M.Tech. BIOTECHNOLOGY
Minimum credits to be earned: 76

First Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
13BT11	Unit Operations in Chemical Engineering	I, II	(a), (c), (i)	3	1	0	4
13BT12	Recombinant DNA Technology	I, II	(b), (c), (d), (f)	3	0	0	3
13BT13	Food Biotechnology	I, II	(b), (c), (e), (f), (g), (i)	3	0	0	3
13BT14	Computational Biology	II	(b), (c), (i)	3	0	2	4
13BT15	Advanced Entrepreneurship	II	(f), (g), (h), (i)	3	0	1	4
	Elective	I, II		3	0	0	3
13BT16	Recombinant DNA Technology and Food Biotechnology Lab	II	(e), (f), (g)	-	-	4	2
13BT17	Technical Seminar	II	(g)	-	-	2	1
			Total	**18**	**1**	**9**	**24**
Second Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
13BT21	Bioseparation Technology	I, II	(a), (b), (c), (d)	3	0	0	3
13BT22	Biopharmaceutical Technology	I, II	(a), (b), (c), (d)	3	0	2	4
13BT23	Bioprocess Technology	I, II	(b), (c), (e), (h)	3	0	0	3
13BT24	Nanobiotechnology	II	(b), (c), (d)	3	0	2	4
	Elective			3	0	0	3
	Elective			3	0	0	3
13BT25	Bioseparation Lab	II	(b), (c), (d), (e)	-	-	4	2
13BT26	Bioprocess Technology Lab	II, III	(b), (c), (d), (e)	-	-	6	3
			Total	**18**	**0**	**14**	**25**
Third Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
	Elective			3	0	0	3
	Elective			3	0	0	3
	Elective			3	0	0	3
13BT31	Project Work - Phase I	I, II, III	(b), (c), (e)	9			6
			Total	**0**	**0**	**0**	**15**
Fourth Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
13BT41	Project Work - Phase II	I, II, III	(b), (c), (e)				**12**

Note: Hours & Credit Pattern: Minimum number of credits to be earned for the award of M.Tech. (Biotechnology) Programme: 76

List of Electives							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
13BT51	Molecular concepts in Biology	I, II	(e), (f), (g)	3	0	0	3
13BT52	Industrial Microbiology	I, II	(e), (f), (g)	3	0	0	3
13BT53	Applied Mathematics	II	(h), (i)	3	0	0	3
13BT54	Biodiversity and Bioprospecting	I	(a), (b), (c)	3	0	0	3
13BT55	Computational Fluid Dynamics	II	(b), (c), (d)	3	0	0	3
13BT56	Medicinal Chemistry	I, II	(a), (b), (c), (i)	3	0	0	3
13BT57	Advanced Immunotechniques	II, III	(b), (c), (i)	3	0	0	3
13BT58	Concepts of Omics	II	(b), (c), (i)	3	0	0	3
13BT59	Bioprocess Modeling and Simulation	I, II	(a), (b), (c), (d), (e)	3	0	0	3
13BT60	Transgenic Animal Biotechnology	II, II	(b), (c), (f)	3	0	0	3
13BT61	Genetic Engineering of Crop Plants	I, II	(b), (c), (f)	3	0	0	3
13BT62	Enzyme Technology	I	(a), (b), (c)	3	0	0	3
13BT63	Research Methodology	I	(f), (g), (h)	3	0	0	3
13BT64	Metabolic Engineering	I	(a), (b), (c)	3	0	0	3
13BT65	Advanced Biostatistics	I	(a), (b), (c)	3	0	0	3
13BT66	Bioprocess Economics and Plant Design	I, II	(a), (b), (c), (d)	3	0	0	3
13BT67	Tissue Engineering	I, III	(a), (c), (i)	3	0	0	3
13BT68	Biomaterials	I, II	(a), (d), (i)	3	0	0	3
13BT69	Biofertilizers and Biopesticides	II, III	(c), (f), (h), (i)	3	0	0	3
13BT70	Agro Industrial Biotechnology	II, III	(d), (e), (f)	3	0	0	3
13BT71	Principles of Biomedical Engineering	II	(b), (c)	3	0	0	3
13BT72	Advanced Cancer Biology	II, III	(g), (h), (i)	3	0	0	3
13BT73	Molecular Modeling and Drug Design	I, II	(a), (b), (g), (i)	3	0	0	3
13BT74	Environmental Science and Technology	II	(b), (c)	3	0	0	3
13BT75	Pilot Plants Models and Scale Methods	II	(b), (c), (d)	3	0	0	3
13BT76	UNIX Operating System and Programming Language C++	II, III	(b), (c), (i)	3	0	0	3
13BT77	Biosensors and Microbial Fuel Cells*	II	(b), (c), (d)	3	0	0	3
13BT78	Biomaterials and Tissue Engineering*	II, III	(e), (f), (i)	3	0	0	3
13BT79	Systems Biology	I, III	(b), (d), (i)	3	0	0	3
13BT80	Cellular Biophysics	II, III	(b), (c), (i)	3	0	0	3
Self Study Electives							
13BTR1	Process Validation and Quality Management	II	(b), (c), (g)	3	0	0	3

* **Open Elective**

13BT11 UNIT OPERATIONS IN CHEMICAL ENGINEERING

3 1 0 4

Course Objectives (COs)

- To provide students the basic knowledge in the principles of unit operations
- To understand the application of material balance and energy balance for unit operation equipments in the chemical and biochemical companies
- To impart the heat transfer concept and its role in industries

Course Learning Outcome (CLO)

- To make the students understand the various unit operation equipments and process and improving their quality
- Students will develop their skills in solving problems for material balance and energy balance
- To learn about fluid flow behaviour and heat transfer

Program Outcomes (POs)

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(d) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

(i) Graduate will develop confidence for self education and ability for trouble shooting.

Unit I

Material balance and Energy balance

Dimensional analysis and its applications, material balance with and without chemical reactions. Energy balance with chemical reaction, energy balance without chemical reaction**.**

9 Hours

Unit II

Unit Operations

Overview of unit operations and their application in biotechnology. Crushing and grinding of particles, particles ultrafine particles by jet mill and nano particles in Attritor. Powder charaterisation: size , size distribution, shape, specific surface area, flowability and dustiness, storage and handling of solids and powders.

9 Hours

Unit III

Seperation techniques

Fluid solid separation: gas solid separation in cyclones and bag filter. Liquid solid separation, hydrocyclone and filtration, coagulation, Froath floatation, settling and sedimentation, mechanical classification and classifiers.

9 Hours

Unit IV

Fluid Flow and Agitation

Classification of fluids: non-newtonian fluids, rhelogical properties of fermentation broths, application of continuity and bernoulli's equation, concept of friction factor, piping system and its components, factors and selection of pipe size, good piping system, types of valves and fitting. Flow measurements: Transportation devices, pumps and their working. Types of agitators, flow patterns in agitated vessels, calculation of power consumption, scale up of mixing system, applications in bioreactor design.

9 Hours

Unit V

Heat Transfer

Basic mechanisms of heat transfer, conduction, convection, radiation; conduction through slab and multi-cylinder, Concept of heat transfer coefficient, heat exchange equipments for bioprocessing, Design of shell and tube heat exchanger. Evaporators-single effect, Multiple effect evaporators**.**

9 Hours
Tutorial: 15 Hours
Total: 45+15 = 60 Hours

References:

1. 1. W.L. McCabe, J.C.Smith and P.Harriot, *Unit Operations In Chemical Engineering*, McGraw-Hill Inc, 2006
2. M. Pauline Doran, *Bio Process Engineering Principles.* Elsevier Academic Press, 1995
3. J.Christie Geankoplis, *Transport Processes and Unit Operation*,. Prentice Hall India Limited, New Delhi, 2002
4. J. M Coulson and J.F Richardson, *Chemical Engineering, Vol –I*, Butterworth Heinemann, 1996
5. G.K Roy, *Solved problems in Chemical Engineering*, Khanna Publishers, Goswami Printers, Delhi, 2006.

13BT12 RECOMBINANT DNA TECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To develop the skill of the student in the area of recombinant DNA technology and its application.
- To familiarize student about the various component and techniques used in DNA manipulation.
- To motivate and facilitate student to undertake the project and research work in rDNA technology.

Course Learning Outcome (CLO)

- At the end of the course students will develop the capacity to construct various rDNA molecule.
- Students will have strong foundation for entering into higher education programme.

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

(f) Graduates will demonstrate knowledge of professional and ethical responsibilities.

Unit I

Concept of Cloning and Expression

Cloning vehicle; DNA manipulative and modifying enzymes; Restriction endonucleases – types, recognition sites, applications; Generation of sticky ends onto blunt ended DNA molecules; Prokaryotic and eukaryotic expression vectors, Expression and purification of recombinant proteins.

9 Hours

Unit II

Molecular Techniques in rDNA

PCR- principles, different types and applications; Overview of primer designing for PCR; DNA Sequencing – basic methods, advanced methods and de novo sequencing, applications; DNA Microarray – principles, usage and types, Methods of nucleic acid labeling.

9 Hours

Unit III

Construction of Library and Screening

cDNA and genomic DNA libraries- construction, advantages and disadvantages; Preparation of DNA and RNA probes; Immune screening and blotting techniques, Genetic markers.

9 Hours

Unit IV

Selection of Recombinant Clones

Strategies of integration of DNA insert into the vector; Approaches for introduction of vectors into suitable host; Selection of clones containing recombinant vectors; Selection of clones containing a specific DNA insert- complementation, colony hybridization, FACS, Insertional inactivation.

9 Hours

Unit V

Application of rDNA

Production of recombinant insulin and growth hormones- interferons, interleukins; Insecticide and herbicide resistant transgenic plants; Antisense RNA technology; Forensic application of molecular biology- identification of crime suspect, sex determinants, Biosafety regulations applicable to rDNA technology.

9 Hours

Total: 45 Hours

References:

1. T. A. Brown, *Gene cloning and DNA analysis: An Introduction*, Chelthenham, UK: Wiley-Blackwell Publishers, 2010
2. S. B. Primrose and R. M. Twyman, *Principles of gene manipulation and genomics*, Oxford, UK: Wiley-Blackwell Publishers, 2008
3. B. D. Singh, *Biotechnology*. India: Kalyani Publishers, 2007
4. J. D. Watson, M. Gilman, J. Witkowski, and M. Zoller, *Recombinant DNA: Genes and Genomes-A.* NY: Scientific American Books, 2001
5. P. J. Smith and C. J. Jones, *DNA recombination and repair*. USA: Oxford University Press, 2000
6. J. Sambrook, D. Russell, and D. W. Russell, *Molecular cloning-A laboratory Manual (A set of Volume 1, 2 and 3)*, USA: Cold Spring Harbor Laboratory Press, 2000

13BT13 FOOD BIOTECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To develop skill of the student in the area of food biotechnology and its applications.
- To disseminate students, various food sources, food spoilage new processing techniques to avoid food borne infections
- To learn the quality, safety and standards of foods packaging and preservation techniques.

Course Learning Outcome (CLO)

- To make the students understand the components of food and their role, causes of spoilage and improving their quality
- Students will develop their skills in producing new food products and also preservation techniques.
- Extraction and estimation of food components.

Program Outcomes (POs)

(b) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(e) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

(f) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

(g) Graduates will demonstrate knowledge of professional and ethical responsibilities.

(i) Graduate will develop confidence for self education and ability for life-long learning.

Unit I

Food and Nutritional chemistry

Introduction- Basic principles, Nutritional importance of Carbohydrates, Proteins and Lipids; Vitamins-deficiency symptoms; Food sources- cereals, millets and pulses -composition, malting and malted beverages; Oilseeds-composition; Vegetables-composition and fermented vegetables; Fruits-composition Fermented products.

9 Hours

Unit II

Food Microbiology

Food as substrate for microorganisms-types of microorganisms in food, primary sources of microorganisms found in food, Intrinsic and Extrinsic parameters of food affecting microbial growth; Food spoilage-principles, Food preservation-principles and methods; Fermented foods- examples, alcoholic fermentation; Microbes as food; Food borne diseases- food infection, Food poisoning.

9 Hours

Unit III

Food Products

Milk products- types, microencapsulated and immobilized enzymes-their application in accelerated ripening of cheese, flavoured milk, ice cream; Fermented Products- meso, soysauce, fish, pickle, Bakers yeast, bread, Idli; Vegetable and fruit products - enzymes used for processing; Food additives- production of mono-sodium glutamate, aspartame for flavour, use of cross-linking enzymes for texture modification; Food coloring agents.

9Hours

Unit IV

Food preservation & Packaging

Preservation: Physical, chemical and biological preservation methods - drying, cooling, deep-freezing, heating, curing, jellying, chemical additives, salting, pickling, smoking, canning, Antimicrobial food preservatives - sorbic acid, benzoic acid, antioxidants - BHA, BHT, Irradiation.

9 Hours

Packaging : Packaging– concepts, definition, significance, classification, development and Retail/Unit; Packaging of foods – fresh and processed; Primary packaging materials, methods of packaging - vacuum packaging, MAP, CAP & bio-degradable packages, costs of packaging, Recycling of materials.

.

9 Hours

Unit V

Food Safety and Quality control

Food sanitation- training & education for safe methods of handling food; sterilization & disinfection-Safety limits of sanitizers; pest control; management and disposal of waste; Quality control - food quality and standards like AGMARK, FRO, BIS and PFA; Good laboratory practice (GLP); Quality systems standards including ISO; Auditing; Good Manufacturing Practice and HACCP; GM foods, Fortification.

9 Hours

Total : 45 Hours

References:

1. B. Sivasankar, *Food processing and preservation*, Prentice Hall of India, 2002
2. S.C. Rastogi , *Biochemistry*, Tata Mc Graw Hill, 1998
3. J. M. Jay, *Modern Food Microbiology*, CBS Publishers & Distributors, New Delhi, 1996
4. G. J. Banwari , *Basic food Microbiology*, CBS Publishers and distributors, New Delhi 1998
5. J. Towers, *Food Theory and Applications*, Mc Milan Publishing Co., 1992
6. L.E.Casida, *Industrial Microbiology*, New Age International publishers, 2007

13BT14 COMPUTATIONAL BIOLOGY

3 0 2 4

Course Objectives (COs)

- To understand the basics of Unix operating system and search engines
- To learn about the database structures used in biological databases
- To learn tha programming languages

Course Learning Outcome (CLO)

- To prepare deep knowledge in the various algorithms
- To prepare students to integrate wet lab with Insilico prediction
- To facilitate the student with overall knowledge about Insilico techniques in biology

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(c) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

(i) Graduate will develop confidence for self education and ability for life-long learning.

Unit I

Introduction to genomics and proteomics

Functional, structural and comparative genomics. Gene finding and annotation. Protein structure. Homology modeling. Differential gene expression. General ideas of drug designing, structure determination by X-ray crystallography and NMR spectroscopy, Genes and protein structure.

7 Hours

Unit II

Characterizing Protein Associations

Protein Sequence and Motif Databases, Docking, Rigid body docking, Flexible docking, Introduction to QSAR, 3D pharmacophores, Molecular docking.

6 Hours

Unit III

Systems Biology

Overview of System Biology, Analysis of High-throughput data, Support vector machines, Perl Programming, R , Python, Perl Programing.

10 Hours

Unit IV

Gene Regulatory Network

Clustering Coordinately Regulated Genes, Discovering Gene Regulatory Signals, Gene Regulatory Modules and Networks, MicroRNA Regulatory Networks, Gene networks.

12 Hours

Unit V

Protein Folding and Structure Prediction

Bimolecular Simulations: Moleculat Dynamics, Metropolis Monte Carlo, Structure Predication and CASP, Comparative Modeling Threading, Ab-initio Methods, Fragment-based assembly, Molecular Dynamics.

10 Hours

Laboratory component

Sequence analysis	: Pairwise and multiple sequence alignment. Tools available for sequence analysis. Motif generation.
Databases	: Exploring biological databases
Gene finding	: Using Genscan, HMMGene etc.
Protein structure Prediction	: Tools for protein structure prediction.
Annotation	: Functional annotation. Writing utilities using Perl and Python

15 Hours

Total: 45 + 15 = 60 Hours

References:

1. Mount D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
3. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2nd ed., East West Press, 2003
4. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
5. Tisdall, James, Beginning PERL for Bioinformatics, O'Reilley, 2001.6. Durbin, R. et al., Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic

13BT15 ADVANCED ENTREPRENEURSHIP

3 0 1 4

Course Objectives (COs)

- To develop the Creativity, responsibility, freedom to be able to decide what work one wants to do and how, dedication, diversity and last but not the least having fun and enjoying what one does.
- To develop the entrepreneurial skill in the field of biotechnology
- To learn the Business strategy and Technology Transfer

Course Learning Outcome (CLO)

- To provide an entrepreneurial learning opportunity showing how startups really get it.
- To kindle the young minds to promote their entrepreneurial spirit
- To write business proposals for varying funding agencies to convert the project into product

Programme Outcomes (POs)

(f) Graduates will demonstrate knowledge of professional and ethical responsibilities.
(g) Graduate will be able to communicate effectively in both verbal and written form.
(h) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
(i) Graduate will develop confidence for self-education and ability for life-long learning.

Unit I

Essentials of Entrepreneurship

Entrepreneurship, Factors and Attributes in Entrepreneurship, Desirables in startups, mistakes to be avoided, Entrepreneurship and Innovation in Networks, Bioentrepreneurship efforts in India, Human resource development, Online Marketing, Entrepreneurship and Innovation in Networks.

9 Hours

Unit II

Entrepreneurial business creation and management

Biotech company road map, History of establishment of pioneer biotechnology companies, Key for success, Mission and Strategy, Successful Bioentrepreneurs in India - case studies, Government schemes and regulations for commercialization of technology, Biotech enterprises: Small, Medium & Large, Govt. regulations for biotech products, Key for success, Mission and Strategy.

9 Hours

Unit III

Biotech Business Models

Biotech Business models; Vertical model, Product Model, Platform Business Model, Hybrid Model, Service Business Model from Genomics based companies, Hybrid Model.

9 Hours

Unit IV

Business Plan

General considerations, Business plan - Do's and don'ts, How to write Business proposal, Checklist for Business proposal writing, Deficiencies in startup Business Plan, Business plan risks, Deficiencies in startup Business Plan.

9 Hours

Unit V

Business Strategies and Technology Transfer

Intellectual property in biotech - Licensing, Accessing University technology, Issues in University Technology transfer, licensing of Biotechnological invention, University support and responsibility for government funded or self-funded discoveries, Funding agencies in India, Financial Bootstrapping, External financing, Practical Ethics: Succeeding in a Transparent World, Funding agencies in India.

9 Hours

Laboratory Component:

15 Hours

1. Lateral thinking
2. Six thinking hats
3. Business plan

Total: 45 + 15 = 60 Hours

References:

1. S.N. Jogdand, *Entrepreneurship and Business of Biotechnology,* Himalaya Publishing Home, 2007
2. C.B. Gupta and S.S. Khanka, *Entrepreneurship and Small Business Management*, National Publishers, 1996
3. R. Oliver, *The coming biotech age: The business of biomaterials*. New York: McGraw Hill, 2000
4. A.S. Shaleesha, *Bioethics*, Wisdom Educational Service, Chennai, 2008
5. *Jerome Katz and Andrew C. Corbett, Advances in Entrepreneurship, Firm Emergence and Growth, Mark Moreau,* 2012
6. Prof. Rajeev roy ,"Entrepreneurship" oxford publications 2nd edition, 2011

13BT16 RECOMBINANT DNA TECHNOLOGY AND FOOD BIOTECHNOLOGY LAB

0 0 4 2

Course Objectives (COs)

- To widen the practical skills in the area of recombinant DNA technology.
- To disseminate student with modern tools & techniques used in rDNA technology.
- To induce and assist student to carry out the project and research work in rDNA technology.

Course Learning Outcomes (CLOs)

- Separation and quantification genomic and plasmid DNA
- Knowledge of gene cloning and transformation techniques
- Analysis of randomly amplified polymorphic DNA profiling

Program Outcomes (POs)

(e) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(f) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(g) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

List of Experiments

1. Detection of target gene(s) by single step and duplex PCR
2. Purification of PCR amplified product
3. Ligation of gene of interest into the vector
4. Transformation using GenePulser and screening
5. Confirmation of cloned gene by PCR.
6. Restriction digestion of chromosomal DNA.
7. DNA fingerprinting by RAPD marker.
8. Isolation and identification of storage microflora from food stuffs/ vegetables/ fruits.
9. Extraction and estimation of antioxidants in vegetables and fruits.
10. Extraction and detection of aflatoxins from mycoflora.

Total: 60 Hours

10BT21 BIOSEPARATION TECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To impart knowledge in cell disruption and product purification using high resolution equipments.
- To study the recent advancement in chromatographic techniques.
- To know the advanced supercritical fluid extraction process and final polishing system.

Course Learning Outcome (CLO)

- To acquire the knowledge of separation process.
- To analyze various parameters to be monitored and controlled during separation processes.
- To facilitate the application of advanced separation technology.

Programme Outcomes (POs)

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(c) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.
(d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Unit I

Overview of Bioseparation Processes

Seperation of biomass from broth, Characteristics of biomolecules and fermentation broths. Cell disruption methods, Primary purification, separation. of in-soluble,: centrifugation, and sedimentation. Filtration, Industrial Applications of filtration.

9 Hours

Unit II

Extraction and Filtration Methods

Isolation of products, Solvent extraction and its applications in pharmaceutical industry, aqueous two-phase extraction, precipitation and adsorption. Membrane processes, dialysis, Ultra filtration, and reverse osmosis. Electrodialysis, separation of protein complex using sucrose gradient method

9 Hours

Unit III

Chromatography & Electrophoresis

Principles of chromatographic separations, Gel filtration, Reversed phase, Ion exchange, Affinity chromatography**,**Immobilized metal affinity chromatography and bio-affinity chromatography. Selection of chromatographic matrices. FPLC,HPLC and HPTLC**,** Design and large scale chromatographic separation processes. Separation of proteins using Electrophoresis methods : SDS,pulse reading, separation of binary protein complex using FPLC.

9 Hours

Unit IV

Product Purification

Final product purification, formulation and packing. Crystallization, Drying and lyophilization and labeling standards, preservation.

9 Hours

Unit V

Advanced Bioseparations

Recent trends in bioseparations, perevaporation, reverse miceller extraction, super critical fluid extraction spin base , magnetic separation and their application, case studies of product purification and recovery.

9 Hours

Total: 45 Hours

References:

1. B. Sivasankar, *Bioseparations: Principles and Technique*, Prentice-Hall of India Pvt.Ltd, 2007
2. P.A Belter, E.L Cussler Hu,*Bioseparation - Downstream Processing for Biotechnology*, Wiley Inter Science Publication, 1988
3. S Roe, *Protein Purification Techniques: A Practical Approach.* Oxford University Press, 2004
4. N.Krishna Prasad, Downstream Processing Technology,PHI Learning Private Ltd,2012.
5. W.L. McCabe, J.C.Smith and P.Harriot, *Unit Operations In Chemical Engineering*, McGraw- Hill Inc, 2006

13BT22 BIOPHARMACEUTICAL TECHNOLOGY

3 0 2 4

Course Objectives (COs):

- To gain the knowledge about different bio resources of pharmaceuticals.
- To study the kinetics of drug metabolism.
- To study the manufacturing principles of drugs and recent advances in drug delivery.

Course Learning Outcome (CLO):

- To make the students understand the concepts of biopharmaceuticals and their kinetics.
- To learn about drug manufacture.
- To learn about drug delivery systems and good manufacturing principles.

Program Outcomes (POs):

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

Unit I

Overview of Biopharmaceuticals

Classification of biopharmaceuticals, pharmaceuticals of plant, animal and microbial origin, delivery of biopharmaceuticals, clinical trials and regulatory authorites.

9 Hours

Unit II

Biopharmaceutics and Pharmacokinetics

Mechanism of drug absorption, distribution, metabolism and excretion, bioavailability, bioequivalence, basic concepts of pharmacokinetics, compartmental models; One, Two and non-compartmental approaches to pharmacokinetics.

10 Hours

Unit III

Production of Biopharmaceuticals

Therapeutic hormone - insulin, polyclonal and monoclonal antibody preparations, vaccine preparations - attenuated, inactivated, toxoid, recombinant hepatitis B and *Porcilis pesti* (veterinary) vaccine.

8 Hours

Unit IV

Formulation of pharmaceuticals

Liquid dosage forms - solutions, suspensions, emulsions; semisolid dosage forms - ointments, creams, suppositories; solid dosage forms - tablets, capsules; pharmaceutical preservatives, packaging.

9 Hours

Unit V

Advancements in Drug Delivery Systems

Controlled drug delivery systems - implants, iontophoresis, transdermal patches; targeted drug delivery - liposomes, niosomes, microspheres, resealed erythrocytes, prodrugs, nanoparticles and monoclonal antibodies.

9 Hours

Laboratory Component:

1. Isolation of naringin from grape peel
2. Synthesis of benzocaine
3. Assay of riboflavin tablet using UV-Visible spectrophotometer

15 Hours

Total: 45 + 15 Hours = 60 Hours

References:

1. D.M. Brahmankar and S.B. Jaiswal, *Biopharmaceutics and Pharmacokinetics - A Treatise*. Vallabh Prakashan, 2006
2. G. Walsh, *Biopharmaceuticals: Biochemistry and Biotechnology*. John Wiley, 2003
3. G. Walsh, *Pharmaceutical Biotechnology: Concepts and Applications*. John Wiley, 2007
4. Remington, *The Science and Practice of Pharmacy (Volume 1 & 2)*. Lippincott Williams & Wilkins, 2005
5. E.A. Rawlins, Ed., *Bentley's Textbook of Pharmaceutics*. Bailliere Tindall, 1996

13BT23 BIOPROCESS TECHNOLOGY

3 0 0 3

Course Objectives (COs):

- To study the development of bioprocesses.
- To study the stoichiometry and energetics of cell growth and product formation.
- To study the design of a fermenter.

Course Learning Outcome (CLO):

- To acquire the knowledge of bioprocesses.
- To analyze various parameters to be monitored and controlled during fermentation processes.
- To facilitate the design and optimization of media for various fermentation processes.

Program Outcomes (POs):

(b) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(d) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.
(h) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Unit I

Introduction to bioprocesses

Overview of traditional and modern applications of biotechnological processes, chronological development of fermentation industry, general requirements of a fermentation, methods for monitoring and controlling fermentation parameters.

8 Hours

Unit II

Design of fermenter

Basic functions of a fermenter, aseptic operation and containment, body construction, temperature control, aeration and agitation, achievement and maintenance of aseptic conditions, valves and steam traps, other fermentation vessels.

10 Hour

Unit III

Media design for fermentation processes

Medium formulation for fermentation processes, design of commercial media for industrial fermentations - Plackett - Burman design, response surface methodology and simplex design.

9 Hours

Unit IV

Metabolic stoichiometry in bioprocesses

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficient, oxygen consumption and heat evolution in aerobic cultures.

9 Hours

Unit V

Modern biotechnological processes

Recombinant cell culture processes, Guidelines for choosing host vector systems, plasmid stability in recombinant cell culture, limits to over expression, modeling of recombinant bacterial cultures.

9 Hours

Total: 45 Hours

References:

1. M.L. Shuler and F. Kargi, *Bioprocess Engineering - Basic Concepts*, Prentice Hall of India, 2008
2. P.M. Doran, *Bioprocess Engineering Principles*, Elsevier, 2006
3. E. Bailey and D.F. Olli's, *Biochemical Engineering Fundamentals*, McGraw Hill, 1986
4. A.H. Patel, *Industrial Microbiology*, Macmillan Publishers India Ltd., 2007

13BT24 NANOBIOTECHNOLOGY

3 0 2 4

Course Objectives (COs)

- To develop the skills of the student in the area of Nano biotechnology and its application.
- To familiarize student with different techniques for synthesizing and characterizing of various nanoparticles.
- To motivate and facilitate student to undertake the project and research work in Nano biotechnology.

Course Learning Outcome (CLO)

- To make the students understand the components of Nano biotechnology
- To have knowledge about the instruments used in Nano biotechnology.
- To make them know the applications of Nano biotechnology in various fields.

Programme Outcome (POs)

b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

Unit I

Introduction to Nanobiotechnology

Synthesis and Characteristics of nanoparticles; Characterization of Nanoscale materials, Strategies for Nano architecture- bottom up, top down and functional approaches; Carbon nanotubes- properties, synthesis and application ,Synthesis of nanoparticles – bacteria, fungi, yeast and plants, c*hemical* Transformation of Biomaterials.

9 Hours

Unit II

DNA and Protein based Nanostructures

DNA-gold particle conjugates; DNA nanostructrures for mechanics and computing; Polymer nanocontainers; Peptide nanotubes and their applications– electronics, antibacterial agents; protein self-assembly,nanochips, nanopolymers.

9 Hours

Unit III

Nanoanalytics and Nano-structured Materials

Scanning electron microscopy; Atomic force microscopy; Scanning probe microscopy; Mass spectroscopy; Fourier transform infrared spectroscopy; Quantum dots, DNA microarrays; Nano biosensors.,Transmission electron microscope-STEM, instruments for thermal characterization of nanomaterials.

9 Hours

Unit IV

Nanoparticles in Drug Delivery

Applications of Nano-biotechnology in drug delivery; Polymeric nanoparticles for drug and gene delivery; Protein targeting- targeting signals, translocation and sorting; Micelles for drug delivery. Synthesis of nanodrugs, nanocomposites.

9 Hours

Unit V

Nanomaterials and Nanomedicine

Cardiavascular implants, Nanotechnology in cancer research,Biomaterials for optamology, Structure, property of Biological Materials: tissues, bones and teeth, collagen rich,tissues, elastic tissues, nanostructured collagen mimics in tissue Engineering. Biopolymers: Preparation of nanobiomaterials – Polymeric scaffolds collagen, Elastins:Mucopolysaccharides, proteoglycans, cellulose and derivates; Dextrans; Alginates;Pectins; Chitin, nanosurgery.

9 Hours

Laboratory Component:

1. Analysis through FTIR spectrophotometer
2. Thermal characterization through DSC
3. Electrical conductivity measurement through an Impedance Analyzer

15 Hours

Total: 45 + 15 Hours = 60 Hours

References:

1. C. M. Niemeyer and C. A. Mirkin, *Nanobiotechnology: Concepts, Applications and Perspectives*, Weiheim: Wiley-VCH Verlag GmbH and Co. KGaA, 2004
2. T. Pradeep, *Nano: The Essentials Understanding Nanoscience and Nanotechnology*, New Delhi: Tata McGraw- Hill, 2008.
3. H. S. Nalwa, *Encyclopedia of Nanoscience & Nanotechnology*, California: American Scientific Publishers, 2004
4. Bhusan, *Handbook of Nanotechnology*, Berlin, Heidelberg, Germany: Springer-Verlag, 2004
5. P. M. Ajayan, L. S. Schadler, and P. V. Braun, *Nanocomposite Science and Technology*, Weiheim: Wiley-VCH Verlag, GmbH & Co. KGaA, 2003
6. M. Kohler and W. Fritzsche, *Nanotechnology: An Introduction to Nanostructuring Techniques*. Weiheim: Wiley-VCH Verlag GmbH & Co. KgaA, 2004

10BT25 BIOSEPARATION LAB

0 0 4 2

Course Objectives (COs)

- To impart the skills in cell disruption, sonication, and homogeniozer equipments
- To under stand the concept of resistance factor involved in ultrafiltration and membrane filtration process.
- To induce and assist student to learn the techniques involved in different types of chromatography.

Course Learning Outcomes (CLO)

- Comparison on different cell disruption techniques.
- Knowledge on different Chromatographic techniques
- Optimization of separation process parameters.

Program Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

(e) Graduate will demonstrate skills to use modern engineering tools, software's and equipment to analyze problems.

List of Experiments

1. Quantification of protein by cell disruption methods – Homogenizer, Sonication and French Press
2. Construction of binodal curve in aqueous two phase extraction
3. Separation of protein present in egg white using ammonium sulphate
4. Purification of macromolecules using Ion exchange Chromatography
5. Separation of biopolymer after degradation from the solution using Gel filtration chromatography.
6. Determination of filter medium and cake resistance of milk and microbial broth using Ultra filtration and micro filtration.
7. Optimization of batch and continuous biosorption of textile dye.
8. Separation of ingredients in medicinal plant extract by HPTLC (Demonstration)
9. Mini Project

Total: 60 Hours

13BT26 BIOPROCESS TECHNOLOGY LAB

0 0 6 3

Course Objectives (COs)

- To understand the connection between microbial growth and product formation and mass transfer.
- To be able to carry out, evaluate and report a biotechnological process in laboratory scale.
- To be able to carry out mass balancing calculations over bioreactors.

Course Learning Outcome (CLO)

- To make the students understand the components of bioreactors.
- To have knowledge about the instruments used in fermentation process
- To make them know the applications of bioprocess engineering in production of bio based products.

Programme Outcome (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
(f) Graduate will demonstrate skills to use modern engineering tools, software's and equipment to analyze problems.

List of Experiments

1. Enzyme kinetics, inhibition
2. Enzyme immobilization studies
3. Fed batch cultivation
4. Continuous cultivation – Pulse and shift techniques
5. Gas analysis – CPR, OUR, RQ estimation and carbon balancing
6. Scale up $-K_{la}$ determination – power correlation
7. Ethanol production and purification
8. Solid state fermentation
9. Mini Project

Total: 60 Hours

13BT51 MOLECULAR CONCEPTS IN BIOLOGY

3 0 0 3

Course Objectives (COs)

- To get familiar with the biological molecules and their structure and functions
- To understand the basics of central dogma of life and fundamentals of cell organization

Course Learning Outcome (CLO)

- Graduates will develop capacity to understand fundamental of biology
- Graduates will have strong foundation for entering into higher education programme

Programme Outcomes (POs)

(e) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(f) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(g) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

Unit I

Introduction to biological molecules

Basic Carbon Chemistry, Types of biomoleules, Molecular structure and function of Biological Macromolecules - Proteins, Nucleic acids, Carbohydrates, Lipids

9 Hours

Unit II

Genes to metabolic end-products

Basics of DNA replication, transcription, translation, biocatalysis, pathways and metabolism

9 Hours

Unit III

Molecular cell biology and energetics

Functional organization of cells at molecular level; membranes, molecular communication across membranes, energetics – proton motive force, ATP synthesis, respiration; photosynthesis

9 Hours

Unit IV

Molecular basis of microbial forms and their diversity

Structural differences between different microbial cell types; over view of primary and secondary metabolism of microbes, commercial products like antibiotics, vitamins from microbes

9 Hours

Unit V

Molecular basis of higher life forms

Molecular differences between various eukaryotic cell types, tissue proteins, blood, important molecular components of blood, albumin, antibodies, hormones and their actions

9 Hours

Total: 45 hours

References:

1. Interactive Concepts in Biochemistry by Rodney Boyer, Copyright 2002, John Wiley & Sons Publishers, Inc. http://www.wiley.com/legacy/college/boyer/0470003790/index.htm
2. Biochemistry by Lubert Stryer, 5th Edition W. H. Freeman and Company, New York
3. Lehninger's Principles of Biochemistry, 4th Edn, by David L. Nelson and Michael M. Cox,
4. Molecular Cell Biology, Sixth Edition., by Harvey Lodish, Arnold Berk, Chris A.Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira
5. Bioenergetics at a Glance: An Illustrated Introduction D. A. Harris, 1995 John Wiley & Sons Publishers, Inc
6. Introduction to General, Organic, and Biochemistry, 8th Edition Morris Hein, Leo R. Best, Scott Pattison, Susan Arena 2004, John Wiley & Sons Publishers, Inc
7. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology Michael Wink (Editor) 2006 John Wiley & Sons Publishers, Inc

13BT52 INDUSTRIAL MICROBIOLOGY

3 0 0 3

Course Objectives (COs)

- To provide student with firm understanding of the techniques involved in fermentation process and reactor systems.
- To understand the significance of bioresources and its role in microbial biotechnology.
- To discuss the treatment techniques pertaining to environmental biotechnology

Course Learning Outcome (CLO)

- Various Fermenter operations.
- Biomaterial productions using microbes

Programme Outcomes (POs)

(e) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(f) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(g) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

Unit I

Introduction

Isolation, identification and methods of purification of microbial strains; Quantification of microorganisms – direct and indirect methods; preservation of microbial cultures, genetic improvement of microbial strains.

9 Hours

Unit II

Fermentation Technology

Types of bioreactors; operation of bioreactors; solid substrate fermentation; media for industrial fermentation; primary and secondary metabolites; principles of microbial growth, culture system.

9 Hours

Unit III

Biotransformations

Biotransformations - reactions, techniques, product recovery; biotransformation of steroids, antibiotics, arachidonic acid, glycerol; biotransformation for the production of ascorbic acid, indigo.

9 Hours

Unit IV

Biomass, Bioenergy and Biomining

Sources and utilization of biomass, production of alcohol, acetone, glycerol, biogas, biohydrogen; commercial biobleaching process, biobleaching of copper, uranium, biosorption of metals.

9 Hours

Unit V

Biodegradation and Bioremediation

Definition, process of xenobiotic degradation, recalcitrant xenobiotics; biodegradation of hydrocarbons, pesticides, and herbicides, aromatic compounds, polychlorinated biphenyls; bioremediation – types and process, bioremediation of contaminated soils and waste lands**.**

9 Hours

Total: 45 Hours

References:

1. U. Sathyanarayana, *Biotechnology,* Kolkata: Books and Allied (P) Ltd., 2005
2. W. Crueger and A. Crueger, *Biotechnology: A Textbook: of Industrial Microbiology*, Panima Publishing Corporation, 2003
3. P. F. Stanbury, S. J. Hall, and A. Whitaker, *Principles of Fermentation Technology,* New Delhi: Adithya Books (P) Ltd., 1997
4. C. Ratledge and B. Kristiansen, *Basic Biotechnology,* Cambridge University Press, 2001

13BT53 APPLIED MATHEMATICS

3 0 0 3

Course Objectives (COs)

- To study the fundamentals of mathematics and its application
- To understand the analytical skills required for biotechnology

Course Learning Outcome (CLO)

- To understand the application of mathematics for biotechnology
- To apply differential equations and integrations to biological systems
- To Measure fluid flow in pipes using model equations

Programme Outcomes (POs)

(h) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(i) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(j) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

Unit – I

Differentiation, integration and matrices

Matrices, differentiation and integration, matrix-addition, multiplication determinants. Differentiation: integration factors - Bernoulli 1^{st} & 2^{nd} order differential equation with constant coefficients- numerical differentiation and integration- Neuter's forward and backward – Trapezoidal, Simpton's rule.

9 Hours

Unit – II

Curve fitting

Curve Fitting –fitting a straight line and second degree curve, Correlation and Regression. fitting a non linear curve, application to Biological Sciences.

9 Hours

Unit –III

Design of Experiments

Design of Experiments – completely randomized design – Randomized Block Design -Latin Square Design – biological samples

9 Hours

Unit –IV

Sampling distributions

Sampling distributions - Testing of hypothesis for mean, variance, properties and differences using t-test, chi-square and F distributions.

9 Hours

Unit-V

Software packages

Software packages like Matlab, Scilab, SPSS

9 Hours

Total: 45 Hours

References:

1. E. Kreyszig, Advanced engineering mathematics, 8th Edition, John Wiley Co., 1999.
2. W. E. Boyce and R. DiPrima, Elementary Differential Equations, 8^{th} Edition, John Wiley Co., 2005.
3. R.A.Johnson, Miller and Freund's *Probability and Statistics for Engineers* 6^{th} Edition. Pearson Edition, Delhi 2009.
4. Merton R .Hubbard, *Statistical Quality control for the Food Industry*. Kluwer Academic/Plenum Publishers, 2003.

10BT54 BIODIVERSITY AND BIOPROSPECTING

3 0 0 3

Course Objectives (COs)

- To gain knowledge on various biodiversity forms and its measurements.
- To discuss the values and policies followed for the conservation of biodiversity.
- To acquaint information on bioprospecting and agreements.

Course Learning Outcome (CLO)

(a) Graduates will demonstrate an ability to identify the geographical causs for divsiy.
(b) Graduate will demonstrate an ability measure the genetic diversity between and among species
(c) Graduates will demonstrate an ability to measure genetic diversity between and among species

Programme Outcomes (POs)

- To understand the principles of microbial divesity
- To acquire knowledge on Biodiversity action plan, Conservation and management.

Unit I

Introduction

Definition, Historical and geographical causes for diversity, Genetic diversity, Molecular taxonomy, Species and population biodiversity, Species richness, Quantifying biodiversity, Maintenance of ecological biodiversity, Morphological and molecular characterization of biodiversity, Hotspots, Endangered species.

9 Hours

Unit II

Microbial Diversity

Introduction, Distribution, Abundance, Ecological niche, and Principles of microbial diversity. Structural, Biochemical and Molecular Phylogenetic relationships of microorganisms, Genomics of viable but nonculturable microorganisms. **9 Hours**

Unit III

Plant Genetic Resources for Agriculture

Genetic diversity, Measurement of genetic diversity between and among species, Gene pool, Germplasm, Molecular genetic markers, Isozyme studies, Phylogenetic relations, Estimation of biodiversity benefits, Agrobiodiversity and cultivated taxa, National & International centres for germplasm.

9 Hours

Unit IV

Policy Concerns & Economic Value

Convention on Biological Diversity and its follow-up, Uses and values of Biodiversity, Biodiversity as a merit good, Intellectual property rights relating to biological resources, Biopiracy, Indigenous systems of knowledge, National policies/legislation and instruments relating the protection of the wild/ domesticated flora and fauna as well as habitats, Biodiversity action plan, Conservation and management.

9 Hours

Unit V

Bio-prospecting

Biochemical resources from microbes, plants & animals, Natural products, Pharmaceuticals, Ethnobotanical approaches and screening, Collection & sustainable harvesting of medicinal plants & storage, Bioprospecting agreements, Bilateral & multilateral contracts, Material transfer agreements, Case studies.

9 Hours
Total: 45 Hours

References:

1. B. Groombridge and M. Jenkins, *Global Biodiversity: Earths Living Resources in the 21st Century*, Cambridge: WCMC, 2000

2. A. T. Bull, *Microbial Diversity and Bio prospecting,* American Society for Microbiology, 2003
3. R. M. Atlas and R. Bartha, *Microbial Ecology: Fundamentals and Application*,. Benjamin Cummings, 1997
4. V. H. Heywood, *Global Biodiversity Assessment.* Cambridge University Press, 1995
5. G. K. Meffe and C. R. Carroll, *Principles of Conservation Biolog*,. Sinauer Associates Inc, Sunderland, Mass, 1997

10BT55 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

Course Objectives (COs)

To provide a better understanding of countless applications especially in the field of fluid-structure interaction through computer modeling.

To simulate flows of gases and liquids, heat and mass transfer, moving bodies, multiphase physics and chemical reaction.

Course Learning Outcome (CLO)

- To acquire the knowledge of behaviour of fluid flow.
- To derive equations for fluid dynamics.
- To facilitate the application of CFD in determining the entropy condition of fluid..

Programme Outcomes (POs)

(b) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(c) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

(d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Unit I

Fluid Dynamics

Introduction, Reasons for CFD. Typical examples of CFD codes and their use. Validation strategies. Derivation of Governing Equations of Fluid Dynamics: Mass conservation and divergence, Navier-Stokes and Euler equations. Energy equations. Conservation formulation and finite volume discretisation. Partial differential equations: classification, characteristic form, PDEs in science and engineering.

9 Hours

Unit II

Basic Numericals

Mathematical behavior of hyperbolic, parabolic and elliptic equations. Well posedness. Discretization by finite differences. Analysis of discretized equations; order of accuracy, convergence. (von Neumann analysis), Stability.

9 Hours

Unit III

Compressible Flow

Euler equations, conservative/non-conservative form. ther-modynamics of compressible flow, scalar conservations laws: Conservation, weak solutions, non-uniqueness, entropy conditions. Shock formation. Rankine-Hugoniot relations.

9 Hours

Unit IV

Finite Volume and Finite Difference Methods

Laplace equation on arbitrary grids, equivalence with finite-differences, linear systems: Gauss-Seidel as smothers for multi-grid. Staggered grid/volume formulation + BC. Unsteady equations: projection and MAC method, discrete Poisson pressure equation.. Steady equations: distributive iteration and SIMPLE methods, Time step restrictions.

9 Hours

Unit V

Turbulence models

Turbulence, and time averaged Navier Stokes Equation, Algebraic Models – One equation model, K - ε Models, K-W model, Algebraic stress model, Reynolds stress equation model, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes. Application of CFD in bioreactors and fermenters, Effect of Turbulence.

9 Hours

Total: 45 Hours

References:

J.C Tannehill, D. Anderson and R Pletche, *Computational Fluid Mechanics and Heat Transfer*. Taylor and Francis, Tata McGraw-Hill Edition, New Delhi, India, 2002

J. Randall and Leveque, *Finite Volume Method for Hyperbolic Problems* Cambridge University Press, 2002

K.A Hoffman and S. Chiang, *Computational fluid dynamics for scientists and engineers*, Tata McGraw-Hill Edition, New Delhi, India, 2001

13BT56 MEDICINAL CHEMISTRY

3 0 0 3

Course Objectives (COs)

- To enable the student to gain an understanding of classification of drugs, Synthesis, physico-chemical properties and characterization to become as medical/pharmaceutical professionals
- To correlate the chemical structures with bioactivities
- To study the solubility, modes and metabolic actions of typical drugs and their chemistry of toxicities.

Course Learning Outcome (CLO)

a. Graduates will be familiar with fundamentals of various science and technology subjects and thus acquire the capability of applying them.
b. Graduates will be applying the basic concepts to design & conduct the experiments and analyze & interpret the data.
c. Graduates will demonstrate their ability to solve societal problems via biotechnological approaches
i. Graduates will have strong foundation for entering into higher education programmes

Programme Outcomes (POs)

1. Drug synthesis and its evaluation
2. Theoretical skills to predict therapeutic effect of molecules
3. Research on medicinal chemistry
4. Prescribing a drug for specific function

Unit I

Drug Design & Structure-Activity

Introduction to medicinal chemistry. Drug designing, discovery of lead structure (different approaches). Classification of drugs on the basis of sources, structure, site and mode of action. Drug receptor interaction, structure activity relationship, physico chemical properties and structural features of drugs. Drug metabolism, inactive and biologically active metabolites, chemically reactive metabolites, phase I and phase II reactions, Chemistry of infectious diseases.

9 Hours

Unit II

Analgesic, Antipyretics and local anaesthetics

Paracetamol, salicylic acid analogues, quinolines derivatives pyrazolone and pyrazolodines, N-arylanthranilic acids, aryl and heteroaryl acetic acid derivatives. Local anaesthetic :Benzoic acid

derivatives, lidocaine derivatives (anilides), amino benzoic acid, Procaine, lignocaine, eucaine, cocaine and benzociane.

9 Hours

Unit III

Cardiovascular Agents and Nervous system depressants

Cardiovascular Agents: Antianginal agents and vasodilators, antiarrhythmic drugs, antihypertensive agents, angiotensin-converting enzyme inhibitors, antihyperlipidemic agents, anticoagulants. Depressents: General and inhalation anesthtics, barbiturates, cyclopropane, halothane, nitrous oxide, chloroform, thiopental sodium, ketmaine, methohexital, thioamylal sodium, fantanyl citrate, tribromo ethanol. Anxiolytics, sedative, hypnotics, such as benzodiazepines, barbiturates, paraldehyde, glutethimide, and chloral hydrate. Alcohols .

9 Hours

Unit IV

Anti-convulsants , Central Nervous System stimulants and diuretics

Anti-convulsants: Barbiturates, hydantoins, oxazolidinediones, succinimides, benzodiazepines.CNS depressants with Skeletal Muscle Relaxant Properties**.** Stimulants: Analeptics, picrotoxin, methylxanthines, monoamine oxidase inhibitors, tricyclic compounds. Indolethylamines, 2-phenylehylamines. Diuretics :Carbonic anhydrase inhibitors, thiazide, high ceiling or loop diuretics, potassium sparing diuretics and miscellaneous compounds such as mercaptomerin, meralluride, Thiazides, sprironolactone, theophylline, furosemide, acetazolamide, ethacrynic acid, Triametrene.

9 Hours

Unit V

Anti-Neoplastic and anti tubercular Agents

Anti-Neoplastic Agents: Alkylating agents, antimetabolites, antibiotics, plant products, hormones, fluorouracil, actinomycenes, anthracyclines, vincristine, tamoxifen. Anti Tubercular Agents: Ethambutol, isonicotinic acid, hydrazid, rifempacin, thioguanine, cytarabine.
5-fluorouracil, dicarbazine, cycloserine, streptomycin.

9 Hours
Total: 45 Hours

References:

1. E. Wolf, *B"urger's Medicinal Chemistry and Drug Discovery*, New York: Wiley-Inter Science, 2003
2. O. F. William, T. L. Lemke, and D. A. William, *Principles of Medicinal Chemistry, Williams & Wilkins*, 1995
3. Wilson and Gisvold, *Textbook of Organic Medicinal and Pharmaceutical Chemistry*, Philadelphia PA: Lippincott-Raven Publisher, 1998
4. G. L. Patrick, *An Introduction to Medicinal Chemistry*, New York: Oxford University Press Inc., 1995

13BT57 ADVANCED IMMUNOTECHNIQUES

3 0 0 3

Course Objectives (COs):

- To study the isolation and quantification of various immune cells and quantify them
- To know different techniques available to study the antigen antibody reactions
- To understand the application of immunological techniques in healthcare studies

Course Learning Outcome (CLO):

- Isolation and purification of complement components
- Knowledge of quantification of immune cells
- Understanding the concepts and various applications of immunotechniques

Program Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
(i) Graduate will develop confidence for self education and ability for life-long learning.

Unit I

Isolation of Complement Components

Isolation of complement component C3 from Human Plasma and its and Purification by Double-immunodiffusion Assay; Assays for Membrane Complement Receptors- Rosette Assay of Neutrophils, Monocytes and Lymphocytes in Suspension; Isolation and Functional Assay of the Membrane Complement, Inhibitors -CD55 (DAF) and CD59 (MIRL).

9 Hours

Unit II

Monoclonal Antibodies and Diagnostics

ELISA; Agglutination tests; Plaque Forming Cell Assay; Radioimmunoassay; Purification of IgG; Synthesis and Use of Multiple Antigen Peptide (MAP) Systems, Identification of Antigenic Determinants using Synthetic Peptide Combinatorial Libraries.

9 Hours

Unit III

Engineering Immune Molecules and Receptors

Bacteriophage Library Construction and Selection of Recombinant Antibodies; Binding of Biotinylated Peptides to MHC Class II Proteins on Cell Surfaces; Measurement of MHC/Peptide Interactions by Gel Filtration and Spin Column Filtration Assay; Affinity-Based, Biosensors for Biomolecular Interaction Analysis.

9 Hours

Unit IV

Isolation and Quantification of Cells

Isolation and purification of mononuclear cells; Enrichment and Fractionation of T and B Lymphocytes by Cell Sorting; Induction and Measurement of Cytotoxic T Lymphocyte Activity; and HLA tetramer staining; Morphological and Flow Cytometric Assays for Apoptosis, Stem cell transplantation technology using Haematopoietic Stem Cell.

9 Hours

Unit V

Immunochemical Techniques

Immunochemical techniques and its applications in Medical Diagnosis: Detection of - parent compounds in blood and tissues, metabolites in excreta; DNA and protein adducts; hormonal disorders; serum concentrations of CA 50, Tumor markers in blood, urine and tissues.

9 Hours
Total: 45 Hours

References:

1. J.E. Coligan, *Current Protocols in Immunology*, Vol.1-5, Wiley Inter Sciences, 2010
2. I.Roitt, J. Brostoff and D. Male, *Immunology*, Edition 6, Mosby, 2001
3. Nigam.A and Ayyagari.A, *Lab Manual in Biochemistry, Immunology and Biotechnology*, Tata Mc Graw- Hill Publishing Company Ltd., 2007

13BT58 CONCEPT OF OMICS

3 0 0 3

Course Objectives (COs)

- To introduce students about the major techniques used in sequence assembly
- To understand the basic principle in the instrumentation in proteomics and genomics
- To give students an application based knowledge on various proteomics tools.

Course Learning Outcome (CLO)

- To prepare deep knowledge in the various omics
- To facilitate the student with overall knowledge on different omics technology
- To prepare students to interpret omics data

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(c) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

(i) Graduate will develop confidence for self education and ability for life-long learning.

Unit I

Introduction to Genomes, Transcriptomes, Proteomes

Introduction to genomes, transcriptomes and proteomes; Organisation and structure of genomes, the science of genomics, DNA sequencing methods [Sanger (chain-terminator or dideoxy method), Maxam-Gilbert (chemical method), modifications of chain-terminator method, automated sequencing, capillary array sequencing, basecalling], High -throughput sequencing.

9 Hours

Unit II

Proteomics - 1

Methods to separate proteins; Expression proteomics – including 2-D electrophoresis (sample prep, isoelectric focusing, second dimension electrophoresis, detection of protein spots, image analysis, spot handling, spot cutting, protein cleavage methods), mass spectrometry, ionization, ion separation, MALDI-TOF, tandem mass spec, protein ID by database search, Peptide mass fingerprinting.

9 Hours

Unit III

Proteomics - 2

Product ion sequence data, de novo sequencing, 2D-MS, LC-MS/MS, and quantitative proteomics; Automation in proteomics, proteomics tools, applications of proteome analysis (drug development and toxicology, phosphorylation site analysis, glycobiology, mapping of protein-protein interactions), protein chips and microarrays, Bridging the gap between genomics and proteomic.

9 Hours

Unit IV

Genome Mapping and Sequencing

Genetic Mapping [DNA markers for sequencing (RFLPs, SNPs), linkage analysis], Physical Mapping (restriction mapping, FISH, STS mapping, Polymorphic sequence-tagged sites,), whole genome sequencing, shotgun sequencing, sequence assembly methods, Human Genome Project, the use of PCR in sequencing and its limitations, randomly amplified polymorphic DNA (RAPD), AFLP, SAGE, TOGA, hybridization mapping, cytogenetic maps, Integration of mapping methods.

9 Hours

Unit V

Functional Genomics

Genome annotation (case study of annotation of the *Saccharomyces cervesiae* genome sequence), studying the transcriptome, metabolome and biological systems, comparative genomics, protein structural genomics, global expression profiling, mutant libraries, applications of genome analysis and genomics (genetic diseases, pharmacogenomics, bacterial pathogenecity. Impact on agriculture.

9 Hours
Total: 45 Hours

References

1. T.A .Brown, *Genomes 3*, Garland Science, 2007
2. S.B Primrose and R.M Twyman,*Principles of Genome Analysis and Genomics*, , Blackwell Publishing Co., 2005
3. R Westermeier and T. Naven, *Proteomics in Practice: A Laboratory Manual of Proteome Analysis*, , Wiley-VCH, 2002
4. S. R Pennington, and M.J. Dunn, *Proteomics: from Protein Sequence to Function First*,India: Viva Books Private Limited, 2002

13BT59 BIOPROCESS MODELING AND SIMULATION

3 0 0 3

Course Objectives (COs)

- To understand various bioprocess models
- Imparts optimization of bioprocess systems
- To study the simulation of bioprocess models *invitro*

Course Learning Outcomes (CLO)

- To increase the productivity through fermentation process
- To gain knowledge on various models of bioreactor.
- To have knowledge about MATLAB

Programme Outcome (POs)

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

Unit I
Introduction and Balance Equations
Material and energy balance, General form of dynamic models, dimensionless models. General form of linear systems of equations, nonlinear function. Laplace Transform.

9 Hours

Unit II
State Space Models for Linear and Nonlinear Models
Solution of general state-space form. Solving homogeneous, linear ODEs with distinct and repeated Eigenvalues. Solving non-homogeneous equation, equation with time varying parameters, Routh stability criterion, Microprocessor based controllers and distributed controls.

9 Hours

Unit III
Transfer Function
Analysis of first order system, self regulating processes, lead-lag models, transfer function analysis of higher order systems, pole location, Pade approximation for dead time, converting transfer function model to state space form, State space representation of physical systems.

9 Hours

Unit IV
Block Diagrams
System in series, pole-zero cancellation, block in parallel, Feedback system, Routh stability criterion for transfer functions. Discrete time models and parameter estimation. Phase plane analysis, nonlinear system,

Nonlinear dynamics, cobweb diagram, bifurcation and orbit diagram, stability, cascade of period doubling. Bifurcation behavior of single ODR system and two state systems. Lorenz equation and stability analysis. Chaos in chemical systems, Function technique.

9 Hours

Unit V

Dynamic Models

Related to linear regression and generalization of linear regression technique. Stirred tank heaters: developing the dynamic model, steady state condition. State space model. Adsorption: dynamic model, steady state analysis. Isothermal continuous stirred tank chemical reactors, Biochemical reactors: model equations, steady-state function, dynamic behavior, linearization, phase plane analysis, multiple steady state, bifurcation behavior, Digital computer simulation of control system.

9 Hours

Total: 45 Hours

References:

1. L. William Luyben, *Process Modeling simulation and Control for Chemical Engineers*, McGraw-Hill publishing company, 2001
2. Coughanowr and Koppel, *Process system analysis and control*, McGraw-Hill publishing company", 2001
3. Mickley, Sherwood and REED, *Applied mathematics in chemical engineering*, McGraw-Hill publishing company, 1998
4. George Stephanopoulos, *Chemical process control: an introduction to theory and practice*, Prentice-Hall of India Private Ltd, 2000

13BT60 TRANSGENIC ANIMAL BIOTECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To understand the latest developments in transgenic animal biotechnology.
- To familiarize student about the various techniques to make transgenic animal.
- To motivate and facilitate student to undertake the project and research work in transgenic animal biotechnology.

Course Learning Outcome (CLO)

- At the end of the course students will develop the interest to work on transgenic animals.
- Students will have strong foundation for entering into higher education programme.

Programme Outcomes (POs)

(b) Graduates will be applying the basic concepts to design & conduct the experiments and analyze & interpret the data.
(c) Graduates will demonstrate their ability to solve societal problems via biotechnological approaches.
(f) Graduates will demonstrate knowledge of professional and ethical responsibilities.

Unit I

Introduction to Transgenics

Concept of transgenics; Methods of gene transfer and their limitations- microinjection, retrovirus infection, embryonic stem cell, electroporation; Suitable promoters for expression of transgenes; Eukaryotic expression vectors, Detection of transgenes in the new born.

9 Hours

Unit II

Assisted Reproductive Biotechnology

History and importance of assisted reproductive biotechnology in transgenic animals; Micromanipulation techniques and instrumentation; Embryo splitting, embryo sexing by different methods; Methodology of super ovulation and in vitro fertilization, Risks and prevention methods in embryo culture.

9 Hours

Unit III

Animal Cloning

Principles of animal cloning; Application of transgenic and cloning technologies for improvement of livestock; Production of transgenic livestock by nuclear transfer and its application; Characterization and applications of embryonic stem cells in transgenesis, Gene knockout technology.

9 Hours

Unit IV

Benefits and Conservation

Transgenic animal as bioreactor; Application of transgenic animals in agriculture, medicine and industries; Conservation of endangered animals; Animal germplasm conservation, Cryopreservation techniques.

9 Hours

Unit V

Animal Welfare and Ethics

Animal right and welfare; Social, ethical, religious, environmental and other regulatory issues related transgenic animal technology, Guidelines for ethical conduct in the care and use of Animals.

9 Hours

Total: 45 Hours

References:

1. T. Richard, *Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies*, Earth scan Publications Ltd., 2010.
2. U. Satyanarayana, *Biotechnology*, India: Books and Allied (P) Ltd., 2008.
3. M. M. Ranga, *Animal Biotechnology*, India: Agrobios India Limited, 2007
4. B. D. Singh, *Text Book of Biotechnology*, India: Kalyani Publishers, 2007.
5. I. Gordon, *Reproductive Techniques in Farm Animals*. CABI, 2005.
6. P. J. H. Ball & A. R. Peter, *Reproduction in Cattle*, Blackwell, 2004.
7. I. Gordon, *Laboratory Production of Cattle Embryos*, CABI, 2003

10BT61 GENETIC ENGINEERING OF CROP PLANTS

3 0 0 3

Course Objectives (COs)

- To study the genetical organization of plant cell
- To know the A Biotic and Biotic Resistance and Nitrogen Fixation
- To learn the Recent Advancements in Plant Bio Technology

Course Learning Outcome (CLO)

- At the end of the course students will develop the interest to work on genetically modified plants.
- Students will have strong foundation for entering into higher education programme.

Programme Outcomes (POs)

(b) Graduates will be applying the basic concepts to design & conduct the experiments and analyze & interpret the data.
(c) Graduates will demonstrate their ability to solve societal problems via biotechnological approaches.
(f) Graduates will demonstrate knowledge of professional and ethical responsibilities.

Unit I

Organization of Genetic Material

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences, Outline of transcription and translation.

9 Hours

Unit II

Chloroplast and Mitochondria

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome and cytoplasmic male sterility, Import of proteins.

9 Hours

Unit III

A Biotic and Biotic Resistance and Nitrogen Fixation

Plant Diseases resistant abiotic, salt tolerance, drought tolerance, Temperature, Frost resistance. Biotic Resistance; Insect, Pest, fungus, viral, bacterial etc., Biological nitrogen fixation nif, nod genes, biofertilizers. Plant traits improve, agronomic traits, production traits increase iron, vitamin, mineral, delaying ripening. Antisense, ribosome technology Nitrogenase activity, Nod genes, nif genes, bacteroids.

9 Hours

Unit IV

Agro Bacterium and Viral Vectors

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral vectors and its benefits. Plasmid Ti and Ri plasmid, Yeast, Bactriophages (M13, yPhage), Basic features of vectors for plant transformation: Binary and cointegrate vector. In-plata, Chloroplast, mitochondrial, Gemini viruses, Califlower mosaic virus, Tobauo virus.

9 Hours

Unit V

Recent Advancements in Plant Bio Technology

Plant Growth Regulators and applications Culture types Suspension culture, protoplast culture, somatic hybrid, cybrid, Somoclonal variation. Plant regeneration. Meristem culture, Anther culture, Ovary culture. Role of tissue in crop improvement (plasticity and totipotency) Plant culture media different types of media: MS, B5 & WPM.Transgenic plants, herbicide and pest resistant plants, molecular pharming. Therapeutic products.

9 Hours

Total: 45 Hours

References:

1. O.L. Gamburg and G.C. Philips, *Plant Tissue and Organ Culture fundamental Methods*, Narosa Publications, 1995
2. B.D. Singh, *Text Book of Biotechnology*, Kalyani Publishers. 1998
3. H.W. Heldt, *Plant Biochemistry & Molecular Biology*, Oxford University Press, 1997
4. S. Ignacimuthu, *Applied Plant Biotechnology*, Tata Mc Graw-Hill, 1996

13BT62 ENZYME TECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To learn enzyme kinetics to practice in applied enzyme technology and determination of kinetic parameters, immobilized enzyme technology, enzyme in non-aqueous solvents for finding a place in bioprocess industries.
- To design an enzyme bioreactor for process scale-up, various industrial applications of enzymes, techniques of engineering enzymes etc
- To study the Biosemiconductor & Enzyme based sensing gadgetry

Course Learning Outcome (CLO)

- Study of Enzyme activity and its kinetics
- Immobilization of enzymes for the production of industrially important product
- Engineering the structural and functional aspects of enzymes for improving bio catalytic activity

Programme Outcomes (POs)

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

Unit I

General Kinetics and biocatalysis with different enzymes

General Enzyme kinetics with soluble and insoluble substrates. Catalysis with Lipase, amidase/aminopeptidase, Acylase, Hydantoinase, lyases, Oxidoreductase, Nitrilase, Epoxide hydrolase, Hydroxylase, Aldolases, Decarboxylase.

9 Hours

Unit II

Immobilized Enzyme kinetics

Enzyme immobilization, immobilized enzyme stability and activity, thermal deactivation of immobilized enzyme, electrostatic and steric effects on kinetics on porous and non-porous solid support (neutral and charged matrix), mass transfer and intraparticle diffusion, film and pore diffusion effects on kinetics of immobilized enzyme; simultaneous film and intraparticle mass transfer resistant effects on kinetics, partitioning effect, formulation of dimensionless groups and calculation of effectiveness factors, immobilized enzyme reactors- general design and operation, reactor type and performance-mass transfer and related effects, heat transfer, temperature effects, operating strategy, multi enzyme systems, cost estimates.

9 Hours

Unit III

Enzymes in organic and ionic liquids & Engineering of enzymes

Various organic solvents and ionic liquids used in biocatalysis; potential of biocatalysis in organic solvents and ionic solvents; random and rational approach of engineering of enzymes; directed evolution and its applications in the field of biocatalysis; various approaches of creating variant enzyme molecules, Future of biocatalysis.

9 Hours

Unit IV

Industrial Applications of Enzymes

Commercially important enzymes and their production from natural sources, plant and microbe derived enzymes, detailed commercial applications of enzymes in food, pharmaceutical, textile, leather, and other industries with specific examples; enzymes for diagnostic applications; use of enzymes in analysis, enzyme inhibitors in drug design. Production of an enzyme using Yeast, General enzyme purification methods. Waste treatment by enzymes in Enzyme technology.

9 Hours

Unit V

Enzyme based sensing-gadgetry

Types of sensing-gadgetry and methods. Case studies - chiral conversion, esterification; theory and applications of various enzyme electrodes and their design, enzyme bio-sensors-classification, design, fabrication, Enzyme biosensors for environmental monitoring, function and applications of enzyme membranes, Biochips /bio-semiconductors and their applications.

9 Hours

Total: 45 Hours

References:

1. J. Rehm and G. Reed, *Enzyme Technology*, Vol. 7a, VCH-Verlag, 2000
2. J. E. Bailey and D. F. Ollis, *Biochemical Engineering Fundamentals*, New York: McGraw Hill, 1986
3. A. Wiseman, *Enzyme Biotechnology*, New York: Ellis Horwood Pub., 1995
4. N. C. Price and L. Stevens, *Fundamentals of Enzymobiology*, USA: Oxford University Press, 2000
5. Subash Chand, *Video course on Enzyme Science and Engineering*, IIT, New Delhi, 1999
6. Z. Sestak, *Advances in Biochemical Engineering/Biotechnology*, Volume 10, 1-26, Springer Berlin/Heidelberg , (General design and operation of enzyme bioreactors), 1978
7. L.S. Michael and F.F. Kargi, *Biopeocess Engineering, Basic concepts*, Prentice Hall India, 2008
8. Chaplin & Bucke, *Enzyme Technology*, Cambridge: Cambridge University Press, 1990

13BT63 RESEARCH METHODOLOGY

3 0 0 3

Course Objectives (COs)

- To understand the concept of research and inculcate research bent of mind
- To plan the work with appropriate methodologies to attain the objective
- To equip the students with good presentation skills

Course Learning Outcome (CLO)

- To prepare specific research plan, design, interpretation of results and report writing
- To facilitate the work for publications
- To write research proposals for funding agencies

Programme Outcomes (POs)

(e) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(f) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(g) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(g) Graduate will be able to communicate effectively in both verbal and written form.

Unit I

Introduction

Meaning of Research; Objectives and Motivation in Research; Types, approaches and Significance of Research; Research Methods versus Methodology; Research and Scientific Method; Importance of Research; Research Process; Criteria of good Research, Problems Encountered by Researches in India.

9 Hours

Unit II

Defining the Research Problem

Research Problem; selecting the problem; Necessity of defining the Problem; Techniques Involved in Defining a Problem; preparation of research proposals, Funding agencies.

9Hours

Unit III

Research Design

Research Design; Need for Research Design; Features of a good Design; Important Concepts Relating to Research Design; Types of Research Design; Basic Principles of Experimental Designs, Developing a Research Plan.

9 Hours

Unit IV

Data Collection Methods and Statistical Analysis

Sampling-systematic sampling, stratified sampling, cluster sampling, Area and multistage sampling, sampling with probability, sequential sampling; Data collection-by observation, personal interviews, telephone interviews, mailing questionnaires, schedule; Processing and analysis of data: Processing operations - editing, coding, classification, tabulation; Statistical analysis – ANOVA, SPSS

9 Hours

Unit V

Interpretation and Report Writing

Interpretation; Technique and precaution in Interpretation; Significance of Report Writing; Different Steps in Writing Report; Layout of the Research Report; Types of Reports; Oral Presentation, Mechanics and precautions for Writing Research Reports.

9 Hours

Total: 45 Hours

References:

1. C.R. Kothari, *Research Methods and Techniques,* Willey Eastern, New Delhi, 1990
2. L.H. Kidder, *Research methods in social relations,* Hall Saunders International, Japan, 1981

3. A.M. Sedhu and A.Singh, *Research Methodology in Social Science*, Himalaya Publishing House, Mumbai, 1998

10BT64 METABOLIC ENGINEERING

3 0 0 3

Course Objectives (CO)

- To study the metabolic pathways and its fluxes
- To understand the material balance and data consistency
- To get trained in Software analysis of metabolic products and its pathways

Course Learning Outcome (CLO)

- To understand the concepts of cellular metabolic pathways
- To acquire knowledge on metabolic analysis

Programme Outcomes (POs)

(a) Graduates will demonstrate an ability to identify, formulate and solve metabolic problems.

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret various metabolic pathways.

(c) Graduates will demonstrate an ability to design a metabolic network system

Unit 1

Review of Cellular Metabolism

Overview of cellular metabolism, transport processes, glycolysis, fermentative pathways, biosynthetic reactions, polymerization, cellular energetics.

9 Hours

Unit II

Metabolic Flux Analysis

Theory, over-determined systems, underdetermined systems, linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.

9 Hours

Unit III

Material Balance and Data Consistency

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.

9 Hours

Unit IV

Metabolic Control Analysis

Fundamentals of Metabolic Control Analysis (MCA), control coefficients and summation theorems, determination of flux control coefficients, MCA of linear pathways, branched pathways, Theory of large deviations.

9 Hours

Unit V

Analysis of Metabolic Networks

Control of flux distribution at a single branch point, grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests, Experimental validation.

9 Hours

Total: 45 Hours

References:

1. G.N.N. Stephanopoulos, G. Jens Nielsen, A.A. Stephanopoulos and J.N. Aristidou, *Metabolic Engineering: Principles and Methodologies,* Elsevier Science & Technology Books, 1998
2. S.Y. Lee and E.T. Papoutsakis, *Metabolic Engineering,* Marcel Dekker Inc., 1999

13BT65 ADVANCED BIOSTATISTICS

3 0 0 3

Course Objectives (COs)

- To design biological experiments, especially in medicine and agriculture; the collection, summarization, and analysis of data from those experiments; and the interpretation of results.
- To provide knowledge on correlation and numerical methods to solve higher order problems in much simpler ways.

Course Learning Outcome (CLO)

(a) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications

Programme Outcomes (POs)

- To perform differential equations and integrations
- To measure of fluid flow in pipes

Unit I

Matrices and Calculus

Elementary and column operations, Inverse matrix, Rank matrix, Normal form, Gaussian elimination method. Linear transform, Eigen values and Eigen vectors. Properties, Cayley-Hamilton theorem. Technique of differentiation & integration - simple function.

9 Hours

Unit II

Probability Theory

Review of set theory, review of counting, introduction to probability, theorem on total probability. Baye's theorem. (Baye's rule. Discrete and continuous probability distributions, exception. Moments and moment generating functions. Chebyshev's theorm. Binomial distribution, Poisson distribution, continuous uniform distribution, normal distribution. Sampling distribution, – Application of SPSS techniques in statistics

9 Hours

Unit III

Hypothesis Testing

Point estimation, interval estimation, Baye's estimation, test of hypothesis, (TOH), TOH concerning mean, (Large sample), TOH concerning two means, TOH concerning ones mean, (small sample), small sample test concerning difference between two means, small sample test concerning differences between two means, paired sample test, TOH one proportion, (large and small samples). TOH two proportions.

9 Hours

Unit IV

Curve fitting, Correlation and Regression

Curve fitting by method of least squares, regression analysis, inferences based on least squares estimation, curvilinear (or non linear), regression, curve fitting by sum of exponentials, linear weight age least square approximation, correlation analysis, rank correlation.

9 Hours

Unit V

Numerical Analysis

Roots of transcendental equations (bisection, Regular Falsi and Newton-Raphson methods, finite differences, interpolation, Lagrange's interpolation, inverse interpolation by Lagrange's interpolation, divided differences, Newton's divide differences formula

9 Hours

Total: 45 Hours

References:

1. Ramana. BV, *Higher Engineering Mathematics*, Tata McGraw-Hill, 2007
2. Steve Selvin, *Biostatistics: How it Works*, Pearson Education, 2005
3. Jerrold H Zar, *Biostatistical Analysis*, Pearson Education, 1999
4. Sundar Rao PSS and Richard J, An *Introduction to Biostatistics and Research Methods*, Prentice Hall of India Pvt Ltd., New Delhi, 2006
5. Singiresu S Rao, *Applied Numerical Methods for Engineers and Scientists*, Tata McGraw-Hill 2002

13BT66 BIOPROCESS ECONOMICS AND PLANT DESIGN

3 0 0 3

Course Objectives (COs)

To understand the design consideration for industrial equipments and its utilities for bioproducts
To study the concept in cost estimation, Depreciation and Taxes.
To know the capital requirement and cost investment for purchasing any industrial equipments**.**

Course Learning Outcome (CLO)

- To acquire the knowledge of design consderation
- To elucidate about cost estimation foe a process plant..
- To facilitate the detailed design criteria for bioprocess equipments..

Programme Outcomes (POs)

(a)Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
(b) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(c) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.
(d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Unit I

General Design Consideration

Selection and specification of major equipment used in bioprocess industries; Utilities for biotechnology production plants; Process economics; Safety considerations; Case studies. Marketability of the product ,availability of technology, raw materials, equipment and utilities, human resources, land and utilities, site characteristics, waste disposal, govt, regulation and legal restrictions, community factors and other factors affecting investment and production cost, Bioprocess validation

9 Hours

Unit II

Bioprocess Plant Design and Development:

Technical feasibility survey, process development. Review of mass and energy balance concepts. Development of the flow sheet and its description. Piping and instrumentation diagrams. Detailed design of the following equipments: Double pipe heat exchanger, shell and tube heat exchanger, distillation columns, storage tanks, fermenter, Driers.

9 Hours

Unit III

Cost Estimation

Capital investment: fixed capital investment including land, building, equipments and utilities, installation cost, working capital investment. Manufacturing cost: Direct production cost, fixed charges .Plant overheads: Administration, safety, and auxiliary services, payroll warehouse storage facilities etc. Profitability Analysis : return on original investment, interest rate of return, Accounting for uncertainty and variations and future developments.

9 Hours

Unit IV

Depreciation and Taxes

Equivalence and cost comparisons : Time value of money and equivalence , Equations that are used in economic analysed , Compound interest as an operator. Depreciations and taxes : Nature of depreciations, Methods for determining depreciation, Taxes and depreciation method : Comparison of depreciation methods, Cost comparison after taxes, Present worth after taxes three continuous interest and discounting,ogic for continuous interest, Continuous interest as an operator.

9 Hours

Unit V

Capital requirement and Investment

Capital requirements and cost of production for process plants: Equipment for process plants, cost index, Nelson refinery construction index, Material cost indices, Process equipment cost index , Material cost indices , Process equipment cost index, Labour cost index - equipment costs , Williams six-tenths factor. Capital investments: Fixed capital investment and working capital, Estimation of capital investment, direct cost and indirect costs. Cost factors in capital investment: Cost and installation of purchased equipment, insulation costs, Instrumentation and controls, Piping, Electric installation, Building, Yard improvements.

9 Hours

Total: 45 Hours

References:

1. Peters and Timmerhaus, *Plant Design and Economics for Chemical Engineers*, McGraw-Hill, 2001
2. G .S .Davies, *Process Engineering Economics*, CEED III Madras
3. Rudd and Watson, *Strategy of Process Engineering*, Willey, 2000
4. Aries and Newton, *Chemical Engineering Cost Estimation*, McGraw-Hill 2000
5. Schweyer, *Process Engineering Economics*, Academic Press, 2001

13BT67 TISSUE ENGINEERING

3 0 0 3

Course Objectives (COs)

- To understand the cell culture systems and bioreactors for engineered tissues
- To familiarize different cell culture techniques and delivery systems
- To study the effect and applications of engineered cell cultures

Course Learning Outcome (CLO)

- To make bioreactors, engineered tissues for various human applications.

Programme Outcomes (POs)

a. Graduates will be familiar with fundamentals of various science and technology subjects and thus acquire the capability of applying them.
c. Graduates will demonstrate their ability to solve societal problems via biotechnological approaches.
i.Graduates will have strong foundation for entering into higher education programmes

Unit I

Introductory considerations

Cell culture; primary cultures; cell quantification; bioreactors for cell cultures; Growth factors and signals for tissue engineering; extra cellular matrix (ECM) (structure, function and applications); Cell adhesion and

cell migration; Regulatory issues concerning tissue engineering.

9 Hours

Unit II

Specific Cell culture techniques

Epithelial cell culture (cornea, pancreatic islets); Mesenchymal cell culture (cardiac cells, bone)

9 Hours

Unit III

Stem Cell Culture

Importance and unique properties of stem cells; Similarities and differences between embryonic and adult stem cells; Pluripotent stem cells: Mouse Cell Embryoid body; Hematopoietic stem cells & lymphoid stems cells; Induced pluripotent stem cells; Potential uses of human stem cells and the obstacles that must be overcome before these potential uses will be realized.

9 Hours

Unit IV

Cell delivery vehicles

Definition & purpose of delivery vehicles; Types of vehicles and comparative performance; Natural polymers: Collagen, albumin, chitosan; Microbial polymers: Polyhydroxy-alkanoates; Synthetic polymers: alginate hydrogels; Microencapsulation: agarose and agarose PSSa microbeads.

9 Hours

Unit V

Applied technologies

Polymeric scaffolds for tissue engineering applications; Biomimetic materials; Nanocomposite scaffolds; Drug delivery in Tissue engineering; Animal models for the evaluation of orthopedic implants; Breast reconstruction; Vascular grafts; Blood cell substitutes.

9 Hours

Total: 45 Hours

References:

1. A. Atala and R.P. Lanza (Eds), *Methods of Tissue Engineering*, Academic Press, 2002
2. J.P.Fisher, A.G.Mikos and J.D.Bronzino, *Tissue Engineering*, CRC Press, 2007
3. http://www.isscr.org/public: Stem cell information for the public from the International Society for Stem Cell Research (ISSCR)
4. http://www.nlm.nih.gov/medlineplus/stemcells.html: Medline Plus is a consumer health database that includes news, health resources, clinical trials, and more
5. http://www.explorestemcells.co.uk: A United Kingdom-based resource for the general public that discusses the use of stem cells in medical treatments and therapies

13BT68 BIOMATERIALS

3 0 0 3

Course Objectives (COs)

- To know the classification of biomaterial, their bulk and surface properties and characterization to prepare the students to find a place in biomedical field
- To learn the various biological responses to the materials and biomechanics
- To have an exposure on the clinical context of their use, manufacturing processes and testing, cost, sterilization, packaging and regulatory issues.

Course Learning Outcome (CLO)

- To select biomaterial for organ replacement and temporary body implant
- Design, analytical, problem solving, technical judgement skills

Programme Outcomes (POs)

a. Graduates will be familiar with fundamentals of various science and technology subjects and thus acquire the capability of applying them.
d. Graduates will demonstrate their ability to solve societal problems via biotechnological approaches.
i. Graduates will have strong foundation for entering into higher education programmes

Unit I

Introduction and Classification

Introduction and classifications; Metals: different types, properties and interaction with the tissue, Polymers: classification and properties, Ceramics: Types, properties and interactions with the tissue, Composites: matrix and reinforcing agents/fillers and properties, Cell adhesion, host- tissue reactions. Tissue derived biomaterials**:** Structure and properties of collagen and collagen-rich tissues, Biotechnology of collagen, design of resorbable collagen-based medical implants soft.

9 Hours

Unit II

Bulk and Surface Characterization

Bulk Characterization: XRD, FT-IR, SEM, energy dispersive X-ray (EDX), DSC, TGA, dielectric analyis (DEA); Surface analysis: XPS, SIMS, AES, surface enhances Raman spectroscopy (SERS), AFM/STM; Structural properties of tissues-bone, teeth and elastic tissues, Effects of sterilization on material properties.

9 Hours

Unit III

Testing

Biocompatibility: blood and tissue compatibility; degradation of biomaterials in biological environment, toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests; In vitro and In vivo testing, implant associated infections, biocompatibility enhancement using carona discharge and plasma processes, surface coatings; Ethical considerations, good manufacturing practice, standards, Regulatory issues.

9 Hours

Unit IV

Tissue Replacement Implants with biomaterials

Tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, Joint replacements.

9 Hours

Unit V

Artificial organs with biomaterials

Artificial heart, prosthetic cardiac valves, limb prosthesis, externally powered limb prosthesis, Dental implants.

9 Hours
Total: 45 Hours

References:

1. D. Shi , Ed., *Biomaterials and Tissue Engineering*, Berlin, New York: Springer, 2004.
2. B. Joon Park, D.B. Joseph and Boca Ration, *Biomaterials: principles and applications*, CRC, press, 2003.
3. L. Hench and J. Jones, *Biomaterials, Artificial Organs and Tissue Engineering*, Woodhead Publishing in Materials, 2002.
4. Kay C. Dee, David A. Puleo and Rena Bizios, *An Introduction to Tissue-Biomaterial Interactions*, John wiley, 2002.
5. Ratner, B. D., et al, (eds.), *Biomaterials Science: An Introduction to Materials in Medicine*, Academic Press, 2004
6. Saltzman *W M, Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues*, Oxford University Press, 2004.

13BT69 BIOFERTILIZERS AND BIOPESTICIDES

3 0 0 3

Course Objectives (COs)

- To understand the types and mechanisms of fertilizers
- Formulation and production of biofertilizers
- Production, formulation and study of regulations of biopesticides

Course Learning Outcome (CLO)

- To formulate fertilizer based on the soil to supply plant nutrients essential for the growth of plants
- To facilitate the production of biofertilizer in large scale
- To develop biofungicides and biopesticides for effective microbial action on disease control

Programme Outcomes (POs)

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
(f) Graduates will demonstrate knowledge of professional and ethical responsibilities.
(h) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Introduction to Biofertilizers

Definition, Classification of fertilizers (synthetic fertilizers & natural fertilizers), Organic Fertilizers, Advantages of Biofertilisers over synthetic fertilizers, Microbial inoculants in Agriculture - contributions of microorganisms to soil fertility, Rhizosphere concept.

9 Hours

Unit II

Biofertilizer Types

Different groups of biofertilizers - bacterial, fungal and algal biofertilizers; Phosphorus Biofertilisers - Rock phosphate solubilisation; Phosphorus mobilization – mycorrhiza -types– endo, ectomycorrhiza and orchidaceous mycorrhiza, Microbial solubilisation of silicates and zinc. Plant growth promoting rhizobacteria. Problems and prospects of biofertilizers. BSI standards of biofertilizers, Economics of biofertilizers.

9 Hours

Unit III

Commercial Production of Biofertilisers

Principles of Mass production - growth characteristics - Fermentation- Principles and techniques - inoculum preparation. Large-scale production of bacterial biofertilizers, *Azolla*- Blue green algae, VAM fungi and Ectomycorrhiza; Field performance of biofertilizers - method of application; Carrier materials - Types and quality characteristics of an ideal carrier. preparation of inoculant packets - Shelf life, Quality control of biofertilizers.

9 Hours

Unit IV

Introduction to Biopesticides

Biopesticides - present status and future prospects; biofungicides - commercial development of biofungicides, microbial action for disease control, bioinsectides - neem and related natural products, commercialization of neem products; Bt: natural and recombinant bioinsecticide products, Bt transgenic plants; Baculoviruses for insect pest control, recombinant Baculo viruses, Mycoherbicides.

9 Hours

Unit V

Biopesticides - Registration and management protocols

Pesticide policy influences on biopesticides technologies; environmental and regulatory aspects: industry view and approach; formulations of biopesticides; delivery systems and protocols for biopesticides; analysis, monitoring and some regulatory implications; principles of dose acquisition for bioinsecticides; strategies for resistance management.

Total: 45 Hours

References:

1. S.Kannaiyan , *Biotechnology of Biofertilizer*, Narosa Publishing House, 2002.
2. R.H.Franklin and J.M.Julius, *Biopesticides - Use and Delivery.* Humana Press Inc., 1999.
3. S.S.Purohit, *Agricultural Biotechnology,* Agrobios India, 2003.
4. P.S.Nutman, *Symbiotic nitrogen fixation in plants,* Cambridge Univ. Press, London, 1976.
5. N.S.Subba Rao, *Advances in Agricultural Microbiology*, Oxford and IBH, Publn. Co., New Delhi, 1982.

13BT70 AGRO INDUSTRIAL BIOTECHNOLOGY

3 0 0 3

Course Objectives (COs)

- To study the genetical organization of plant cell
- To know the A Biotic and Biotic Resistance and Nitrogen Fixation
- To learn the Recent Advancements in Plant Bio Technology

Course Learning Outcome (CLO)

- To understand the mechanism of nitrogen fiation
- To acquire knowledge on molecular markers assisted plant breeding

Programme Outcomes (POs)

(d) Graduates will demonstrate an ability produce the plant through tissue culture
(e) Graduate will demonstrate an ability to produce a bioic and biotic resistance plants
(f) Graduates will demonstrate an ability perform the genome mapping .

Unit I

Recent Advancements in Plant Bio Technology

Plant Growth Regulators and applications Culture types Suspension culture, protoplast culture, somatic hybrid, cybrid, Somoclonal variation. Plant regeneration. Meristem culture, Anther culture, Ovary culture. Role of tissue in crop improvement (plasticity and totipotency) Plant culture media different types of media: MS, B5 & WPM.Transgenic plants, herbicide and pest resistant plants, molecular pharming, Therapeutic products

9 Hours

Unit II

A Biotic and Biotic Resistance and Nitrogen Fixation

Plant Diseases resistant abiotic, salt tolerance, drought tolerance, Temperature, Frost resistance. Biotic Resistance; Insect, Pest, fungus, viral, bacterial etc., Biological nitrogen fixation nif, nod genes, biofertilizers. Plant traits improve, agronomic traits, production traits increase iron, vitamin, mineral, delaying ripening. Antisense, ribosome technology, Nitrogenase activity, nod genes, nif genes, bacteroids.

9 Hours

Unit III

Agro Bacterium and Viral Vectors

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral vectors and its benefits. Plasmid Ti and Ri plasmid, Yeast, Bactriophages (M13, yPhage), Basic features of vectors for plant transformation: Binary and cointegrate vector. In-plata, Chloroplast, mitochondrial, Gemini viruses, Califlower mosaic virus, Tobauo virus.

9 Hours

Unit IV

Organization & Molecular dissection of different genomes

Nuclear, Chloroplast and Mitochondrial Organization of genome – molecular markers for genome analysis – Types of molecular markers protein markers – isozyme marker – DNA markers – PCR based markers –STS markers – Microsatellite markers, New generation markers.

9 Hours

Unit V

Methods of sequencing

Genome mapping – Genetic map construction – physical map development - DNA contigs – cosmids, YAC, BAC, MAC, PAC libraries. Chromosome walking – Map based cloning – Microarray technology – application. Application of molecular marker in characterization of plant genetic resources – choice of molecular marker for germplasm characterization - markers used in genetic resource management. Finger printing of fungi, insects and other organisms- Tagging of economic importance using molecular markers, MAS – success story.

9 Hours

Total: 45 Hours

References:

1. O.L. Gamburg and G.C. Philips, *Plant Tissue and Organ Culture fundamental Methods*, Narosa Publications, 1995
2. B.D. Singh, *Text Book of Biotechnology*, Kalyani Publishers. 1998
3. H.W. Heldt, *Plant Biochemistry & Molecular Biology*, Oxford University Press, 1997
4. S. Ignacimuthu, *Applied Plant Biotechnology*, Tata Mc Graw-Hill, 1996

10BT71 PRINCIPLES OF BIOMEDICAL ENGINEERING

3 0 0 3

Course Objectives (CO)

- To provide an exposure to basic biology and engineering problems associated with living systems and health care delivery for equipping the students to find a place in medical field
- To introduce about biopotential electrodes, biomedical instruments, blood flow and respiratory measurements, medical imaging.
- To learn the critical factors affecting the development and success of clinical treatments and life science products.

Course Learning Outcome (CLO)

- To understand the concepts of various recording systems used in diagnostic tools
- To acquire knowledge on biological parameters & biomedical instrumentation

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret various biological parameters.

(c) Graduates will demonstrate an ability to design a instrumental system

Unit I

Biopotential electrodes

Electrode electrolyte interface, half cell potential, polarization and non polarisable electrode, calomel electrode, needle and wire electrode, Micro electrode – metal micro pipette.

9 Hours

Unit II

Recording system

Low noise pre amplifier, main amplifier and driver amplifier, ink jet recorder, thermal array recorder, photographic recorder, magnetic tape recorder, X – Y recorder, medical oscilloscope, ECG, EMG, EEG. PCG, EOG-lead system and recording methods typical wave forms, frequency spectrums, abnormal wave form, Evoked response.

9 Hours

Unit III

Blood flow and biochemical measurement

pH, pO_2, pCo_2, $pHCo_3$, electro phoresis, calorimeter, spectro photometer, flame photometer, auto analyzer. Electro magnetic and ultra sonic blood flow meter, indicator dilution method, thermo dilution method manual and automatic counting of RBC, WBC and platelets.

9 Hours

Unit IV

Non Electrical Parameter and Respiratory Measurements

Respiration, Heart rate, temperature, pulse blood pressure, cardiac output, O_2, CO_2 measurements, spirometer, BMR apparatus.

9 Hours

Unit V

Modern Imaging Systems

X-Ray machines and computer Tomography – magnetic resonance imaging systems – basic NMR components – ultrasonic imaging systems – medical thermography – electron microscopy – blood gas analysers, Computer application in medical field.

9 Hours

Total: 45 Hours

References:

1. Leslie Cromwell, *Bio medical instrumentation and measurement*, Prentice Hall of India, New Delhi 2003
2. R.S. Khandpur, *Hand book of Bio-Medical Instrumentation*, TMH Publication, New Delhi 2005
3. J.G. Webster., *Medical Instrumentation application and design*, John Wiley and sons, New York, 1999
4. A. Richard, *Principle of Bio- Instrumentation*, John Wiley and sons, New York, 1988

13BT72 ADVANCED CANCER BIOLOGY

3 0 0 3

Course Objectives (COs):

- To develop fundamental concepts of cancer identification, etiology and epidemiology.
- To know the signaling pathways and their relation to cancer
- To understand the cellular and molecular basis of current strategies for cancer prevention and treatment.

Course Learning Outcome (CLO):

- To understand the cellular mechanisms and cell cycle
- To acquire knowledge on molecular aspects of Cancer

Programme Outcomes (POs):

(g) Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

(h) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(i) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

Unit I

Introduction to Cancer Biology

Regulation of cell cycle; mutations that cause changes in signal molecules; Apoptosis and caspases; Cancer Epidemiology; Chemical and Radiation Carcinogenesis

9 Hours

Unit II

Molecular Aspects of Cancer

Signal targets and cancer; activation of kinases; Oncogenes; detection of oncogenes; retroviruses and oncogenes; Oncogenes/proto oncogene activity; Tumor Suppressor Genes; Growth factors related to

transformation.

9 Hours

Unit III

Metastasis & Angiogenesis

Three step theory of invasion; basement membrane disruption; metastatic cascade; Angiogenesis; Tumor Progression and Metastasis; Cell Proliferation and Cell Death.

9 Hours

Unit IV

Cancer Management

Different forms of therapy- chemotherapy; radiation therapy; immuno therapy- engineered monoclonal antibodies and vaccines; use of signal targets towards therapy of cancer; Gene therapy; pharmacology of Antineoplastic agents.

9 Hours

Unit V

Cancer markers and its Detection

Diagnostic Tests; Detection using biochemical assays; tumor markers; ideal markers; risk markers; diagnostic markers; prediction of aggressiveness of cancer; molecular tools for early diagnosis of cancer; Hormones and cancer; Immune system and cancer.

9 Hours
Total: 45 Hours

References:

1. M.R. Alison, *The cancer handbook,* Nature publishing groups, 2003
2. R. W. Ruddon, *Cancer Biology*, Oxford University Press**,** 2007
3. S. Pelengaris and M. Khan, *The Molecular Biology of Cancer*, John Wiley & Sons Inc., Publishers, 2009
4. B.Pardee and G. Stein, *The Biology and Treatment of Cancer*, John Wiley & Sons Inc., Publishers, 2009
5. J. Gabriel, *The Biology of Cancer*, 2nd Edition, John Wiley & Sons Inc., Publishers, 2007

13BT73 MOLECULAR MODELING AND DRUG DESIGN

3 0 0 3

Course Objectives (COs)

- Familiarise the basic concepts of computational/theoretical chemistry/biology for drug design Provide a back ground on modeling tools and docking programme for predicting the three-dimensional structure of biomolecules
- Give an understanding of how drugs interact with macromolecules and strategies used in designing novel drugs and prodrugs

Course Learning Outcome (CLO)

1. Theoretical and software skills to model biomolecules
2. Ability to design new molecules with therapeutic values
3. Can engineer biomolecules by modification
4. Can identify lead molecules in drug design

Programme Outcomes (POs)

a. Graduates will be familiar with fundamentals of various science and technology subjects and thus acquire the capability of applying them.

b. Graduates will be applying the basic concepts to design & conduct the experiments and analyze & interpret the data.

g. Graduates will be equipped with knowledge and skills necessary for entry-level placement in both Biotechnologyas well as Software concerns.

i. Graduates will have strong foundation for entering into higher education programmes

Unit I

Introduction and Molecular Mechanics

Introduction to Molecular Modelling. Areas of application – Single molecule calculation, assemblies of molecules. Reaction of the moleculesDrawbacks of mechanical models as compared to graphical models. Co-ordinate systems two – matrix, potential energy surface.The molecular potential energy function, Computer hardware and software.

9 Hours

Unit II

Force fields and Molecular dynamics

The empirical force field. Sources of force field data. Some examples of important force fields (OPLS AMBER , solvation models- Water models, Condensed-phase calculations (DGhydration) Poisson-Boltzmann Surface Area (PBSA)Generalized Born Surface Area (GBSA) Bond stretch, bend, torsional angles, and non-bonded interactions). Conformational analysis . Molecular dynamic simulation using simple and continuous potential methods. Monte carlo simulations, Molecular modeling software: BIOSUITE

9 Hours

Unit III

Quantum Mechanics

Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional theory calculations, molecular size versus accuracy. Approximate molecular orbital theories, energy minimization, Global optimization, calculation of thermodynamic parameters.

9 Hours

Unit IV

Drug Design

Analog Based : Introduction to QSAR. lead module, linear and nonlinear modeled equations, biological activities, physicochemical parameter and molecular descriptors, molecular modelling in drug discover. **Structure Based :** 3D pharmacophores, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. Further applications on the design of new molecules 3D data base searching and virtual screening, conformational flexibility, Sources of data, molecular similarity and similarity searching, Combinatorial libraries–generation and utility.

9 Hours

Unit V

Prodrug Design

Introduction, chemical bond, gastro intestinal absorption, parenteral administration, distribution, transdermal absorption, pharmacokinetic and biopharmaceutical aspects, Rationale of prodrug design and practical considerations.

9 Hours
Total: 45 Hours

References:

1. Andrew R. Leach, *Molecular Modelling, Principles and Applications*, Pearson, Prentice Hall, 2001
2. Burkert U and Allinger NL, *Molecular Mechanics*, ACS Monograph 177. Washington D.C., American Chemical Society, 1982
3. McCammon J A. and Harvey S C, *Dynamics of Proteins and Nucleic Acids*, Cambridge University Press, 1987
4. Hans Pieter H and Folkens G, *Molecular Modelling* , VCH, 1999
5. Claude Cohen. N, *Guide book on molecular modeling in drug design Synergix drug design*, Israel,1996
6. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.

13BT74 ENVIRONMENTAL SCIENCE AND TECHNOLOGY

3 0 0 3

Course Objectives(CO)

- To gain deep knowledge on the environmental adaptation of soil organisms.
- To acquaint the problems of industrial wastes and its treatment using bioreactors.
- To enlist the problems faced due to hazardous wastes and biotechnological applications for its eradication.

Course Learning Outcome (CLO)

- To understand the concepts of various aspects of environmental science.
- To acquire knowledge on treatment methods of environmental issues.

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret various environmental problems.

(c) Graduates will demonstrate an ability to design a methodology to tackle environmental issues.

Unit I

Introduction

Microbial flora of soil, growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms. Environmental monitoring – sampling, physical,chemical and biological analysis, Monitoring of pollution.

9 Hours

Unit II

Biological wastewater treatment methods

Waste water characteristics, The activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, nitrification, secondary treatment using a trickling biological filter, anaerobic digestion, mathematical modeling of anerobic digestor dynamics, anaerobic denitrification, Phosphate removal.

9Hours

Unit III

Bioremediation

Introduction to Bioremediation, Types of Bioremediation, Bioremediation of surface soil and sludges, Bioremediation of subsurface material, In situ technologies, Ex-situ technologies, Phytoremediation, Bioaugmentation of naturally occurring microbial activities; Environmental modification - use of co-substrates, oxygen supplementation, Composting and aerobic bioreactors, in situ aeration.

9 Hours

Unit IV

Treatment of industrial wastes

Dairy, Pulp, Dye, Leather,Hospital and Pharmaceutical industrial waste treatment and management, Solid waste management.

9 Hours

Unit V

Harzdous waste management

Introduction - Hazardous wastes-biodegradation of Hazardous wastes - biological detoxification of cyanide - market for hazardous waste management-biotechnology applications to hazardous waste management - Source and Management Safety.

9 Hours

Total: 45 Hours

References:

1. M. Wainwright, *An Introduction to Environmental Biotechnology*, 1999
2. K. H. Baker and D.S. Herson, *Bioremediation.* Inc.New York: McGraw Hill, 1994
3. S. S. Gray, R. Fox and W. James, *Blackburn Environmental Biotechnology for Waste Treatment*, New York: Plenum Press, 1991

4. C. F. Foster and D. A. John Ware, *Environmental Biotechnology*, Ellis Horwood Ltd., 1987
5. B. E. Rittmann, E. Seagren, B. A. Wrenn and A. J. Valocchi, C. Ray and L. Raskin, *Insitu Bioremediation*, U.S.A.: Nayes Publ., 1994

13BT75 PILOT PLANT MODELS AND SCALE UP METHODS

3 0 0 3

Course Objectives (COs)

- To impart knowledge in scaleup methods for industrial plant.
- To study the recent advancement in process industries.
- To know the advanced techniques in scaleup..

Course Learning Outcome (CLO)

- To acquire the knowledge of process in plant.
- To analyze various parameters to be monitored and controlled for scaleup.
- To facilitate the application of scale up process in biotech industries.

Programme Outcomes (POs)

(b) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(c) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

(d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

UNIT-I

Introduction

Description and evolution of a process system, Fundamental principles of mathematical modeling, Dimensional analysis, Homogeneous reactor scale-up, Process flow sheet.

9 Hours

UNIT-II

Reactors for Fluid Phase Processes Catalyzed by Solids

Pseudo-homogeneous and heterogeneous models, Two-dimensional models, Scale up considerations. Fluid-fluid Reactors**:** Scale-up considerations in packed bed absorbers and, Applicability of models to scale-up, Scale-up. for bubble columns.

9 Hours

UNIT-III

Mixing Processes

Scale- up relationships, Scale- up of polymerization units, continuous stages gas-liquid slurry processes, Fluidized Beds**:** Major scale-up issue's, Prediction of performance in large equipment, Practical commercial experience, Problem areas, Liquid-liquid emulsions.

9 Hours

UNIT-IV

Continuous Mass Transfer Process

Fundamental considerations, Scale-up procedure for distillation, absorption, and extraction units, Stripping.

9 Hours

UNIT-V

Solid-Liquid Separation Processes

Fundamental considerations, Small scale studies for equipment design and selection, Scale- up techniques, Uncertainties, Leaching.

9 Hours

Total: 45 Hours

References:

1. A Bisio,. and Kabel, R.L., Scale up of Chemical Processes, John Wiley (2000)
2. Johnstone, R. E. and Thring, M. W., Pilot Plants, Models and Scale-up Methods in Chemical Engineering, McGraw-Hill (2000).
3. Johnstone, Robert E ,Pilot Plants, Models, and Scale-up Methods in Chemical Engineering, ACS Publication,2001

13BT76 UNIX Operating System and Programming Language C++

3 0 0 3

Course Objectives (COs)

- To understand the basics of Unix operating system and search engines
- To learn about the kernels and file formatting
- To learn C programming languages

Course Learning Outcome (CLO)

- To prepare deep knowledge in the various algorithms
- To prepare the students to learn different algorithms
- To facilitate the student with overall knowledge about Insilico techniques

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
(i) Graduate will develop confidence for self education and ability for life-long learning.

UNIT - I

Introduction

Unix utilities –1 : Introduction to unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, cp, mv, ln, rm, unlink, mkdir, rmdir, du, df, mount, umount, find, unmask, ulimit, ps, who, w, finger, arp, ftp, telnet, rlogin.

9 Hours

UNIT - II

Unix Text

Unix utilities –2:Text processing utilities and backup utilities , detailed commands to be covered are cat, tail, head , sort, nl, uniq, grep, egrep,fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, tar, cpio.

9 Hours

UNIT - III

Commands

Problem solving approaches in Unix : Using single commands, using compound. Commands, shell scripts, C programs, building own command library of programs.

9 Hours

UNIT - IV

Shell Programming

Working with the Bourne shell : What is a shell, shell responsibilities, pipes and input Redirection, output redirection, here documents, the shell as a programming language, shell meta characters, shell variables, shell commands, the environment, control structures, shell script examples.

9 Hours

UNIT - V

Unix Kernals

Unix Internals - 1 : Unix file structure, directories, files and devices, System calls, library functions,low level file access, usage of open, creat, read, write, close, lseek, stat, fstat,ioctl, umask, dup and dup2, the standard i/o (fopen, fopen, fclose,fflush, fseek, fgetc, getc, getchar, fputc, putc, putchar, fgets, gets), formatted I/O, stream errors, streams and file descriptors, file and directory maintenance (chmod, chown, unlink, link, symlink, mkdir, rmdir, chdir, getcwd), Directory handling system calls (opendir, readdir, closedir,rewinddir, seekdir, telldir).

9 Hours
Total: 45 Hours

References:

1. Unix the ultimate guide, Sumitabha Das, TMH.
2. Unix Network Programming, W.R.Stevens Pearson/PHI.
3. Advanced programming in the Unix environment, W.R.Stevens, Pearson education.
4. Unix system programming using C++, T.Chan, PHI.
5. Unix programming environment, Kernighan and Pike, PHI. / Pearson Education

13BT77 BIOSENSORS AND MICROBIAL FUEL CELLS

3 0 0 3

Course Objectives(COs)

- To understand the principle, operations and classification of biosensors
- To introduce transducers and physiological property measurement using biosensor
- To espouse the science and engineering by application of biosensors in various fields
- At the end of the course the students may be able to fabricate biosensors for various applications

Course Learning Outcome (CLOs)

- To make the students understand the components of biosensor and microbial fuel
- The students may be able to design and fabricate laboratory type biosensors and microbial fuel cells.
- To know operational principles of biosensor and microbial fuel cell and their applications in various fields.

Programme Outcome (POs)

(b) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(c) Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

(d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

Unit I

Electrochemistry and Biosensor Classification

Electrochemistry – single electrode potential- Nernst equation – Tafel plot – Electrical components – DC and AC circuits – Operational amplifiers and functions – Classification and components of Biosensor - Advantages and limitations.

9 Hours

Unit II

Operation of Biosensors

Various types of transducers - principle and applications, enzyme field effect transistor (ENFET), Biocatalysis based biosensors, Types of enzyme electrodes; Biochips and biosensor arrays; Problems and limitations

9 Hours

Unit III

Bioselective layers

Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers); Membrane receptors and transporters; Immunoreceptors; Chemoreceptors; Methods for application of bioselective layers in desired patterns- pin-based spotting, ink-jet dispensing, and microstamp printing, slf assembled layers.

9 Hours

Unit IV

Biosensor Engineering and Applications

Applications: Test-strips for glucose monitoring; Clark electrode, Urea and cholesterol determination; Implantable sensors for long-term monitoring; Drug development and detection; Industrial on-line monitoring, Environmental monitoring; Technological process control and electronic industries.

9 Hours

Unit V

Microbial fuel cells

Introduction, microbial population, feed-stock(fuels), voltage and power generation, MFC materials (electrodes-reference, working and counter, membranes, saltbridge), architecture and fabrication, Electrochemistry of MFC, mechanism of electron transfer, current-voltage and current- potential characteristics, Stacked MFC, BOD sensor

9 Hours

Total: 45 Hours

References

1. D.G. Buerk, "*Biosensors: Theory and Applications"*, pp. 1-18. Technomic, Lancaster, U.K. 1993.
2. Jon Cooper and Tony cass *"Biosensors"* Second edition, Oxford university press, 2004.
3. Ursula Spichiger-Keller, "*Chemical Sensors and Biosensors for Medical and Biological Applications*", Wiley-VCH. 1998.
4. Skoog D A, Holler F J, Nieman A Timorthy, "Principles of Instrumental analysis", Latest edition, Thomson Brooks/cole

13BT78 BIOMATERIALS AND TISSUE ENGINEERING

3 0 0 3

Course Objectives(COs)

- To understand the basic properties of biomaterials and their biocompatibility
- To expose the students on the biomaterials used for body implants and tissue engineering
- To understand the various scaffolds and cell delivery vehicles used in tissue engineering
- At the end of the course the students may be able to understand the principle behind the fabrication of biomaterials for body implants and tissue engineering.

Course Learning Outcome (CLOs)

- The students acquire the knowledge on biomaterials and their use in tissue engineering and body implants
- To make the students understand the properties of biomaterials and their biocompatibility
- The students may be able to select a biomaterials for specific body implants.

Programme Outcome (POs)

e) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
f) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
i) Graduates will have strong foundation for entering into higher education programmes.

Unit I

Biomaterias- Overview & Classification

Biomaterials: Definition, Classification: Polymers , metals and alloys, ceramics (biosorbable and bio active) and composites, migration of additives- Hydrophobic and hydrophilic.

9 Hours

Unit II

Characteristic Properties of biomaterials

Mechanical properties of implants-(tensile, wears , fatique, fracture toughness etc) in-vivo and invitro, corrosion studies, structure–property relations, property improvements. Polymers filled with osteogenic fillers (e.g.hydroxyapatite). Effects of physiological fluid on the properties. Surface, physical and chemical properties of materials.

9 Hours

Unit III

Bulk and Surface Characterization

Structure of solids and solid imperfections. Characterization of biomaterials. Bulk & Surface analysis- XRD, FTIR, TGA, AFM/STM. Structural properties of tissues- Bone, Teeth, Elastic tissues. Ethylene oxide, gamma radiation, Standards in biomaterials - Product development and regulations

9 Hours

Unit IV

Biomechanics

Biomechanics - Principles of mechanics, viscoelasticity, generalized theory of elasticity, creep-recovery, stress relaxation, strain rate sensitivity, aging and environmental stress cracking, mechanics of soft and hard tissues, kinematics of human motion, forces and stress of human joints, mechanics of hips, knee, other joints & spine.

9Hours

Unit V

Tissue Engineering

Introduction, Hard tissue replacement implant: , Orthopedic implants, (Hip, Knee, etc.), Dental implants- Adhesives and Sealants, Soft tissue replacement implant, skin implants, Burn (wound) dressings /Synthetic Skin, Scaffolds, Heart valve implants- . Artificial Kidneys & Livers, Hydrogels as Stimuli-sensitive biomaterials.

9Hours

Total: 45 Hours

References

1. Ratner, Hoffman, and Schoen, Lemons. , Biomaterials Science – An Introduction to Materials in Medicine, Academic Press 1996
2. Yannas, I. V., Tissue and Organ Regeneration in Adults, New York: Springer. 2001
3. Sharma C.P., and Szycher, M. , Blood compatible materials and devices, Technomic Publishing Co. Ltd. 1991
4. John P. Fisher, J.P., Mikos, A.G., and Bronzino, J. D. , Tissue Engineering, CRC Press,2007

13BT79 SYSTEMS BIOLOGY

3 0 0 3

Course Objectives (COs)

- To understand the basics of systems biology
- To learn about the detailed concepts and methods in systems biology
- To learn its application in biotechnology.

Course Learning Outcome (CLO)

- At the end of the course, students will develop complete idea on Systems Biology.
- Students will have strong foundation for entering into higher education programme.

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(d) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
(i) Graduates will have strong foundation for entering into higher education programmes.

Unit I

Fundamentals of Systems Biology

Basic concepts in systems biology, Why mathematical models, Fundamentals of mathematical modelling, Biological networks and its representations, Mathematics for metabolic modelling, Databases and tools for systems biology

9 Hours

Unit II

Metabolic networks

Principles of metabolism, Metabolic networks, Basic elements of metabolic modelling, Constraint-based modelling using linear/quadratic programming, Kinetic modelling using ODEs, Parameter estimation, Metabolic Flux Analysis, Systems Biology Markup Language (SBML)

9 Hours

Unit III

Signalling networks

Protein-protein interaction networks, Signalling networks, Static network biology, Analysis of massive complex networks: parameters, centralities and algorithms, Examples: MAP Kinase Cascade, Jak/Stat pathway, Protein interaction maps

9 Hours

Unit IV

Gene regulatory networks

Gene regulatory circuits, Modelling gene regulatory network, Robustness/sensitivity analysis, Discrete modelling of biological systems, Boolean network modelling, Gene Expression Data and Analysis

9 Hours

Unit V

Applications of Systems Biology

Applications of systems-level modelling: metabolic engineering; diseases and drug discovery, Synthetic biology, integrative biology, Pathway Modeling, Perspectives and challenges in systems biology

9 Hours

Total: 45Hours

References

1. Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig, "Systems Biology: A Textbook", Wiley-Vch; 1st ed., 2009
2. Bernhard O. Palsson, "Systems Biology: Properties of Reconstructed Networks", Cambridge University Press; 1 edition, 2006
3. Uri Alon, "An Introduction to Systems Biology: Design Principles of Biological Circuits", Chapman & Hall/CRC, 2007.
4. Andreas Kremling, "Systems Biology: Mathematical Modeling and Model Analysis", Chapman & Hall/CRC, 2013.

13BT80 CELLULAR BIOPHYSICS

Course Objectives (COs)

- To understand the basics of membrane biophysics and molecular electrophysiology
- To learn about the patch clamping technique
- To learn the mechanism involved in activation and inactivation of ion channels

Course Learning Outcome (CLO)

- To prepare deep knowledge in the molecular biophysics
- To prepare students to integrate patch clamp with drug discovery
- To facilitate the student with overall knowledge about molecular electrophysiology

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
(c) Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
(i) Graduate will develop confidence for self education and ability for life-long learning.

Unit I

Background of membrane biophysics

Basic structure and composition of membrane, Structure of ionic channels, The resting membrane potential, Contribution of electrogenic transport to the membrane potential, Donnan equilibrium, GHK, Ion transport system overview.

9Hours

Unit II

Introduction and Basics of Electrophysiology

Ohm's law, diffusion, electric fields, potentials, and charge, I-V curves, rectification, basics of voltage clamp, stochastic processes, The Resting Cell Membrane, whole cell and single channel behavior.

9Hours

Unit III

Ion channel structure and gating function

Common elements organized to make specific function, Protein structure, pore formation, charge field, Control of channel function, voltage activation, ligand activation, signaling, gating kinetics, Ion selectivity

9Hours

Unit IV

Ion channel types and characterization

Channel types, structure, function, same channels in different cell types, Molecular biology in ion channels, Channelopathies

9Hours

Unit V

Neuron synapse, synaptic plasticity

Structure of the synapse, electrochemical transduction, Postsynaptic integration and information processing, cardiac cell-to-cell communication, Gap junction structure, function.

9Hours
Total: 45 Hours

References

1. Antonio Zaza and Michael R. Rosen An Introduction to Cardiac Electrophysiology, Harwood Academic Publishers, 2000.
2. Berul C and Towbin Jeffrey A, Molecular Genetics of Cardiac Electrophysiology, Springer, 2000.
Berti Hille, Ion channel of Excitable Membranes, Sinauer Associates, 3rd edition edition, 2001

13BTR1 PROCESS VALIDATION AND QUALITY MANAGEMENT

3 0 0 3

Course Objectives (COs)

- To consistently produce a result or product meeting its pre-determined specifications
- To promote knowledge creation, together with its disclosure and exploitation, to achieve fair allocation of rights, to reward innovation, and to achieve a broad participation of private and public entities
- The documented evidence that device specifications to conform the user needs and intended use(s)

Course Learning Outcome (CLO)

- To facilitate the industrial process validation
- To understand the process improvement and product testing aspects

Programme Outcomes (POs)

(b) Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

(c) Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

(g) Graduate will be able to communicate effectively in both verbal and written form.

UNIT I

Overview of Process validation

Purpose, scope, order of priority; Retrospective validation, Revalidation.

UNIT II

Prospective Process Validation

Master documentation; critical process steps and quality control steps; analysis of data.

UNIT III

Technology Acquisition and Marketing

Technology absorption and diffusion; knowledge management.

UNIT IV

Product Improvement Strategies

Case studies in food and agricultural industries related to continuous crop/product improvement and estimation of product parameter; new product development strategies.

UNIT V

Quality Engineering and QFD

Quality Function and Deployment systems; Patentable subject matter; TRIPS agreement; Implementation in developing countries.

References

1. Accredited Quality Assurance
2. European Journal of Clinical Microbiology and Infectious Diseases
3. Economic Theory
4. Drug development and Industrial Pharmacy
5. Biotechnology Progress
6. Applied Microbiology and Biotechnology
7. Journal of Technology Transfer