis.

UNIT V

Cancer Therapy:

Therapy forms – Surgery, chemotherapy, radiation therapy - Detection of cancers – Prediction of aggressiveness of cancer – Advances in cancer detection – Tumor markers; New approaches of cancer therapy – mAbs, vaccines, gene therapy, stem cell therapy.

REFERENCES

1. Fialho, A. and Chakrabarty, A., "Emerging Cancer Therapy: Microbial Approaches and Biotechnological Tools" 1st Edition, Wiley,2010.
2. Pelengaris, S. and Khan, M., "The Molecular Biology of Cancer", Blackwell Publishing, 2006.
3. Ruddon, R.W., "Cancer Biology", 2nd Edition, Oxford University Press,2007
4.Schulz, W.S., "Molecular Biology of Human Cancers – An Advanced Students Text Book", Springer,2005.
5. Weinberg, R.A., "The Biology of Cancer", Taylor & Francis, Garland Science,2007

MTBT-116-2:TISSUE ENGINEERING

Course Objectives:

To enable the students

- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications

Course Outcomes:

Upon completion of this course, the students would get

1. Ability to understand the components of the tissue architecture
2. Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
3. Awareness about the properties and broad applications of biomaterials
4. Overall exposure to the role of tissue engineering and stem cell therapy in organogenesis

SYLLABUS

UNIT I

Fundamental of tissue engineering:

Cell cycle – Stem cells – Types, factors influencing stem cells – Mechanical properties of cells and tissues, cell adhesion – Extracellular matrix – Glycans, laminin, fibronectin, collagen, elastin, extracellular matrix functions – Signalling – Mechanics and receptors – Ligand diffusion and binding, trafficking and signal transduction – *In vitro* cell proliferation.

UNIT II

Biomaterials For Tissue Engineering:

Measurement of protein adsorption – Direct and indirect methods, fibrinogen adsorption – Displaceable and non-displaceable – Changes in protein conformation upon adsorption – Vroman effect principle to maximize the amount of fibrinogen adsorption – Devices for tissue engineering transplant cells.

UNIT III

Delivery of molecular agents and cell interactions with polymers:

Molecular agents in tissue engineering – Controlled released of agents – Methods, in time and space – Future applications of controlled delivery – Microfluidic systems – Microfluidics and microfluidic devices – Cell interactions – Factors influencing cell

interactions – Cell interactions with polymer surfaces and suspension – Cell interactions with three-dimensional polymer.

UNIT IV

Polymers And Controlled Drug Delivery:

Natural and synthetic biodegradable Polymers – Engineered tissues – Skin regeneration – Nerve regeneration – Liver, cartilage, bone – Biodegradable polymers in drug delivery – Polymeric drug delivery systems – Applications of biodegradable polymers.

UNIT V

Biopolymer- based biomaterials as scaffolds and stem Cells:

Natural polymers – Structural and chemical properties, scaffold processing, mechanical properties and biodegradability – Biocompatibility and host response – Application of scaffolds in tissue engineering. Use of stem cells in tissue engineering – Embryonic stem cells, mesenchymal stem cells (MSC), adult stem cells, markers for detection of stem cells – Risks with the use of stem cells.

REFERENCES

1. Pallua, N. and Suscheck, C.V., "Tissue Engineering: From Lab to Clinic" Springer,2010
2. Palsson, B., Hubbell, J.A., Plonsey, R. and Bronzino, J.D., "Tissue Engineering", CRC Press, 2003.
3. Palsson, B.O. and Bhatia, S., "Tissue Engineering", Pearson Prentice Hall,2004.
4. Saltzman, W.M., "Tissue Engineering", Oxford University Press,2004.
5. Scheper, T., Lee, K. and Kaplan, D., "Advances in Biochemical Engineering / Biotechnology – Tissue Engineering I", Volume 102, Springer-Verlag Berlin Heidelberg,2006.

MTBT116-3: ANIMAL BIOTECHNOLOGY

Course Objectives:

- To provide the fundamentals of animal cell culture, diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

Course Outcomes:

Upon completion of this subject the student will be able to

1. Understand the animal cell culture, animal diseases and itsdiagnosis
2. Gain the knowledge for therapy of animal infections
3. Know the concepts of micromanipulation technology and transgenic animal technology
4. Use the knowledge gained in this section to apply in the field of clinical research

SYLLABUS

UNIT I

Cell Culture

Culturing of cells– Primary and secondary cell lines – Genetics of cultured cells – Scaling up in suspension –Monolayer culture – Bio-reactors used for animal cell culture –Roller bottle culture– Bioreactor process control –Stirred animal cell culture –Air-lift fermentor, Chemostat/Turbidostat– Cell lines and their applications.

UNIT II

Gene Cloning Vectors And Immunology:

Viral disease in animals–Animal viral vectors –Vector design–SV40, adeno virus, retrovirus, vaccinia virus, herpes virus, adeno associated virus and baculo virus– Immune response – Lymphocyts, immune system – Baculo virus expression vectors–Vaccines and their applications in animal infections –High technology vaccines – Hybridoma technology.and production of monoclonal antibodies.

UNIT III

Stem Cell And Cloning:

Characteristics of ES cells –Types of stem Cells – ES cell research–*In vitro* derivation of gametes

–Maintenance of stem cells in culture and applications – Somatic cell nuclear transfer – Gene expression of pluripotent cells –Cellular reprogramming –Induced pluripotency– Cloning techniques in animals and therapeutic cloning.

UNIT IV

Genetic Engineering:

Gene therapy –Prospects and problems – Single gene – Gene mapping – Hematopoietic cells for cellular gene therapy of animal disease –Knockout mice and mice model for human genetic disorder –Baculo virus in biocontrol– Enzymes technology – Somatic manipulation of DNA – Nucleic acid hybridization and probes in diagnosis– Preparation of probes, evaluation and applications.

UNIT V

Applications:

Rumen manipulation– Probiotics embryo transfer technology – *Invitro* fertilization, transgenesis– Methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods–Biopharming– Transgenic animal technology, application to production and therapeutics (mice, sheep, cattle) – Artificial insemination and embryo transfer – Transgenic growth hormonegenes.

REFERENCES

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

MTBT-117 : Biotechnology Lab-1

Course Objectives:

- To Provide hands on experience on production and down streaming through simple experiments

Course Outcomes:

1. Gain ability to design and conduct experiments, analyse, interpret and apply laboratory skills to solve bioprocess engineering problems.
2. Skills and knowledge gained is useful for bio industry and research

List of Experiments:

1. Preparation of Acetate buffer system and validation of Hendersen-Hesselbalch Equation
2. Determination of Absorption spectrumof BSA using UV- Visible Spectrophotometer and validation of Beer-Lamberts Law
3. A. Separation of Aminoacids and Selection of solvents by Thin Layer Chromatography.

   B. Titration of Aliphatic and Aromatic aminoacids.
4. Determination of Growth curve for *Bacillus cereus* in Nutrient Broth
5. Screening of two substrates for *Bacillus cereus* for amylase production by submerged cultivation
6. Optimization of Amylase production medium for Bacillus cereus using Barley starch as substrate by Response surface Methodology
7. Partial purification of Proteins by Salt precipitation
8. Desalting of Protein sample by Dialysis
9. Enzyme purification by Ion-Exchange Chromatography
10. Adsorption of Methylene Blue on to activated carbon and Evaluation of Langmuir and Fruendlich Isotherms
11. Extraction of Ethanol obtained by submerged fermentation using distillation principle
12. Protein purification by Affinity chromatography
13. Effect of pH on the production of antibiotic (Streptomycin) using *Streptomyces griseus*

II SEMESTER

MTBT-121: GENETIC ENGINEERING

Course Objectives:

To make the student to understand

- the basic tools in genetic engineering
- Cloning and expression vectors
- Preparation of genomic and cDNA libraries
- Production and downstream processing of recombinant proteins

Course Outcomes:

1. The students after completing this course would be aware of clone methods of commercially important genes.
2. The students would be aware of producing the commercially important recombinant proteins.
3. The students would be aware of gene and genome sequencing techniques.
4. The students would be aware of applications of gene cloning in medicine, agriculture and environment.

SYLLABUS

UNIT I

Cloning vectors:

Ideal features of cloning vectors – plasmids and bacteriophages – cloning vectors for *E.coli* ; pBR322, pUC vectors, M13 and other plasmid vectors – Cosmids, Phagemids – vectors for Bacillus, Streptomyces Restriction mapping and analysis

UNIT II

Enzymes And Techniques for cloning:

DNA modifying enzymes – ligases – Nucleic acid probe preparation; Radioactive and nonradioactive labels – Hybridization techniques – PCR; different types and applications – DNA sequencing – DNA fingerprinting – RFLP, RAPD – chromosome walking.

UNIT III

Expression vectors:

Expression vectors in prokaryotes – Expression vectors in Eukaryotes-Yeast cloning

vectors – selectable markers for eukaryotes – SV40, Papilloma, Retrovirus, Baculoviral vectors – mammalian cell expression system – Gene transfer techniques – Agrobacterial plasmids – Ti plasmid and viral vectors – cloning in plants.

UNIT IV

Genomic And cDNA library:

Different strategies for in vitro and in vivo cloning – Preparation of rDNA, Preparation of cDNA and genomic DNA libraries – screening procedures – linkers, adapters, homopolymer tailing and TA cloning – gene transfer technologies – Mutagenesis – site directed mutagenesis – application.

UNIT V

Application Of gene cloning:

Fusion protein- down-stream processing of recombinant proteins- Applications in medicine – Gene therapy- Diagnostics, pathogenesis, recombinant vaccines –humanized antibodies and their applications genetically modified food – bioremediation with recombinant micro organisms– forensic science – genetic diversity – Agriculture, crop improvement – production of biosensors, enzymes – safety guidelines in rDNA research – containment and disposal.

Text Books:

1. Introductory Bio - Technology by R. P. Singh.
2. Principles of genetic Engineering by Old and Primarose.

REFERENCES:

1. Jeremy W. Dale, Malcolm von Schantz, Nicholas Plant. From Genes to Genomes: Concepts and Applications of DNA Technology-3rd Edition. 2011.Wiley-Blackwell.
2. Michael R. Green and Joseph Sambrook. Molecular Cloning: A Laboratory Manual (Fourth Edition). 2012. Cold Spring HarborPress.
3. Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick. Lewin's GENES XI. 2012. Jones & BartlettLearning.
4. Sandy B. Primrose and Richard Twyman. Principles of Gene Manipulation and Genomics. 2009.Wiley.
5. T. A. Brown. Gene Cloning and DNA Analysis: An Introduction, 6th Edition. 2010.Blackwell.

MTBT -122: ENZYME ENGINEERING

Course Objectives:

1. To understand the importance of enzymes, their classification, sources, extraction and purification of enzymes.
2. To understand the mechanism of enzyme action, their kinetics and types of enzyme inhibitions.
3. To know about the advantages of immobilization of enzymes, methods of immobilization.
4. To acquaint with the applications of enzymes in solution as well as immobilized enzymes.

Course Outcome:

1. The student is able to appreciate the importance of enzymes and know about their sources and extraction.
2. The student can analyze the kinetics of enzyme reactions, and can identify the type of enzyme inhibition.
3. The student will know to use different immobilization techniques and enzyme purification.
4. The student will be aware of different enzymes and their applications used in various industries.

SYLLABUS

UNIT I

Introduction To Enzymes: Importance of enzymes in Biotechnology, Nomenclature and classification of enzymes, enzyme specificity, coenzymes, enzyme units and turnover number, factors affecting enzyme activity (pH, temperature, chemical agents and irradiation), mechanism of enzyme catalysis.

UNIT II

Enzyme Kinetics: Simple enzyme kinetics, Michaelis-Menten equation, Quasi-steady-state kinetics and Briggs –Haldane approach, Evaluation of parameters in Michaelis-Menten equation.

Enzyme Inhibition: Inhibition of enzyme reactions-Competitive, non-competitive, uncompetitive, substrate and product inhibition, deactivation kinetics, derivations of M-M form of equations for various inhibitions.

UNIT III

Sources Of Enzymes: Plant, animal and microbial sources and their advantages and disadvantages.

Enzyme Extraction And Purification: Methods of production of enzymes, cell disruption, extraction of enzymes, purification of enzymes.

UNIT IV

Enzyme Immobilization: Methods of immobilization- physical and chemical (covalent binding, cross-linking, adsorption, matrix entrapment and microencapsulation), advantages and disadvantages of different immobilization techniques, kinetics of immobilized enzymes, mass transfer effects in immobilized enzyme systems.

UNIT V

Enzyme Applications: Application of enzymes in various industries (brewing, detergent, starch, baking, dairy, food, leather, wool, animal feed, textile, paper and pulp, pharmaceutical).

Application Of Immobilised Enzymes: Immobilized enzyme processes, HFCS, production of amino acids, antibiotics.

Text books:

1. Enzyme Technology by Chaplin, M.F and Bucke, C Cambridge University Press,1990.
2. Enzyme Technology 2nd Ed S.Shanmugan, T.Sathish Kumar, M.Shanuga Prakash I.K.International Publishing House Pvt. Ltd.
3. Biochemical Engineering Fundamentals. J.E.Bailey and David F Ollis 2nd Edition 1986, McGraw Hill.

References books:

1. Enzyme Engineering. L.B.Wingard, J.Inter Science, New York 1972.
2. Enzymes Trevor Palmer East West Press Pvt. Ltd. New Delhi

MTBT-123: ENVIRONMENTALBIOTECHNOLOGY

Course Objectives:

The proposed course is designed

- To understand the scientific and engineering principles of microbiological treatment technologies to clean up contaminated environments
- To replace of conventional treatment methodologies by molecular biology and genetic engineering strategies
- To seek the way for the alternate sources of energy to avoid environmental issues

Course Outcomes:

Upon successful completion of the course

1. Environmental Pollution or problems can be solved
2. Scientific solutions and participation can be served for the environmental Protection
3. improvement for the alternate sources of energy to avoid environmental disasters

SYLLABUS

UNIT I

Biodegradation And Bioremediation:

Aerobic and Anaerobic degradation of aliphatic and aromatic compounds – Biodegradation of herbicides and pesticides. Bioremediation technologies – Biostimulation, Bioaugmentation, Bioventing, biosparging and Phytoremediation – Bioleaching, bioprecipitation, bioaccumulation and biosorption of heavy metals.

UNIT II

Microbial Metabolism In wastewater treatment:

Decomposition of organic compounds in natural ecosystems – Co-metabolic degradation of organo-pollutants - Hydrolysis of biopolymers by aerobic and anaerobic microorganisms – Anaerobic degradation of carbohydrates, proteins, lipids – Nitrogen removal – Ammonification, nitrification, denitrification

UNIT III

Biological Treatment of Wastewater:

Physico-chemical characteristics of wastewater – Overview of aerobic and anaerobic treatment processes – Process design of aerobic and anaerobic system – Activated sludge process – Trickling filter – Rotating biological contactors – Fluidized bed reactor – Up flow anaerobic sludge blanket reactor (UASB) – Membrane bioreactors – Algal photosynthesis in wastewater treatment.

UNIT IV

Biotechnology For Air Pollution And waste management:

Air pollution control and treatment strategies – Biotechnology for treating air pollutants – Biofilters and Bioscrubbers – Biotechnology for the management of agricultural, plastic, dairy, paper and pulp, textile, leather, hospital and pharmaceutical industrial wastes.

UNIT V

Bioproducts From renewable sources

Overview of renewable sources – Production of biocompost and vermicompost – Production of biofertilizers and biopesticides – Production of biomethane, bioethanol, biohydrogen, biodiesel – Production of bioplastics and biopolymers – Bioelectricity generation and value added products from renewable sources.

TEXT BOOKS:

1. Environmental Pollution Control Engineering by C. S. Rao. Wiley Eastern Limited
2. Waste Water Treatment: Rational Methods of design and industrial practices by M. Narayana Rao and Amal K. Datta. Oxford & IBH publishing Co. Pvt. Ltd.
3. Environmental Biotechnology: Basic concepts and applications by Indu Shekhar Thakur. 1. K. International Pvt. Ltd.

References:

1. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series , Vol.1, Gulf Publications Co., London,1989.
2. Evans, G.G. and Furlong, J., Environmental Biotechnology: Theory and Application, 2nd Edition, John Wiley & Sons,2011.
3. Henze, M., Harremoes, P., Jansen, J.C. and Arvin, E., "Wastewater Treatment: Biological and Chemical Processes", 2nd Edition, Springer,2013.
4. Jordening, H.J. and Winter, J., "Environmental Biotechnology: Concepts and Application", Wiley-VCH Verlag GmbH & Co.,2005.
5. Wong J.W-C., Tyagi R.D., and Pandey. A., "Current Developments in Biotechnology and Bioengineering Solid waste" Elsevier,2016.
6. Zarook, S. and Ajay,S., Biotechnology for Odor and Air Pollution Control, Springer,2005.

MTBT-124: Bio Nanotechnology

Course Objectives:

To enable the students

- To learn about basis of nanomaterial science, preparation method, types and application

Course Outcomes:

Upon completing this course, the students

1. Will familiarize about the science of nanomaterials
2. Will demonstrate the preparation of nanomaterials
3. Awareness about the properties and broad applications of biomaterials

SYLLABUS

UNIT I

Nanoscale Processes and nanomaterials:

Overview of nanoscale processes and characterization of nanomaterials – Physicochemical properties of nanomaterials – Concepts in nanotechnology – Natural nanomaterials –Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Polymeric nanoparticles, Buckyballs, Nanotubes) – Interaction between biomolecules and nanoparticle surface –Synthesis and assembly of nanoparticles and nanostructures using bio-derived templates.

UNIT II

Structural And Functional Principles Of Bionanotechnology:

Biomolecular structure and stability – Protein folding – Self-assembly – Self-organization – Molecular recognition – Flexibility – Information-Driven nanoassembly – Energetics – Chemical transformation – Regulation – Biomaterials – Biomolecular motors – Traffic across membranes – Biomolecular sensing – Self-replication – Machine-phase bionanotechnology.

UNIT III

Protein-Based Nanotechnology:

Overview of protein nanotechnology – Nanotechnology with S-Layer protein – Engineered nanopores – Bacteriorhodopsin and its potential – Protein assisted synthesis of metal nanoparticles – Synthesis of protein-based nanoparticles – Protein nanopaticle-hybrids – Covalent and non-covalent protein nanoparticle conjugates – Protein-carbon nanotubeconjugates.

UNIT IV

DNA-Based nanotechnology:

DNA-based nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks – Self assembling DNA structures – DNA-nanoparticle conjugates – DNA-carbon nanotube conjugates – DNA templated electronics – DNA nanostructures for mechanics and computing – DNA nanomachine.

UNIT V

Nanomedicine and nanosensing:

Promising nano biotechnologies for applications in medicine – Role of nanotechnology in methods of treatment – Liposomes in nanomedicine – Therapeutic applications of nanomedicine – Nano- Sized carriers for drug delivery and drug carrier systems – Protein and peptide nanoparticles, DNA based nanoparticles, Lipid matrix nanoparticles for drug delivery – Design and development of bio nanosensors using DNA, enzymes – Nano biosensors for imaging and diagnosis.

REFERENCES:

1. Gazit, E., and Mitraki, A., "Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology", Imperial College Press, 2013.

2. Goodsell, D.S., "Bionanotechnology", John Wiley and Sons,2004.

3. Jesus M. de la Fuente and Grazu, V., "Nanobiotechnology: Inorganic Nanoparticles Vs Organic Nanoparticles" Elsevier,2012.

4. Niemeyer, C.M. and Mirkin, C.A., "Nanobiotechnology: Concepts, Applications and Perspectives", Wiley- VCH,2006.

5. Shoseyov, O. and Levy I., "Nanobiotechnology: Bioinspired Devices and Materials of the Future", Humana Press,2008.

MTBT-125: ELECTIVE-III

MTBT- 125-1: Industrial Biotech Products

Course Objectives:

- To study the structure and functions of various fermentors and study indetail the production media preparation, inoculums preparation and sterilization methods.
- To study the production ethyl alcohol, vinegar, lactic acid , citric acid and amino acids using microbial fermentation processes.
- To study the production of alcoholic and non alcoholic beverages in detail and to study the production of antibiotics, vitamins and baker's yeast, microbial enzymes and co-enzymes in detail using modern fermentation techniques.

Course Outcome:

1. Students will obtain vast knowledge in the fermentation technology to produce various industrially important bio products.
2. Students will acquire knowledge in handling bioreactors and sterilization methods.
3. Students can start small scale industries to produce bio products using fermentation techniques.
4. As this subject gives advanced level knowledge in the production of industrial biotech products, the further improvement and advances can be achieved by research.

SYLLABUS

UNIT I

Fundamentals involved in the' production of industrial Microbial products such as details of the Fermentors, Synthetic and natural medium, processors, Sterilization methods, and innocuium preparation. A detailed study of 'Ethanol' production by fermentation, using black blinap molasses, aarchy substance and glus\cosic like waste sulphate liquid purification methods of the fermented broth and production, of absolute ethyl alcohol.

UNIT II

Materials for fermentative production of Vinegar, Lactic Acid, Citric Acid, and Amino acids. The method Involves selection of the particular strain of the micro-organism for Industrial Fermentation, process details and purification.

UNIT III

Production of Alcoholic beverages with Beer, Brandy, Whisky and Wine. Baked goods, cheese and other dairy products.

UNIT IV

Production *of* Antibiotics, Tetracyclines, Alkaloids Bakers yeast and Microbial Enzymes and Co-enzymes.

UNIT V

Fermentative materials for producing vitamins, Products from plant cell Cultures, Non -

alcoholic beverages (Coco, Coffee, Tea fermentation).

Textbook:

"Industrial Microbiology" by Samuel C. Presscott and Cecil, G. Dunn; A McGraw - Hill Publication.

References:

1. "Industrial Mic~obiology" by L.E. Casida. Jr. Wiley Eastern Limited. , .
2. "Microbial Technology Vol. 1 and Vol. 2 by H.J. Peppler and D. Pulman (Academic Press).

MTBT- 125-2: Pharmaceutical Biotechnology

Course Objectives:

- To understand the required parameters for lead molecule identification and optimization
- To introduce various analytical tools employed in industrial sector during preclinical trials.
- To highlight the various drug delivery systems and production of biologicals in pharmaceutical market.

Course outcomes: At the end of the course **s**tudent is able to

1. Understand drug metabolism
2. Gain knowledge in Drug design and drug delivery systems
3. Summarize biologically derived therapeutic products .

UNIT I

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 II

QSAR AND drug design:

Drug Action – physicochemical properties and stereochemistry of compound. Isosterism and bioisosterism – 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.

UNIT III

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 IV

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.

UNIT V

Biological Products:
Properties of biotechnology derived therapeutic products. Production of Human insulin, Interferons, somatotropin, human growth hormone, somatostatin. Gene Therapy, vaccines, Monoclonal Antibody Based Pharmaceuticals, Recombinant Human Deoxyribonuclease

REFERENCES

1. K. D. Tripathi, "*Essentials of Medical Pharmacology*," 6th Edition, Jaypee publications,2008.
2. Gary Walsh, "*Pharmaceutical Biotechnology-Concepts and Applications*," Wiley,2007.
3. D. J. A. Crommelin, Robert D. Sindela, "*Pharmaceutical Biotechnology*," - 2nd Edition -2004.
4. Remington, "*The science and Practice of Pharmacy*," Vol. I and II, 20th Edition,2007.
5. Medicinal chemistry: A molecular and biochemical approach, 3rd Edition, OUP,2005.
6. Alfred Burger, "*Guide to Chemical Basis of Drug Design*," by (John Wiley & Sons)1983.
7. John Smith &Hywel Williams, "*Introduction to the Principles of Drug Design*,"Wright PSG,1983.

MTBT- 125-3: Agriculture Biotechnology

Course Objectives

:

- To give the details of conventional methods of breeding for crop improvement
- To understand about plant tissue culture and its applications
- To provide the basics of agro bacterium and methods of transformation in plants
- To familiarize commercial applications of genetic engineering in plants and also about biofertilizers

Course outcomes: At the end of the course **s**tudent is able to

1. Understand methods of breeding of various crops for improvement
2. Learn about micropropagation, somatic hybridization , synthetic seed and can use gained knowledge for entrepreneurship
3. Summarize applications of genetic engineering in agriculture
4. Understand the ethics and responsibility for safety.

UNIT 1

Introduction to Agricultural biotechnology :

Conventional methods of crop improvement, Objectives of plant breeding, Types of breeding, Genetic variation and manipulation of variability, Breeding of selected crops- important cereals, pulses, oilseeds, fibre, sugar and cash crops, Classical deliberate interbreeding, Intraspecific hybridization, Methods of breeding of self-pollinated crops and cross- pollinated crops, Methods of breeding asexually propagated crops, self incompatibility and male sterility in crop breeding, mutation breeding, Ploidy breeding, Innovative breeding methods, Hybrid varieties

UNIT 2

Plant tissue culture and its application:

Principles of plant micropropagation, The totipotency concept, Role & composition of Plant tissue culture media, Micropropagation pathways, Callus induction & culture, organogenesis and embryogenesis, Meristem tip culture, Haploid production, Hardening of plants, Techniques of anther, embryo and ovule culture, Protoplast isolation, Somatic hybridization, Cybrids, Somaclones, Artificial seed Technology(synthetic seed), Embryo rescue, Production of secondary metabolites, Cryopreservation and germplasm storage

UNIT 3

Plant molecular biology:

Organelle DNA, Regulation of gene expression, Methods of gene transfer in plants, Achievements and recent developments of genetic engineering in agriculture, Development of transgenies for biotic & abiotic stress tolerance, Ribozfore Technology, Ti plasmid-based transformation, Agrobacterium biology, crown gall and hairy root disease, Ti and Ri plasmids, T-DNA genes, borders, overdrive, chromosomal and Ti plasmid virulence genes and their functions, vir gene induction, mechanism of T-DNA transfer, Ti pasmid vectors, vir helper plasmid, super virulence and monocot transformation, binary vector, Transgene silencing, Strategies to avoid transgene silencing, Direct transformation of protoplasts using PEG, electroporation, Transformation by particle bombardment, Assembly of particle gun, Microprojectile preparation and bombardment, Chloroplast transformation by particle bombardment.

UNIT 4

Advanced technology for crop improvement:

Genetic engineering of crops, Commercial status of transgenic plants, Herbicide resistance, glyphosate, sulfonyl urea, phosphinothricin, atrazine, Pest resistance, B.t. toxin, synthetic B.t. toxin, Bt brinjal, Bt cotton, Protease inhibitor, GNA and other lectins, α-amylase inhibitor, nematode resistance, Genetic engineering for male sterility-Barnase-Barstar, Delay of fruit ripening, polygalacturanase, ACC synthase, ACC oxidase, Improved seed storage proteins, Improving and altering the composition of starch and plant oils, Golden rice for β-carotene accumulation, Production of antibodies and pharmaceuticals in plants, Biofertilizers,

UNIT5

Ethics and Biosafety:

Ethical issues in biotechnology, Biosafety and Risk assessment of GMOs, Public perception. IPR and Trade related aspects, Methods for producing transgenic plants, Important genes of agronomic interest, Current trends in finding useful genes, GMO Act 2004. Traceability, Legislative aspects.Introduction, Historical Backround, 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 Cartegana Protocol

Text books

1.Keshavachandran.R and K V Peter. 2008 .Plant Biotechnology: Tissue culture and Genetransfer. Orient and Longman, (Universal Press) Chennai.

2.Gresshoff, Peter M. (Ed). Plant biotechnology and development. 1992.

3.Jones, MGK & Lindsey, K. "Plant Biotechnology" in Molecular biology and biotechnology, Walker, JM & Gingold, EB (Eds). 2000.

4.Kumar H D, Agricultural Biotechnology, India ,2005

Reference books:

1.Esau's Plant Anatomy, Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development, 3rd Edition, John Wiley & Sons, 2006.

2.R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.

3.M. J. Chrispeels and D.F. Sadava (eds), Plants, Genes and Crop Biotechnology, 2nd Edition, Jones and Barlett Press, 2003

4.J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds), Plant Biotechnology, Springer Verlag, Heidelberg. 2000

5.BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007

6.Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

7.Encyclopedia of ethics, legal and policy issues in biotechnology. 2000

MTBT-126 – ELECTIVE - IV

MTBT-126-1: BIOTECHNOLOGY IN FOOD PROCESSING

Course Objectives:

To enable the students

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, food spoilage diseases.
- To know different techniques used for the preservation of foods.

Course outcomes:

Through this subject the student can understand about

1. Different constituents present in food and microorganism involved in processing of food.
2. Principles and different preservations techniques of food.
3. Unit operations in modern food processing and impact of the process on food quality

SYLLABUS

UNIT I

Food Processing:

Heat Processing using steam or water (Blanching, Pasteurization) – Heat sterilization (Evaporation and distillation) – Heat processing using hot air (Dehydration, baking and roasting) – Heat processing using hot oils – Processing by the removal of heat (chilling , Freezing) – High pressure processing of foods – Pulsed electric field processing of liquids and beverages – Non-thermal processing by radiofrequency electric fields.

UNIT II

Food Fermentation:

Fermentative production of foods – Single cell protein (yeast, mushroom) – Microorganisms responsible for production of fermented foods – Enzyme in bakery and cereal products – Enzymes in fat/oil industries – Protease in cheese making and beverage production – Production of Pectinases and Utilization in Food Processing – Food Flavour Production – Utilization of food waste for production of valuables.

UNIT III

Fermented Foods:

Overview of fermented foods – Bean-based – Grain-based – Vegetable-based – Fruit-based – Honey-based – Dairy-based – Fish-based – Meat-based – Tea-based – Advantages of fermented foods Health benefits of fermented foods – Nutritive value of fermented food – Biotechnological approaches to improve nutritional quality – Microbial changes in fermented food.

UNIT IV

Food Preservation techniques:

Spoilage of food - Microbiology of water, meat, milk, vegetables – Food poisoning – Cold preservation – Heat conservation – Ionizing radiation – High pressure – Electric field – Chemical food preservation – Combination of techniques for food preservation – Natural antioxidants – Antimicrobial enzymes – Edible coatings – Control of pH and water activity.

UNIT V

Food Quality and Control:

Analysis of food – Major ingredients present in different product – Food additives, vitamins – Analysis of heavy metal, fungal toxins, pesticide and herbicide contamination in food – Microbial safety of food products – Chemical safety of food products – Good manufacturing practice

REFERENCES

1. Adams M., Adams M. R. and Robert NoutM. J., "Fermentation and food safety", Springer, 2001.
2. Da-Wen S., "Emerging Technologies for Food Processing", Academic Press,2005.
3. Fellows, P.J., "Food Processing Technology: Principles and Practice", 3rd Edition, CRC Press,2009.
4. HutkinsR. W., "Microbiology and Technology of Fermented Foods", IFT Press series, Volume 32 of Institute of Food Technologists Series, Wiley-Blackwell,2006.
5. Pometto A, Shetty K, Paliyath G and Levin R. E., "Food Biotechnology", 2nd Edition , CRC press,2005.
6. Zeuthen P. and Bogh-Sorensen, L., "Food Preservation Techniques", 1st Edition, CRC Press,2003.

MTBT-126-2: BIOFUELS AND PLATFORM CHEMICALS

Course Objectives:

- To impart the knowledge Bioconversion of renewable lignocelluloses biomass to bio fuel and value added products
- To demonstrate a drive towards products benign to natural environment increasing the importance of renewable materials
- To emphasize the development of Biomass an inexpensive feedstock considered sustainable and renewable to replace a wide diversity of fossil based products

Course Outcomes:

On completion of the course, students will have gained knowledge on

1. The use of Biomass an inexpensive feedstock as sustainable and renewable energy
2. To replace fossil based products with Biodiesel
3. To source other alternate energy such as bio hydrogen and biorefinery

SYLLABUS

UNIT I

Introduction:

Cellulosic Biomass availability and its contents. Lignocellulose as a chemical resource. Physical and chemical pretreatment of lignocellulosic biomass. Cellulases and lignin degrading enzymes.

UNIT II

Ethanol:

Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III

Biodiesel:

Chemistry and Production Processes; 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

UNIT IV

Other Biofuels

Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts

UNIT V

Platform chemicals:

Case studies on production of C3 to C6 chemicals such as Hydroxy propionic acid, 1,3 propanediol, propionic acid, succinic acid, glucaric acid, cis-cis muconic acid.

Reference:

1. Lee, Sunggyu; Shah, Y.T. “Biofuels and Bioenergy”. CRC / Taylor & Francis, 2013 BY5020

MTBT-126-3: BIOPROCESS MODELING AND SIMULATION

Course Objectives:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- Provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

Course Outcomes:

Upon completion of Bioprocess Engineering course graduates will be able to

1. Select appropriate bioreactor configurations and operation modes based upon the nature of bio products and cell lines and other process criteria.
2. Apply modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
3. Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.
4. Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.

SYALLBUS

UNIT I

Concepts and Principles:

Introduction to modelling–Systematic approach to model building–Material and energybalance –Classification of models – General form of dynamic models dimensionless models – General form of linear systems of equations nonlinear function – Conservation principles thermodynamic principles of process systems

UNIT II

Models:

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

UNIT III

Modelling of Bioreactors:

Modelling of non-ideal behaviour in Bioreactors – Tanks-in-series and Dispersion models – Modelling of PFR and other first order processes – Analysis of packed bed and membrane bioreactors Recombinant Cell Culture Processes – Plasmid stability in recombinant Cell Culture limits to over-expression

UNIT IV

Monitoring of Bioprocesses:

On-line data analysis for measurement of important physico-chemical and biochemical parameters – State and parameter estimation techniques for biochemical processes – Biochemical reactors- model equations – Steady-state function – Dynamic behavior – Linearization – Phase plane analysis – Multiple steady state – Bifurcation behavior

UNIT V

Solution strategies:

Solution strategies for lumped parameter models – Stiff differential equations – Solution methods for initial value and boundary value problems – Euler's method – R-K method – shooting method – Finite difference methods – Solving the problems using MATLAB/SCILAB – ISIM-Simulation of bioprocesses using models from literature sources

References:

1. Bailey, J.A. and Ollis, D. F., Fundamentals of Biochemical Engineering", McGraw Hill – 1986.
2. Bequette, B.W., "Process Control: Modeling, Design & Stimulating", Prentice Hall,2003.
3. Boudreau, M.A. and McMillan, G.K.," New Directions in Bioprocess Modelling and Control", ISA,2006.
4. Hangos, K.M. and Cameron, I.T., "Process Modelling and Simulation",2001.
5.Heinzle, E., Biwer, A.P. and Cooney, C.A.L., "Development of Sustainable Bioprocess: Modeling", Wiley,2007.

MTBT-127: BIOTECHNOLOGY LAB –II

Course objectives:

- To let the students know the recent evolution biological databank usage
- To provide hands on experience in performing basic recombinant technique

Course Outcomes:

1. Develop Bioinformatics tools with programming skills
2. Apply computational based solutions for biological perspectives
3. Describe principle, methods for preparation & cloning of DNA
4. Able to use biotechnology techniques to manipulate genetic material and develop new and improved living organisms

Bioinformatics Lab:

1. Sequence formats
2. Structure formats
3. Sequence Retrieval from NCBI-GenBank using Entrez
4. Sequence Retrieval from EMBL-ENA using SRS
5. Sequence Retrieval from DDBJ using ARSA
6. Protein Sequence Retrieval from Swiss-Prot
7. Protein Sequence Retrieval from PIR-PSD
8. Protein Structure Retrieval from RCSB-PDB
9. Searching Bibliography Databases
10. DotPlot
11. DotPlot using BioEdit
12. NCBI BLAST
13. Global Alignment
14. Local Alignment
15. Multiple Sequence Alignment using MEGA
16. Phylogeny using MEGA
17. Structural Visualization of proteins using RasWin
18. Restriction Mapping using BioEdit
19. ORF Finding using NCBI ORF Finder

Molecular Biology Lab:

1. Isolation of Genomic DNA
2. Isolation of Plasmid
3. Restriction Digestion
4. Ligation
5. Transformation
6. Southern Hybridization