M. Tech. (Biotechnology)

2015 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai
Approved by AICTE - Accredited by NBA New Delhi, NAAC with 'A' Grade and ISO 9001:2008 Certified)
SATHYAMANGALAM – 638 401 Erode District Tamil Nadu
Phone : 04295 226000 Fax : 04295 226666
Web:www.bitsathy.ac.in E-mail : bitsathy@bannari.com

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. The graduates of Biotechnology will acquire the skills in approaching and solving challenges related to healthcare, agriculture and environmental sectors through Biotechnological approaches.

II. The graduates of Biotechnology shall be equipped to develop and deliver novel designs/processes/products that could cater to the industrial demands to improve the social ecosystems.

III. The graduates of Biotechnology will have multidisciplinary skills to become entrepreneurs and contribute for sustained economic growth and generate employment.

IV. The graduates of Biotechnology shall maintain continuous learning to update the latest developments and contribute for sustainable existence of all life forms.

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.

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

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

(g) Graduate will be able to articulate and 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.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcome (s)								
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
I	x	x	x	x	x			x	x
II	x	x	x	x	x			x	
III						x	x	x	x
IV	x	x	x	x	x		x	x	x

M. Tech. Biotechnology (Full Time)

Minimum credits to be earned: 77

First Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
15BT11	Applied Probability and Statistics[ρ]	II	(a), (b), (c)	3	2	0	4
15BT12	Unit Operations in Chemical Engineering	I, II	(a), (c), (i)	3	2	0	4
15BT13	Recombinant DNA Technology	I, II	(b), (c), (d), (f)	3	0	0	3
15BT14	Bioprocess Technology	I, II	(b),(c),(e),(h)	3	0	2	4
15BT15	Agricultural and Food Biotechnology	I, II	(b) (c),(e),(f),(g),(i)	3	0	0	3
	Elective I			3	0	0	3
15BT17	Recombinant DNA Technology Laboratory	II	(e), (f), (g)	0	0	4	2
15BT18	Agricultural and Food Biotechnology Laboratory	II, III	(b), (c), (d), (e)	0	0	4	2
15GE19	Business English - I[α]			1	0	2	2
			Total	**19**	**4**	**12**	**27**

Second Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
15BT21	Research Methodology	I	(a), (b)	3	0	0	3
15BT22	Computational Biology	II	(b), (c), (i)	3	0	2	4
15BT23	Advanced Separation Technology	I, II	(a), (b), (c), (d)	3	0	0	3
15BT24	Biopharmaceutical Technology	I, II	(a), (b), (c), (d)	3	0	0	3
	Elective II			3	0	0	3
	Elective III			3	0	0	3
15BT27	Advanced Separation Technology Laboratory	II	(b), (c), (d), (f)	0	0	4	2
15BT28	Technical Seminar	II	(g)	0	0	2	1
15GE29	Business English - II[α]			1	0	0	1
			Total	**19**	**2**	**6**	**23**

Third Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
	Elective IV			3	0	0	3
	Elective V			3	0	0	3
	Elective VI			3	0	0	3
15BT34	Project Work - Phase I	I, II, III	(b), (c), (e)	-	-	-	6
			Total	**9**	**0**	**0**	**15**

Fourth Semester

Code No.	Course	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
15BT41	Project Work - Phase II	I, II, III	(b), (c), (e)	-	-	-	12
			Total	-	-	-	**12**

[ρ] Common to Industrial Safety and Engineering & Bio Technology

[α] Common to all M.E. / M.Tech. Programmes

M. Tech. Biotechnology (Part Time)

First Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BT11	Applied Probability and Statistics[ρ]	II	(a), (b), (c)	3	2	0	4
15BT12	Unit Operations in Chemical Engineering	I, II	(a), (c), (i)	3	2	0	4
15BT13	Recombinant DNA Technology	I, II	(b),(c),(d),(f)	3	0	0	3
15BT17	Recombinant DNA Technology Laboratory	II	(e), (f), (g)	0	0	4	2
15GE19	Business English - I[α]			1	0	2	2
			Total	**10**	**4**	**6**	**15**
Second Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BT21	Research Methodology	I	(a), (b)	3	0	0	3
15BT22	Computational Biology	II	(b), (c), (i)	3	0	2	4
15BT23	Advanced Separation Technology	I, II	(a),(b),(c),(d)	3	0	0	3
15BT27	Advanced Separation Technology Laboratory	II	(b),(c),(d),(f)	0	0	4	2
15GE29	Business English - II[α]			1	0	0	1
			Total	**10**	**2**	**4**	**13**
Third Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BT14	Bioprocess Technology	I, II	(b),(c),(e),(h)	3	0	2	4
15BT15	Agricultural and Food Biotechnology	I, II	(b), (c), (e), (f), (g),(i)	3	0	0	3
15BT24	Biopharmaceutical Technology	I, II	(a),(b),(c),(d)	3	0	0	3
15BT18	Agricultural and Food Biotechnology Laboratory	II,III	(b),(c),(d),(e)	0	0	4	2
			Total	**9**	**0**	**6**	**12**
Fourth Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
	Elective I			3	0	0	3
	Elective II			3	0	0	3
	Elective III			3	0	0	3
15BT28	Technical Seminar	II	(g)	0	0	2	1
			Total	**9**	**0**	**2**	**10**
Fifth Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
	Elective IV			3	0	0	3
	Elective V			3	0	0	3
	Elective VI			3	0	0	3
15BT34	Project Work - Phase I	I, II, III	(b), (c), (e)	-	-	-	6
			Total	**9**	**0**	**0**	**15**
Sixth Semester							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BT41	Project Work - Phase II	I, II, III	(b), (c), (e)	-			**12**

[ρ] Common to Industrial Safety and Engineering & Bio Technology

[α] Common to all M.E. / M.Tech. Programmes

List of Electives							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BT51	Industrial Microbiology	I, II	(e), (f), (g)	3	0	0	3
15BT52	Microbial Enzyme Technology	I	(a), (b), (c)	3	0	0	3
15BT53	Biomass and Bioenergy	I, II	(b), (c), (e), (h)	3	0	0	3
15BT54	Nanobiotechnology	II	(b), (c), (d)	3	0	0	3
15BT55	Biofertilizers and Biopesticides	II, III	(c), (f), (h)	3	0	0	3
15BT56	Computational Techniques for Bioprocess	II	(b), (c), (d)	3	0	0	3
15BT57	Omics Technology	II	(b), (c), (i)	3	0	0	3
15BT58	Advanced Cancer Biology	II, III	(g), (h), (i)	3	0	0	3
15BT59	Molecular Modeling and Drug Design	I, II	(a), (b), (g), (i)	3	0	0	3
15BT60	Pharmacology	I, II	(a), (b), (c), (d)	3	0	0	3
15BT61	Marine Biotechnology	I, II	(b), (c), (e), (f), (g)	3	0	0	3
15BT62	Biomaterials	I, II	(a), (d), (i)	3	0	0	3
15BT63	Tissue Engineering and Regenerative Medicine	I, III	(a), (c), (i)	3	0	0	3
15BT64	Medical Biotechnology	II	(b), (c)	3	0	0	3
15BT65	Biomedical Engineering	II	(b), (c)	3	0	0	3
15BT66	Environmental Biotechnology	II	(b), (c)	3	0	0	3
15BT67	Systems Biology	I, III	(b), (d), (i)	3	0	0	3
15BT68	Cellular Biophysics	II, III	(b), (c), (i)	3	0	0	3
One Credit Courses							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
15BTXA	Molecular Marker Technologies	II	(e), (f), (g)	1	0	0	1
15BTXB	Translational Research	II	(f), (g), (h), (i)	1	0	0	1
15BTXC	Marine Food Technology	I, II	(b), (c), (e), (f), (g), (i)	1	0	0	1

15BT11 / 15IS11 APPLIED PROBABILITY AND STATISTICS
(Common with Industrial Safety and Engineering & Bio Technology)

3 2 0 4

Course Objectives

- To design biological and industrial 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 sampling techniques to solve problems in an efficient way.

Course Outcomes (COs)

1. Students will demonstrate an ability to identify, formulate and solve engineering problems.
2. Students will demonstrate an ability to design and conduct experiments, analyze and interpret data.
3. Students will demonstrate an ability to design a system, component or process as per needs and specifications

Unit I

Probability

Axioms of probability - Addition and multiplication theorems on probability - Conditional probability - Baye's theorem (problems only) - Random variable: Continuous and discrete random variables - Distribution function - Expectation with properties - Moments, mean, Variance and standard deviation of a random variable.

9 Hours

Unit II

Standard distributions

Discrete distributions: Binomial, Poisson and Geometric - Continuous distributions: Normal, Exponential and Gamma - Simple problems and properties.

9 Hours

Unit III

Two Dimensional random variables

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Regression: properties and problems - Rank correlation - Multiple and Partial Correlations.

9 Hours

Unit IV

Testing of hypothesis

Concepts of sampling - Methods of sampling - Sampling distributions and classifications - Standard Error - Tests of hypothesis: Tests of hypothesis about proportion, mean and their differences - Chi-square distributions: Test of goodness of fit and test of independence of attributes.

9 Hours

Unit V

Design of experiments

Basic principles of experimental designs - Analysis of variance : one-way, Two-way classifications - Latin square design - 2 Factorial Design.

9 Hours

Unit VI[$]

Data collection with two samples for a particular variable in an industry- Setting of hypothesis – Verification of hypothesis – Presentation of the data with results.

Total: 45+30 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Reference(s)

1. Johnson R.A., *Miller & Freund's: ,Probability and Statistics for Engineers* , Pearson Education, 8th Edition, 2013 .
2. Walpole R.E , Myers R.H, Myers R.S.L and Ye K, *Probability and Statistics for Engineers and Scientists* , Pearsons Education, Delhi , 2002.
3. Lipschutz S and Schiller J, Schaum's outline Series: *Introduction to Probability and Statistics*, McGraw Hill Publications, New Delhi, 1998.
4. Gupta S.C and Kapur J. N, *Fundamentals of Mathematical Statistics* , Sultan Chand, NewDelhi 1996.
5. Ross. S , *A first Course in Probability* , 8th Edition, Pearson Education , New Jersey, 2010.

15BT12 UNIT OPERATIONS IN CHEMICAL ENGINEERING

3 2 0 4

Course Objectives

- 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 Outcomes (COs)

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

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 characterization: size , size distribution, shape, specific surface area, flow ability and dustiness, storage and handling of solids and powders.

9 Hours

Unit III

Separation 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

Classification of fluids: non-newtonian fluids, rheological 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.

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

Unit VI[$]

Agitators used in Bioreactor

Types of agitators, flow patterns in agitated vessels, calculation of power consumption, scale up of mixing system, applications in bioreactor design.

Total: 45+30 Hours

Reference(s)

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

15BT13 RECOMBINANT DNA TECHNOLOGY

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

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

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 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.

9 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

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.

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.

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.

9 Hours

Unit VI[$]

Purification of recombinant proteins, Methods of nucleic acid labeling, Genetic markers, FACS, Insertional inactivation, Biosafety regulations applicable to rDNA technology

Total: 45 Hours

Reference(s)

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, 2014
3. Jeremy W. Dale, Malcolm von Schantz, Nicholas Plant, *From genes to genomes: Concepts and applications of DNA technology*, Oxford, UK: Wiley-Blackwell Publishers, 2011
4. Terry Brown, *Gene cloning and DNA analysis*, Oxford, UK: Wiley-Blackwell Publishers, 2015
5. B. D. Singh, *Biotechnology*. India: Kalyani Publishers, 2007
6. P. J. Smith and C. J. Jones, *DNA recombination and repair*. USA: Oxford University Press, 2000
7. J. Sambrook, D. Russell,andD. W. Russell, *Molecular cloning-A laboratory Manual (A set of Volume 1, 2 and 3)*, USA: Cold Spring Harbor Laboratory Press, 2000

15BT14 BIOPROCESS TECHNOLOGY

3 0 2 4

Course Objectives

- 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 Outcomes (COs)

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

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit I

Introduction to Bioreaction engineering

Overview of traditional and modern applications of biotechnological processes, chronological development of fermentation industry, Concepts of Biochemistry, Microbiology and Molecular Biology in bioprocess, Principles of biochemical reactions; Enzymatic and microbial kinetics.

9 Hours

Unit II

Bioreactor Design and Control

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, Various types of bioreactors (Enzyme and microbial reactors); Instrumentation in bioreactors.

9 Hours

Unit III

Media design for fermentation processes

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

9 Hours

Unit IV

Introduction to Biosystem Engineering

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

Unit VI[$]

Process economics-Case studies, Capital cost estimation, operating cost estimation, profitability analysis. Energy conservation and audit in a bioprocess plant.

Laboratory Component:

1. Determination of mixing time and fluid flow behaviour in bioreactor under variety of operating conditions.
2. Comparative studies of Ethanol production using different substrates.
3. Production of microbial products in bioreactors.

Total: 45+30 Hours

Reference(s)

1. P. F. Stanbury and A. Whitaker, Principles of Fermentation Technology (2nd Edition), Butterworth-Heinemann; 2 edition (February 19, 1999)
2. Basic Biotechnology, edited by Colin Ratledge and Bjorn Kristiansen, Cambridge University Press 2003
3. Biochemical Engineering Fundamentals, Bailey, and Ollis, McGraw Hill Book Co.1986.
4. Najafpour, G. D., "Biochemical Engineering and biotechnology", Elsevier, 2007.
5. M.L. Shuler and F. Kargi, *Bioprocess Engineering - Basic Concepts*, Prentice Hall of India, 2008
6. P.M. Doran, *Bioprocess Engineering Principles*, Elsevier, 2006

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT15 AGRICULTURAL AND FOOD BIOTECHNOLOGY

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

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

Unit I

Introduction to Application of Plant Biotechnology

Introduction to plant tissue culture, Culture types: Suspension culture, Protoplast culture, Somatic hybrid, cybrid, somoclonal variation, Plant regeneration: Meristem culture, Anther culture, Ovary culture, Transgenic plants, Herbicides resistant plants, Pest resistance plants, Molecular Pharming.

9 Hours

Unit II

Techniques for Plant Transformation

Agro bacterium-mediated gene transfer; Ti plasmid; Process of T-DNA transfer and integration; Direct gene transfer methods - particle bombardment, PEG mediated transformation, electroporation, silicon carbide fibres; Basic features of vectors for plant transformation - promoters and terminators, selectable markers, reporter genes, resistance to biotic and abiotic stress; resistance to diseases – bacterial, fungal, viral and nematode.

9 Hours

Unit III

Nutritional chemistry and Food Microbiology

Introduction- Basic principles, Nutritional importance of Carbohydrates, Proteins and Lipids; Vitamins-deficiency symptoms;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, Microbes as food; Food borne diseases- food infection.

9 Hours

Unit IV

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 flavor, use of cross-linking enzymes for texture modification, Food coloring agents.

9 Hours

Unit V

Food preservation, Packaging and Quality control

Physical, chemical and biological preservation methods, chemical additives, salting, pickling, smoking, canning, Antimicrobial food preservatives - sorbic acid, benzoic acid, antioxidants - BHA, BHT, Irradiation., Packaging– concepts, definition, significance, classification, Packaging of foods – fresh and processed; Primary packaging materials, methods of packaging - vacuum packaging, MAP, CAP & bio-degradable packages, Food sanitation- training & education for safe methods of handling food; sterilization & disinfection- pest control; Quality control - food quality

,AGMARK, FRO, BIS and PFA; Good laboratory practice (GLP); ISO; Auditing; Good Manufacturing Practice and HACCP.

9 Hours

Unit VI[$]

Water management, Transgenics as bioreactors, Food poisoning. Food coloring agents, Fortification, Application of Plant Biotechnology in Therapeutic products.

Total: 45 Hours

Reference(s)

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

15BT17 RECOMBINANT DNA TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- 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 Outcomes (COs)

1. Learning of PCR technique for gene amplification
2. Knowledge of gene cloning and transformation techniques
3. Analysis of RNA and recombinant proteins

List of Experiments

1. Invitro amplification of desired gene by PCR
2. Purification and ligation of amplified gene
3. Transformation and screening of recombinant
4. Confirmation of cloned gene
5. DNA fingerprinting by molecular marker
6. RNA isolation
7. Recombinant protein expression.
8. Purification of recombinant protein
   Miniproject

Total: 60 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT18 AGRICULTURAL AND FOOD BIOTECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- 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 Outcomes (COs)

1. To make the students to understand the components of bioreactors.
2. To have knowledge about the measurement of parameters used in fermentation process
3. To make them know the applications of bioprocess engineering in production of bio based products.

List of Experiments

1. Isolation, identification of storage microflora from food stuffs/vegetable/fruit
2. Food colorants from microbes and their separation by HPTLC
3. Extraction and estimation of antioxidant in vegetables/fruits/food
4. Extraction and Characterization of Gluten
5. Regeneration via direct organogenesis from different explants
6. Regeneration via indirect organogenesis from different explants.
7. Isolation of plant genomic DNA.
8. Preparation of competent cells of E. coli for harvesting plant transformation vector.
   Mini Project

Total: 60 Hours

15GE19 BUSINESS ENGLISH I

1 0 2 2

Course Objectives

- To acquire skills for using English in workplace effectively.
- To communicate for essential business needs.
- To prepare students for taking BEC Vantage level examination which is an International Benchmark for English language proficiency of Cambridge English Language Assessment (CELA).

Course Outcomes (COs)

1. To enable students to get International recognition for work and study.
2. To use English confidently in the International business environments.
3. To be able to take part in business discussion, read company literature, write formal and informal business correspondences and listen and understand business conversations.

Unit I

GRAMMAR AND VOCABULARY

Comparison of adjectives – forming questions – asking complex questions – expressing purpose and function – tenses – conditionals – time statements – modal verbs – active and passive voice – articles – direct and indirect speech – cause and effect – relative pronouns – expressions followed by – *ing* forms – countable / uncountable – acronyms – marketing terms / vocabulary – financial terms – collocations – discourse markers.

10 Hours

Unit II

LISTENING

Purposes of listening – features of listening texts – potential barriers to listening – specific listening skills – strategies to use when listening– distinguishing relevant from irrelevant

information – gap filling exercise – multiple-choice options – note completion – matching and multiple choice questions – listening for specific information, gist, topic, context and function.

7 Hours

Unit III

SPEAKING

Word and sentence stress – clear individual sounds – turn taking – initiating and responding - intonation patterns – pronunciation – mother tongue intrusion– conversation practice – turn-taking and sustaining the interaction by initiating and responding appropriately.

10 Hours

Unit IV

READING

Purposes of reading – potential barriers to reading – paraphrasing – identifying facts and ideas – skimming and scanning for information – matching statements with texts– spotting reference words – understanding text structure – understanding the ideas in a text – distinguishing between the correct answer and the distractor – understanding cohesion in a text – deciphering contextual meaning of words and phrases – cloze – proof reading - transcoding.

8 Hours

Unit V

WRITING

Paragraphing a text – using appropriate connectives – editing practice –Longer Documents: writing a proposal.

10 Hours

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.

15BT21 RESEARCH METHODOLOGY

3 0 0 3

Course Objectives

- To impart the knowledge on analysis of Research methodology
- The students will be able to estimate the performance of different testing method for research.

Course Outcomes (COs)

1. The Students will be able to analysis the methods used for data collection hypothesis testing and sampling process for research methodology

Unit I

Introduction

Definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps.

Data collection methods - Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data-internal sources of data, external sources of data.

9 Hours

Unit II

Sampling Methods

Scales – measurement, Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement,

stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.

9 Hours

Unit III

Hypotheses Testing

Testing of hypotheses concerning means -one mean and difference between two means -one tailed and two tailed tests, concerning variance – one tailed Chi-square test.

9 Hours

Unit IV

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 V

Interpretation and Report Writing

Interpretation; Techniques and precautions 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

Unit VI[$]

Case Study: apply Research Methodology principles for Project Proposal submission to a funding agency.

Total: 45 Hours

Reference(s)

1. Kothari, C.R., Research Methodology –Methods and techniques, New Age Publications, New Delhi, 2009.
2. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi, 2004.

15BT22 COMPUTATIONAL BIOLOGY

3 0 2 4

Course Objectives

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

Course Outcomes (COs)

1. To prepare deep knowledge in the various algorithms
2. To prepare students to integrate wet lab with Insilico prediction
3. To facilitate the student with overall knowledge about In-silico techniques in biology

Unit I

Algorithms and Programming

Algorithms in Computing; Analyzing algorithms; Algorithm design techniques; Combinatorial Pattern Matching; Genetic Algorithm; Hidden Markov Models; Artificial Neural Networks; Clustering and Trees; Data Mining and
Machine Learning; LINUX Operating System, C, C++, Python, Perl & Bioperl

12 Hours

Unit II

Genomics, proteomics and Structural Biology

Genomics and Metagenomics, Epigenetics - DNA microarray, Microarray and SAGE Databases,

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Comparative genomics – basic concepts and applications, Functional Genomics - Application of sequence based and structure-based approaches to assignment of gene functions, Proteomics - Protein array, bioinformatics-based tools for analysis of proteomics data, Structure determination by X-ray crystallography and NMR spectroscopy.

12Hours

Unit III

Sequence Analysis and Structure Prediction

Data- alignment and applications, Nucleic acid sequence analysis, Protein sequence analysis, Structure Prediction using Molecular Modeling approaches, Homology modeling, Comparative Modeling Threading, Ab-initio Methods, Fragment-based assembly, Molecular Docking, Drug Design concepts - QSAR, 3D pharmacophores**,** Biomolecular Simulations: Molecular Dynamics, Metropolis Monte Carlo

9 Hours

Unit IV

Systems Biology

Overview of System Biology, Simulation of pathways, Networks and Motifs, Signalling & Experimental methods in systems biology, Robustness and optimality in Biology, Design of Circuits and Databases, Synthetic Biology

6 Hours

Unit V

Gene Regulatory Network

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

6 Hours

Unit VI[$]

Database Management Systems, Computational Mass Spectrometry–Based Proteomics, Transmembrane prediction methods, Exception Handling, I/O & JDBC, Multithreading and Communication

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 : Tools for protein structure prediction.
Prediction Annotation : Functional annotation.
Writing utilities using C++, Python and Perl

Total: 45 + 30 Hours

Reference(s)

1. Mount D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor
2. 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. 6. Durbin, R. et al., Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic acids.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT23 ADVANCED SEPARATION TECHNOLOGY

3 0 0 3

Course Objectives

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

Course Outcomes (COs)

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

Unit I

Overview of Bioseparation Processes

Separation 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

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.

9 Hours

Unit IV

Electrophoresis

Separation of proteins using Electrophoresis methods: SDS, pulse reading, separation of binary protein complex using FPLC.

9 Hours

Unit V

Product Purification

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

9 Hours

Unit VI[$]

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.

Total: 45 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Reference(s)

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

15BT24 BIOPHARMACEUTICAL TECHNOLOGY

3 0 0 3

Course Objectives

- To introduce the students about biopharmaceuticals and their resources.
- To impart fundamental knowledge concerning the production and application of biopharmaceuticals.
- To provide essential knowledge for the students to understand the formulation and metabolism of drugs.

Course Outcomes (COs)

1. At the end of this course work, the students would be expected to learn the different types of pharmaceutical dosage forms.
2. On completion of the course, the students would have learnt pharmacokinetic properties of drugs and how to improve drug absorption and Biopharmaceuticals.
3. The course work will provide basic and advanced knowledge in drug delivery methods which will help the student to absorb advanced techniques in their future industry career.

Unit I

Introduction to Pharmaceuticals

History and definition of drugs, sources of drugs - plant, animal and microbes, different dosage forms, routes of drug administration, classification of biopharmaceuticals

9 Hours

Unit II

Biotherapeutics and Production of Biopharmaceuticals

Hematopoietic growth factors, coagulation factors, interferons and cytokines for anti-infective and cancer therapy, enzymes and production of insulin, polyclonal and monoclonal antibodies, recombinant hepatitis B and *Porcilispesti* (veterinary) vaccine.

9 Hours

Unit III

Advancements in Drug Delivery Systems

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

9 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.

9Hours

Unit V

Drug kinetics and Bio pharmaceutics

Mechanism of drug absorption, distribution, metabolism and excretion, pharmacokinetics - compartment models, bioavailability and bioequivalence

9 Hours

Unit VI[$]

Current status and future prospects of biopharmaceuticals, aerosols, transdermals, liposomes, resealed erythrocytes, nucleic acid therapeutics - gene therapy, good manufacturing practices (GMP).

Total: 45 Hours

Reference(s)

1. Leon Shargel and Andrew B.C. Yu, *Applied Biopharmaceutics& Pharmacokinetics*, McGraw-Hill Medical, 2015
2. G. Walsh, *Pharmaceutical Biotechnology: Concepts and Applications*. John Wiley, 2007
3. D.M. Brahmankar and S.B. Jaiswal, *Biopharmaceutics and Pharmacokinetics - A Treatise*. VallabhPrakashan, 2006
4. Remington, *The Science and Practice of Pharmacy (Volume 1 & 2)*. Lippincott Williams & Wilkins, 2005
5. G. Walsh, *Biopharmaceuticals: Biochemistry and Biotechnology*. John Wiley, 2003
6. E.A. Rawlins, Ed., *Bentley's Textbook of Pharmaceutics*. BaillereTindall, 1996

15BT27 ADVANCED SEPARATION TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- To impart the skills in cell disruption, sonication, and homogenizer equipments
- To understand the concept of seed germination and tissue culture media preparation.
- To induce and assist student to learn the techniques involved in explants preparation and callus induction.

Course Outcomes (CO)

1. To make the students to understand the components of bioreactors.
2. To have knowledge about the measurement of parameters used in fermentation process
3. To make them know the applications of bioprocess engineering in production of bio based products.
4. Comparison on different cell disruption techniques.
5. Knowledge on different Chromatographic techniques

List of Experiments

1. Microbial production and downstream processing of an enzyme, e.g. amylase
2. Quantification of protein by cell disruption methods – Homogenizer and Sonication.
3. Construction of bimodal curve in aqueous two phase extraction.
4. Purification of macromolecules using Ion exchange Chromatography.
5. Purification of protein by dialysis.
6. High resolution purification of biological molecules using HPLC.
7. High resolution purification of biological molecules using FPLC.
8. Finishing operation of bio product using freeze drying.
   Miniproject.

Total: 60 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15GE29 BUSINESS ENGLISH II

1 0 0 1

Course Objectives

- To acquire skills for using English in business environment .
- To communicate appropriately in business contexts.
- To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).

Course Outcome (COs)

1. To enable students to acquire business terms for communication.
2. To use English confidently in the business contexts.
3. To be able to take part in business discussion and write formal and informal business correspondences.

Unit I

SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

6 Hours

Unit II

WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

9 Hours

Total: 15 Hours

Reference(s)

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.

15BT51 INDUSTRIAL MICROBIOLOGY

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

1. Ability to select microbes and media and optimize culture conditions
2. Ability to produce various biomolecules of microbial origin
3. Ability to operate fermenters for maximum production of biomass and bioproducts

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; media for industrial fermentation, solid substrate 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 bioleaching process, bioleaching of copper, uranium, biosorption of metals.

9 Hours

Unit V

Biodegradation and Bioremediation

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

9 Hours

Unit VI[$]

Enzymes - sources, types, applications of cellulase, pectinase, xylanase, laccase, amylase, glucose isomerase, SCP, Aminoacids - sources and applications of Methionine, Lysine; commercially important fermentation processes.

Total: 45 Hours

Reference(s)

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, A. Whitaker and S. J. Hall, *Principles of Fermentation Technology,* Butterworth-Heinemann (Elsevier Science), 2005
4. C. Ratledge and B. Kristiansen, *Basic Biotechnology,*CambridgeUniversity Press, 2001

15BT52 MICROBIAL ENZYME TECHNOLOGY

3 0 0 3

Course Objectives

- To learn enzyme reactions and its characteristics along with the production and purification process.
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetic.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions

Course Outcomes (COs)

1. To make the students understand about microbial enzyme technology and its significance in industrial sectors.
2. To impart the skills needed for developing industrial products.
3. To acquire the knowledge of immobilization for improving the product yield and stability.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit I

Microbial Growth

Salient features of growth curve-synchronous and diauxicgrowth, Factors affecting the growth, Measurement of cell numbers; cell mass and metabolic activity, batch and continuous culture, Determination of viable and total number of cells, Measurement of cell size.

9 Hours

Unit II

Microbial Energetics

Stoichiometry of Cell growth and product formation, Sporulation and spore germination in bacteria, Induction and repression of enzymes. Metagenomics for the isolation of genes for novel enzymes,

9 Hours

Unit III

Industrial Enzymes

Microbial sources for industrial enzymes –Amylases, Glucose Isomerase, LAsparaginase, Proteases Renin, Penicillin acylases, Lactases; Pectinases; Lipases and their applications, solid state and submerged fermentations, Recombinant microorganisms for Industrial enzymes, artificial enzymes.

9 Hours

Unit IV

Immobilization of enzymes and cells

Enzyme kinetics- Theories of Enzyme Catalysis, improvement of enzyme activity, stability and selectivity via immobilization techniques, Mass transfer effects in Immobilized Enzyme Systems, Modeling of rate equations for single and multiple substrate reactions., enzyme/cell electrodes-case studies.

9 Hours

Unit V

Enzyme Technology

Bioreactor strategies for maximizing product formation, recovery, stability and formulation of bacterial and fungal enzymes, Effectof pH,temperature and inhibitors on enzyme activity, Molecular weight determination, purity check of the enzyme, Development of enzyme assay by multi locus enzyme electrophoresis.

9 Hours

Unit VI[$]

Role of enzymes in food industry, preparation of purification chart, different types of inhibitors and activators, coenzyme and cofactors, Marker enzymes.

Total: 45 Hours

Reference(s)

1. Industrial microbiology by G. Reed, Publishers: CBS.
2. Scragg.A.H “Bioreactors in Biotechnology”- A Practical approach.
3. Wang D. I. C., Cooney C. L., Demain A. L., Dunnil P., Humphrey A. E., Lilly
4. M. D., Fermentation and Enzyme Technology, John Wiles and Sons., 1980.
5. Enzymesby Trevor palmer Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
6. Shuler, M.L. and Kargi, F. Bioprocess Engineering : Basic concepts, 2nd ed., Prentice-Hall,2002.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

7. Selander RK et al Methods of multilocus enzyme electrophoresis for bacterial population genetics and systematic, Appl Environ Microbiol. 1986 May;51(5):873-84.

13BT53 BIOMASS AND BIOENERGY

3 0 0 3

Course Objectives

- To provide the students a broad insight on converting biomass into bioenergy
- To make students aware of the methods available to generate energy from biomass
- To familiarise the students on the techniques for utilising the available biomass

Course Outcomes (COs)

1. Students will understand the need for biomass conversion
2. Students will develop their skills on utilization of biomass from various sources
3. Students will be analysing the efficiency of bioenergy and the approaches to improve the biomass conversion efficiency

Unit I

Biomass properties and preparation

Biomass Sources and Classification; Chemical composition and properties of different biomass materials and bio-fuels – Sugarcane molasses and other sources for ethanol fermentation; Sources and processing of oils and fats for liquid fuels; Cellulosic Biomass availability and its contents-Lignocellulose as a chemical resource; Energy plantations -Preparation of woody biomass, Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass

9 Hours

Unit II

Bio-Ethanol and Bio-Diesel Technology

Production of Fuel Ethanol by Fermentation of Sugars; Gasohol as a Substitute for Leaded Petrol – Trans Esterification of Oils; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions; Expansion of biodiesel production.

9 Hours

Unit III

Biogas Technology

Feedstock for biogas production; Aqueous wastes containing biodegradable organic matter and animal residues; Microbial and biochemical aspects- Operating parameters for biogas production; Kinetics and mechanism - Dry and wet fermentation; Digesters for rural application - High rate digesters for industrial waste water treatment; KVIC plants and process kinetics

9 Hours

Unit IV

Combustion of Biomass and Cogeneration Systems

Combustion of Woody Biomass; Theory, Calculations and Design of Equipments- Design and operation of Fixed and Fluidized Bed Gasifiers; Combined heat and power generation using biomass; Cogeneration in Biomass Processing Industries; Case Studies-Combustion of Rice Husk, Cogeneration of biomass.

9 Hours

Unit V

Biomass Conversion Technologies

Thermo-chemical and bio-chemical routes; Pyrolysis and Gasification of Biomass; Thermo-chemical conversion of ligno-cellulose biomass; Biomass processing for liquid fuel production; Pyrolysis regime-effect of particle size and temperature

9 Hours

Unit VI[$]

Energy conservation

Process modifications; Carbon credits; Kyoto protocol; Preventing energy loss, Waste utilisation, Energy audit

Total: 45 Hours

Reference(s)

1. A. Chakraverthy, *Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes*, Oxford & IBH publishing Co, 1989.
2. K. M. Mital, *Biogas Systems: Principles and Applications*, New Age International publishers (P) Ltd., 1996.
3. P. VenkataRamana and S. N. Srinivas, *Biomass Energy Systems*, Tata Energy Research Institute, 1996.
4. J. Rezaiyan and N. P. Cheremisinoff, *Gasification Technologies, A Primer for Engineers and Scientists*, Taylor & Francis, 2005
5. D. Aye, N. John, W. Terry, *Biofuels Engineering Process Technology*, McGraw Hill, 1st edition, 2008.

15BT54 NANOBIOTECHNOLOGY

3 0 0 3

Course Objectives

- 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 nano particles.
- To motivate and facilitate student to undertake the project and research work in Nano biotechnology.

Course Outcomes (COs)

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

Unit I

Introduction to Nanotechnology

Physical basis and principles of nanotechnology; Industrial applications of nanoparticles; Implications of nanotechnology for environmental health research.

9 Hours

Unit II

Synthesis and Properties of Nanoparticles

Synthesis of semiconductor quantum dots; Syntheses of water soluble QDs; Optical properties of QDs; Chemical and biological synthesis of silver and gold nanoparticles; Dynamic optical properties of Au and Ag NPs; Synthesis of magnetic nanoparticles; Synthesis of Carbon nanotube; Protein and DNA based nano structures; Polymer nanoparticles and thin films.

9 Hours

Unit III

Integrating Nanotechnology with Biotechnology

Microorganisms as nanofactories- biological syntheses of QDs, Au and Ag NPs, protein mediated synthesis of magnetic nanocrystals, viruses and nanoparticles.

9 Hours

Unit IV

Biological Applications of Nanoparticles

Biofunctionalization of nanoparticles.; Surface Enhanced ramen scattering of metal nanoparticles and its applications in bio-imaging; Antimicrobial activity of silver nanoparticles; Photodynamic

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

therapy using nanoparticles; Imaging of intracellular and extracellular processes using QDs; Quantum dots in cancer therapy; Bioconjugated silica nanoparticles for bioanalytical applications; Magnetic nanoparticles in resonance imaging.

9 Hours

Unit V

Nanoparticles and Drug delivery

Cell penetrating peptides; Liposomes; dendrimers; Fundamentals- Physicochemical principles of nanosized drug delivery systems - Nanotubes, Nanorods, Nanofibers, and Fullerenes for nanoscale drug delivery; Carbon nanotubes biocompatibility and drug delivery; Magnetofection.

9 Hours

Unit VI[$]

Nanoscale process- Conjucation to nanoparticals- Nanocarriers- Nanodevices-Nanoemulsions

Total: 45 Hours

Reference(s)

1. Biju, V., Itoh, T., Anas, A., Sujith, A. & Ishikawa, M. Semiconductor quantum dots and metal nanoparticles: syntheses, optical properties, and biological applications. *Analytical and Bioanalytical Chemistry* 391, 2469-2495 (2008).
2. Amiji, M.M. (ed.) Nanotechnology in cancer therapy. (Taylor and Francis,; 2006).
3. Bruchez, M.P. & Hotz, C.Z. (eds.) Quantum Dots Applications in Biology. (Humana Press; 2007).
4. Bulte, J.W.M. & Modo, M.M.J. (eds.) Nanoparticles in biomedical imaging: Emerging technologies and applications. (Springer; 2008).
5. Niemeyer, C.M. & Merkin, C.A. (eds.) Nanobiotechnology concepts, applications and perspectives. (WILEY-VCH, Verlag Gmb H&Co, 2004).
6. Vo-Dinh, T. (ed.) Nanotechnology in biology and medicine: methods, devices and applications. (CRC Press; 2006).
7. Rosenthal, S.J. & Wright, D.W. (eds.) Nanobiotechnology protocols. (Humana Press; 2005).
8. Nicolini, C. (ed.) Nanobiotechnology & Nanobiosciences. (Pan Stanford Publishing Pte. Ltd, 2009).

15BT55 BIOFERTILIZERS AND BIOPESTICIDES

3 0 0 3

Course Objectives

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

Course Outcomes (COs)

1. To formulate fertilizer based on the soilto supply plant nutrients essential for the growth of plants
2. To facilitate the production of biofertilizer in large scale
3. To develop biofungicides and biopesticides for effective microbial action on disease control

Unit I

Introduction to Biofertilizers

Definition and 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

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit II

Types of Biofertilizers

Different groups of biofertilizers - bacterial, fungal and algal biofertilizers; Phosphorus Biofertilisers - Rock phosphate solubilisation; Phosphorus mobilization – mycorrhiza -types– endo, ectomycorrhiza and orchidaceous mycorrhiza, 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. Largescale 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.

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.

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.

9 Hours

Unit VI[$]

Plant growth promoting rhizobacteria, Microbial solubilisation of silicates and zinc, preparation of inoculant packets - Shelf life, Quality control of biofertilizers; Baculoviruses for insect pest control, recombinant Baculo viruses, Mycoherbicides.

Total: 45 Hours

Reference(s)

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*,AgrobiosIndia, 2003.
4. P.S.Nutman, *Symbiotic nitrogen fixation in plants*, Cambridge Univ. Press, London, 1976.
5. N.S.SubbaRao, *Advances in Agricultural Microbiology*, Oxford and IBH, Publn. Co., New Delhi, 1982.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT56 COMPUTATIONAL TECHNIQUES FOR BIOPROCESS

3 0 0 3

Course Objectives

- To develop skills of the student in the domain of computational methods and its applications in bioprocess
- To disseminate students on analytical methods, models and designs for investigating the operation of bioreactor
- To inculcate the students about optimisation and simulation of the bioreactor for enabling them to apply in large scale industrial production

Course Outcomes (COs)

1. Students will understand the mathematical modelling and numerical methods for using computational methods for monitoring bioprocesses
2. Students will develop their skills in implementing prediction and simulation models on various types of bioreactors
3. Students will develop an insight on optimising the variables of the bioprocess by means of softwares

Unit I

Computational Methods

Mathematical modelling errors in numerical computation; Convergence, Conditioning and Stability; Frequency response analysis of linear process control systems; stability of linear process control; stability of control systems - Routh test, Nyquist and Bode stability criterion, Ziegler Nicholas controller setting.

9 Hours

Unit II

Bioreactors analysis and design

Hydrodynamics and Mass Transfer in Bioreactors, Hydrodynamic regime-Mixing and Backmixing, Transitional zones, Mass Transfer Coefficient- Significance and determination, Analysis of batch, fed - batch and continuous bioreactors, non-ideal effects, Stability analysis of microbial reactors, bioreactors such as packed bed, fluidized bed, photo-bioreactors, animal and plant cell bioreactors etc.

9 Hours

Unit III

Bioprocess Modeling

Construction of state-space dynamic models; Optimal experimental design for the estimation of yield co-efficient dynamic models of fed-batch operation; Modeling of Non-Ideal Behaviour in Bioreactors – Tanks-in-series and Dispersion models; Immobilized Enzyme Bioreactors – Mass transfer in immobilized biocatalytic systems; Analysis of film and pore diffusion resistances and their effect on overall reaction kinetics.

9 Hours

Unit IV

Simulation of Bioprocesses

Design of algorithms for estimating on-line state variables; On-line measurement of specific growth rate; Software packages for simulation of bioprocesses – MATLAB-SIMULINK-ISIM; Simulation of bioprocesses using models from literature sources

9 Hours

Unit V

Bioprocess control and optimization

Control of fermentation process- Model based adaptive linearizing control; Regulation of substrate and product during fed-batch fermentation; Optimization in bioprocess engineering – maximum productivity in Chemostat, cost analysis, breakeven point and sensitivity analysis.

9 Hours

Unit VI[$]

Artificial neural networking for modelling state variables; Hybrid and other modelling techniques; Process flow-sheet simulation;

Total: 45 Hours

Reference(s)

1. Donald R. Coughanowr, *Process Systems Analysis and Control*, 2nd ed., McGraw Hill, 1991.
2. T. K. Ghose, *Bioprocess Computations in Biotechnology*, Vol.I, Ellis Horwood Ltd.1989.
3. Shuichi Aiba, Arthur E. Humphery and Nancy F. Mills, *Biochemical Engineering*, Academic Press, 1965.
4. Bioreactor Design and product Yield-BIOTOL Series, Butterworth Heinemen UK, 1992.
5. J. A. Bailey and D. F. Ollis., *Fundamentals of Biochemical Engineering*, McGraw Hill – New York, 1986.
6. Scragg, *Bioreactors in Biotechnology – A practical approach*, Ellis Horwood Ltd., 1991.
7. W. L. Luyben, *Process Modeling, Simulation and control for Chemical Engineers*, Second Edition, McGraw Hill, 1989.

15BT57 OMICS TECHNOLOGY

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

1. To prepare deep knowledge in the various omics
2. To facilitate the student with overall knowledge on different omics technology
3. To prepare students to interpret omics data

Unit I

Genomics

Structure and organization of prokaryotic and eukaryotic (*Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Homo sapiens*) genomes, Evolution of bacterial operons and operonisation, Yeast-two-hybrid system, Evolution and structure of mitochondrial genomes, Genome Mapping, Genome Sequencing, Genome annotation

9 Hours

Unit II

Transcriptomics

Expression Profiling, Microarray profiling methods and data analysis, Technology for Transcriptomics, Data capture and preliminary checks, Transcriptome data analysis, Generation of transcriptional regulatory networks, Introduction of databases and software for Transcriptomics.

9 Hours

Unit III

Proteomics

Proteomics classification, 1D-SDS-PAGE and 2D-SDS PAGE, Detection and quantitation of proteins in gels, Basics of mass spectrometry, MaldiTof and ESI and their application in

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

proteomics, Tandem MS/MS spectrometry, Peptide sequencing by tandem mass spectrometry, Affinity purification of protein, TAP tag.

9 Hours

Unit IV

Bioinformatics

Bioinformatics and its application, Major online databases, Practical use of databases, DNA, RNA, Proteins in bioinformatics, Amino acid classification, Similarity, homology, local and global sequence alignment, Scoring matrices (PAM, BLOSUM), Pairwise alignment, Dot sequence alignment, BLAST and its variants, FASTA ClustalW BOXSHADE.

9 Hours

Unit V

Metabolomics

Sampling in metabolomics, Data handling in metabolomics, Metabolite Identification and Annotation, Uncertainty of measurements, Role of CE-MS in metabolomics, NMR based metabolomics analysis, Data Integration, Applications and the Future of Metabolomics, Current and future challenges for metabolomics.

9 Hours

Unit VI[$]

High throughput sequencing, Peptide mass fingerprinting, Bridging the gap between genomics and proteomics, FASTA and BLAST algorithms comparison, Micrometabolomics.

Total: 45 Hours

Reference(s)

1. Heyer L, Campbell A, 2006, Discovering Genomics, Proteomics and Bioinformatics, Cold Spring Harbor Lab Press.
2. S.B Primrose and R.M Twyman, 2006, Principles of Gene Manipulation and Genomics, Blackwell Publishing.
3. Daniel C. Liebler, 2002, Introduction to Proteomics : Tools for the New Biology, Humana Press.
4. Michael Lämmerhofer, Wolfram Weckwerth,Metabolomics in Practice: Successful Strategies to Generate and Analyze Matabolic data, 2010.

15BT58 ADVANCED CANCER BIOLOGY

3 0 0 3

Course Objectives (CO):

- To understand the basics of cancer and its development
- To learn about the detailed concepts and methods involved in studying cancer
- To learn the application of biotechnology in eliminating cancer

Course Outcomes (COs):

1. Students will understand advanced biology of cell growth and its malfunctioing
2. Molecular functioning and signalling of various genes and their resulting proteins

Unit I

Fundamentals of cell cycle and signalling

Regulation of cell cycle, check points, cell proliferation, apoptosis; signal transduction pathways, receptor tyrosine kinases (RTKs), intracellular signalling from activated tyrosine kinase receptors.

9 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit II

Introduction to cancer

Causes of cancer - Infection, Radiation, Ionising radiation, Ultraviolet radiation, magnetic fields, Tobacco, Alcohol, Tea and coffee, Stress; defective apoptotic pathways leading to cancer; mutations that cause changes in signal molecules, effects on receptor, signal switches, modulation of cell cycle in cancer; Mechanism of spread.

9 Hours

Unit III

Detailed view on cancer

Different forms of cancers, Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogene activation, retroviruses and oncogenes, detection of oncogenes Oncogenes/proto oncogene activity; tumor suppressor genes - Rb, p53, APC, BRCA paradigms; Telomerases, Principles of Cancer Metastasis: three step theory of invasion, proteinases and tumour cell invasion; Angiogenesis.

9 Hours

Unit IV

Cancer signalling networks

The central axis: ARF, MDM2, p53, INK4, RB1, MYC and RAS; Cancer and cell senescence; Tumourigenic DNA viruses; Signalling pathways that impact on the central axis; Cellular responses during tumour development; Signalling and systems biology.

9 Hours

Unit V

Future of cancer prevention, diagnosis and treatment

The development of anti-cancer drugs: Chemotherapeutic strategies for cancer, Drug resistance, Non-specific effects, The efficacy of chemotherapy; Cancer detection: tumour imaging and molecular imaging, Proteomics, Metabolomics, Gene expression profiling, Protein imaging, Nanotubes, graphene and nanocells.

9 Hours

Unit VI[$]

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation, mechanisms of radiation carcinogenesis, Life style and its consequences for cancer.

Total: 45 Hours

Reference(s)

1. Pelengaris S and Khan M., "The Molecular Biology of cancer ", Blackwell Scientific Publications, Oxford, 2006.
2. Robin Hesketh, "Introduction to Cancer Biology", Cambridge University Press, 2013.
3. Kufe, DW, Pollock, RE, Weichselbaum, RR, Bast R.C., Gansler TS., Holland JF Frei, E, "Cancer medicine", 6th Edn, BC Deckker Inc., Toranto, Canada, 2003.
4. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications, 1991.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT59 MOLECULAR MODELING AND DRUG DESIGN

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

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

Unit I

Introduction to Molecular Modelling

Introduction - Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces, Molecular Graphics. Surfaces. Computer Hardware and Software.

6 Hours

Unit II

Force Fields

Fields. Bond Stretching. Angle Bending. Introduction to Non-bonded Interactions. Electrostatic Interactions. Vander Waals Interactions. Hydrogen Bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.

9 Hours

Unit III

Energy Minimisation and Computer Simulation:

Minimisation and Related Methods for Exploring the Energy Surface. Non-Derivative method, First and Second order minimisation methods. Computer Simulation Methods. Simple Thermodynamic Properties and Phase Space Boundaries. Analyzing the Results of a Simulation and Estimating Errors. GROMACS and CNS.

9 Hours

Unit IV

Molecular Dynamics & Monte Carlo Simulation:

Molecular Dynamics Simulation Methods. Molecular Dynamics Using Simple Models. Molecular Dynamics withContinuous Potentials. Molecular Dynamics at Constant Temperature and Pressure. Metropolis Method. Monte Carlo Simulation of Molecules. Models Used in Monte Carlo Simulations of Polymers. Molecular Modelingsoftware: BIOSUITE

9 Hours

Unit V

Structure Prediction and Drug Design:

Structure Prediction - Introduction to Comparative Modeling. Sequence Alignment. Constructing and Evaluating a Comparative Model. Predicting Protein Structures by 'Threading', Molecular Docking, AUTODOCK and HEX. Structure based DeNovo Ligand design, Drug Discovery – Chemoinformatics – QSAR, Drug Design – Analog and Structure based drug design.

12 Hours

Unit VI[$]

Quantum mechanical calculations, QM/ MM simulations, Virtual Screening, Brownian Dynamics simulations, Rationale of prodrug design.

Total: 45 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Reference(s)

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.
7. SatyaPrakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

15BT60 PHARMACOLOGY

3 0 0 3

Course Objectives

- To impart the knowledge about drug dosage forms and routes of drug administration.
- To explain the mechanism of drug actions at cellular and molecular level.
- To understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases.

Course Outcomes (COs)

1. To strengthen the basic knowledge in the field of pharmacology.
2. To impart recent advances in the drugs used for the treatment of various diseases.
3. To understand the concepts and design clinical trial according to various guidelines.
4. To understand the importance of adverse drug reactions and therapeutic drug monitoring.

Unit I

Introduction to Pharmacology

Sources of drugs, dosage forms and routes of drug administration, mechanism of action of drugs, combined effect of drugs, factors modifying drug action, tolerance and dependence, drug interactions, biological standardization and bioassay of drugs - insulin and heparin.

9 Hours

Unit II

Pharmacology of Peripheral and Central Nervous System

Parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agent, general anaesthetics, antipsychotics, antidepressants, antiepileptics, analgesics, antipyretic, anti-inflammatory (NSAIDS), CNS stimulants

9 Hours

Unit III

Pharmacology of Cardiovascular System

Cardiac glycosides, anti anginals, antihypertensives, vasodilators including calcium channel blockers, anti arrhythmic and anti hyperlipidemic agents.

9 Hours

Unit IV

Drugs acting on Respiratory System and Gastro intestinal tract

Antiasthmatics, antitussives, expectorants, respiratory stimulants, antacids, antiulcer drugs, laxatives, anti-diarrhoeal drugs, emetics and antiemetics.

9 Hours

Unit V

Antimicrobial Pharmacology

Basic principles of chemotherapy, chemotherapy of tuberculosis, leprosy, viral diseases, fungal infections, malaria, amoebiasis, cancer and AIDS**.**

9 Hours

Unit VI[$]

Factors modifying drug action, drug interactions, antiparkinsonism drugs, local anaesthetics, peripherally and centrally acting muscle relaxants, plasma volume expanders.

Total: 45 Hours

Reference(s)

1. B.G.Katzung, S.B.Masters, A.J.Trever, *Basic and Clinical Pharmacology*, The McGraw-Hill Companies, Inc., 2010.
2. Goodman and Gilman's, *The Pharmacological basis of therapeutics*, The McGraw - Hill, 2010.
3. F.S.K.Barar, *Essentials of Pharmacotherapeutics*, S.Chand& Company, 2009.
4. M.M.Das, *Pharmacology for Second Professional Students*, Books and Allied (P) Ltd., 2004.
5. J.G.Hardman and L.E.Limbird, *Goodman and Gilman's: The Pharmacological Basis of Therapeutics*, Medical Publishing Division, 2001.
6. D.R.Laurence and P.N.Bennet, *Clinical Pharmacology*, Churchill Livingstone, 1994.

15BT61 MARINE BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To develop the skills of the student in the area of Marine biotechnology and its application.
- To familiarize student with different techniques in Marine biotechnology.
- To motivate and facilitate student to undertake the project and research work in Marine biotechnology.

Course Outcomes (COs)

1. To make the students understand the components of Marine biotechnology
2. To have knowledge about the instruments used in Marine biotechnology.
3. To make them know the applications of Marine biotechnology in various fields.

Unit I

Isolation of Marine Natural Products

Marine chemical ecology; Collection of marine Organisams; Isolation and separation of marine natural products from marine flora and fauna; Common extraction methods; solvents used; partitioning; bioassay guided fractionation; chromatographic systems used for separation.

9 Hours

Unit II

Bioactive Compounds and Biomaterials from Marine Environment

Diversity of marine derived compounds - Alkaloid, Terpenoids and steroides, nucleoside, aminoacids, peptides, depsipeptide, polyketide, Macrolide; Marine Toxins - Paralytic shellfish poisoning (PSP), Neurotoxic shellfish poisoning (NSP), Diarrhetic shellfish poisoning (DSP), Ciguatera poisoning, Amnesic shellfish poisoning (ASP), azaspiracid shellfish poisoning, tetradotoxin, other miscellaneous toxins; Marine Enzymes- protease, lipase, chitinase, glucanase; Marine biominerals; Biominerelized structures; Biocomposites; Biopolymers - polysaccharides, chitin, marine collagens.

9 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit III

Screening Platforms and Instrumentation

Assay plates; Spectrophotometers; Micro-plate readers; Fluorescence assisted cell sorting (FACS); Fluorescence Microscopy; Atomic Force Microscopy (AFM); Chromatography – basic considerations, FPLC, HPLC, HPTLC; Mass spectrometry; Microarrays; Gene chips; Protein arrays; Protein chips; Automated and robotic Systems.

9 Hours

Unit IV

High-throughput Screening Assays (HTS**)**

Types of HTS assays: *In vitro* biochemical and cell based assays; Isotopic detection techniques; Non-isotopic detection techniques; Enzyme linked immunosorbent assay; Radio immunoassay; Scintillation proximity assays; Chromogenic assays; Fluorescence assays; Fluorescence polarization; Homogenous time resolved fluorescence assays; Fluorescence correlation spectroscopy; Fluorescence life time assays; Fluorescence resonance energy transfer (FRET), Electrochemiluminescence.

9 Hours

Unit V

Bioassays for Screening Enzymes and Bioactive Molecules

Enzyme assays- protease, lipase, amylase, cellulase; Bench top and primary bioassay screens - Brine shrimp lethality assay; microwell cytotoxicity assay; antibacterial assay; antifungal; antiviral and anticancer assay; Comet assay; DNA laddering assay; MTT assay; LDH assay; Caspase assay; Antimitotic assays using sea urchin eggs. Assays for tropical diseases - antimalarial assay, Larvicidal assay, Molluscicidal assay, Amoebicidal assay, Cercaricidal assay, antileishmanial assay; Hypoglycemic / antidiabetic activity assay; Diuretic activity assay; Anthelminthic assay; Immunomodulating assay; Analgesic assay; Antifouling assay.

9 Hours

Unit VI[$]

Discovery and development cycle of drugs - toxicity evaluation, animal experiments, clinical trails protocols, ethical considerations; Marine derived drugs in preclinical and clinical trail- their source, nature, mode of action and targeted diseases; FDA approved and EMEA approved marine derived drugs and their use and mode of action.

Total: 45 Hours

Reference(s)

1. Atta-ur-Rahman, Iqbal Choudhary, M., and Thomsen, W.J. eds. 2005. Bioassay Techniques for Drug Development (Taylor and Francis).
2. Seethala, R., and Fernandes, P.B. eds. 2001. Handbook of Drug Screening (Marcel Dekker Inc).
3. Zhang, L., and Demain, A.L. eds. 2005. Natural Products Drug Discovery and Therapeutic Medicine. Humana Press.
4. Lansing Taylor, D., Harkins, J.R., and Giuliano, K.A. eds. 2007. Methods in Molecular Biology, Volume 356. Humana Press.
5. Braga, P.C., and Ricci, D. eds. (2005). Methods in Molecular Biology, Volume 242.
6. Hammes, G.G. ed. 2005. Spectroscopy for the biological sciences. Wiley Interscience.
7. Kastin, A.J. ed. 2006. Handbook of biologically active peptides. Elsevier.
8. D.S. Bhakuni and D.S. Rawat 2005 Bioactive Marine Natural Products (Springer and Anamaya Publishers, New Delhi, India
9. Ehrlich**,** Hermann ed 2010. Biological Materials of Marine Origin. Invertebrates (Springer)
10. http://www.mdpi.com/journal/marinedrugs

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT62 BIOMATERIALS

3 0 0 3

Course Objectives

- 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 tissue responses to the materials
- To have an exposure on the clinical context of their use, manufacturing processes and testing, cost, sterilization, packaging and regulatory issues.
- To Understand what distinguishes polymers from other compounds

Course Outcomes (COs)

1. Can select appropriate biomaterial for organ replacement and temporary body implant
2. Design, analytical, problem solving, technical and judgement skills
3. Able to differentiate between the scientific and the regulatory definition of biomaterials
4. Can broadly differentiate between the different classes of biomaterials

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. Bioactive glasses and hollow fiber membranes

9Hours

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 biomaterial properties. Cell-surface interaction by fluorescence and reflection confocal microscopy and protein-surface interactions. Non-co-operative cell-surface interactions. Phenotype changes due to cell adhesion.

9Hours

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.

9Hours

Unit IV

Tissue Replacement Implants

Tissue replacements, wound dressings and sutures, surgical tapes, adhesives and sealants , percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, Joint replacements, implants for bone regeneration. Naturally occurring extracellular matrix-structure and function and use in dermal regeneration.

9Hours

Unit V

Artificial organs

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

9 Hours

Unit VI[$]

Biomaterials in wound dressings, nephrology, neurology, ophthalmology, stem cell research, bioartificial pancreas, repair of tendon and ligament injuries and resorbableosteosysnthesis materials in craniomaxilliofacieal surgery, and controlled drug delivery.

Total: 45 Hours

Reference(s)

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.

15BT63 TISSUE ENGINEERING AND REGENERATIVE MEDICINE

3 0 0 3

Course Objectives

- To develop the skill of the student in the emerging field of Regenerative medicine.
- To familiarize student about the various techniques used in Tissue engineering.
- To make the students think about higher studies and career in the field of Tissue engineering

Course Outcomes (COs)

1. Students will understand the importance of the rising need of Tissue engineering in the current scenario
2. Students will have strong background and understanding of Tissue engineering which will make them pursue a career in the same field
3. Students will have an perception about the regulatory issues that govern Tissue engineering

Unit I

Tissue Engineering for Regenerative Medicine:

The History of Tissue Engineering and Regenerative Medicine in Perspective, Cell culture; primary cultures &cell lines; cell quantification; bioreactors for cell cultures; Growth factors and signals for tissue engineering; extra cellular matrix (ECM) (structure, function and applications); typical tissue engineered deviceEthical Issues in Tissue Engineering.

9 Hours

Unit II

Biomaterials in Tissue Engineering:

Biomaterials: Definition, Classification: Polymers, ceramics (biosorbable and bio active) and composites. Surface, physical and chemical properties of materials - mechanical properties of

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

implants.Bulk analysis- FTIR, SEM; Surface analysis - AES. Sterilization techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties.

9 Hours

Unit III

Bioreactors in Tissue Engineering

Theories of mechanobiology, various types of mechanical stimulation, bioreactors for various tissues, e.g. cartilage, muscle, tendon, bone and blood vessels. set-ups of bioreactors, characterization of stimulated tissue engineering constructs.

9 Hours

Unit IV

Current Problems in Regenerative Medicine

Current challenges in tissue regeneration, fundamentals of cell-based therapies, critical discussion of recent scientific research papers in the field of regenerative medicine.

9 Hours

Unit V

Stem Cells in Regenerative Medicine

Knowledge of production, efficacy, limitations and applications of different stem cells in regenerative medicine; clinical and preclinical studies for the application of stem cells in regenerative medicine based on recent scientific papers.

9 Hours

Unit VI[$]

Hard tissue replacement implant; Orthopedic implants, (Hip, Knee, etc.), Soft tissue replacement implant; skin implants, Burn (wound) dressings Synthetic Skin, Heart valve implants. Blood and tissue compatibility of biomaterials, biomimicry, inflammation and Wound healing process- Tissue response to biomaterials, , toxicity of biomaterials. Enhancement of biocompatibility

Total: 45 Hours

Reference(s)

1. Atala& R. P. Lanza, *Methods of Tissue Engineering*, Academic Press, 2002.
2. J. P. Fisher, A.G. Mikos and J.D. Bronzino, *Tissue Engineering*, CRC Press, 2007.
3. Ratner, Hoffman, Schoen and Lemons, *Biomaterials Science – An Introduction to Materials in Medicine*, Academic Press, 1996.
4. V. Yannas,*Tissue and Organ Regeneration in Adult*, Springer, 2001.
5. http://www.isscr.org/public: Stem cell information for the public from the International Society for Stem Cell Research (ISSCR).
6. 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.
7. R. P. Lanza, R. Langer, and W. L. Chick, *Principles of Tissue engineering*, Academic Press, 1997.
8. W. M. Saltzman, *Drug Delivery: Engineering Principles for Drug Therapy*, Oxford University Press, 2001.
9. John P. Fisher, Antonis G. Mikos and Joseph D. Bronzino, *Tissue Engineering*, CRC Press, 2007.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT64 MEDICAL BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To understand the application of biotechnology in the field of medical science
- To familiarize the student with the various biotechnological components and techniques employed in medical sciences.
- To motivate students to undertake projects which are of tremendous use to humanity to overcome diseases.

Course Outcomes (COs)

1. At the end of the course, the students will be able to appreciate the usefulness of biotechnology in medicine.
2. The students will be self motivated to utilize theoretical knowledge of biotechnology in the field of chronic diseases and find solutions to leading helath problems across the globe.

Unit I

Molecular Diagnostics

Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis, Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot.

9 Hours

Unit II

Immunotechnology

CMI and Imaging techniques CD nomenclature, Identification of immune Cells; Principle of Immunofluoresence Microscopy, Flurochromes; Staining techniques for live cell imaging and fixed cells; Flow cytometry, Instrumentation, Applications; Cell Functional Assays – lymphoproliferation, Cell Cytotoxicity, mixed lymphocyte reaction, Apoptotosis, Cytokine expression; Cell cloning, Reporter Assays, In–situ gene expression techniques; Cell imaging Techniques- In vitro and In vivo; Immuno-electron microscopy; In vivo cell tracking techniques; Microarrays; Transgenic mice, gene knock outs.

9 Hours

Unit III

Molecular Therapeutics

Gene therapy; Overview of inherited and acquired diseases for gene therapy, Cellular therapy, Recombinant therapy; Clinical applications of recombinant technology, Immunotherapy; Gene silencing technology.

9 Hours

Unit IV

Genomics in Medicine

Human disease genes; DNA polymorphism including those involved in disease; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information.

9 Hours

Unit V

Bioethics

Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology; Ethics and the Law Issues: Genetic Engineering, Stem Cells, Cloning, Medical techniques, Transhumanism, Bioweapons; Research concerns - Animal

Rights, Ethics of Human Cloning, Reproduction and Stem Cell Research; Emerging issues: Biotechnology's Impact on Society; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy - To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.

9 Hours

Unit VI[$]

Immunity to Infection : Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor.

Total: 45 Hours

Reference(s)

1. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1 Edition, Academic Press, 2005.
2. Prem S. Mann, Introductory Statistics, 6th Edition, Wiley, 2006.
3. F.C. Hay, O.M.R. Westwood, Practical Immunology, 4 Edition-, Blackwell Publishing, 2002
4. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21 century medicine, 1 Edition, Sringer, 2008.

15BT65 BIOMEDICAL ENGINEERING

3 0 0 3

Course Objectives

- To learn the various medical instruments and disease diagnosis
- 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 have an exposure on the clinical context of their use, manufacturing processes and testing, cost, sterilization, packaging and regulatory issues.

Course Outcomes (COs)

1. To understand the various platforms of biomedical engineering and medical instrumentation
2. Design, analytical, problem solving, technical skills in the field of biomedical engineering

Unit I

Healthcare and Medical Instruments

Health, Healthcare, mortality and medical ethics; Human experimentation – definition, purpose, informed consent, medicine regulation & medical devices; Safe medical Devices, Bioinstrumentation systems – Neuromuscular, electrical properties of nerves and muscles

9 Hours

Unit II

Biomaterials

Material types & functions; tissue response mechanisms, testing – invivo&invitro, Prosthetic devices – Hard & soft tissues, Rheology of Biofluids, Case studies of materials used to mimic body functions

9 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit III

Biophotonics

Light interaction with tissues, Fiber optic communication systems – transmission of signals, gastroenterology, endoscope, bronchoscope, gastro scope; Laser Doppler flowmetry; Photodynamic therapy – photochemical, thermal, photoablative interaction mechanisms

9 Hours

Unit IV

Medical imaging

Design considerations of X-ray tubes, Projections – 2D, 3D, slice identification; Medical Images – Magnetic Resonance, CAT, PET, single photon emission computed tomography, CT, signal processing; Imaging parameters – resolution, contrast, noise data acquisition, sampling, quantification & clinical significance.

9 Hours

Unit V

Biosensors

Biological components of sensor, transducers, Immobilization of enzymes & microbial cells; fabrication and medical application – electrochemical, optical &piezzo electric based biosensors, BIOMEMS

9 Hours

Unit VI[$]

Medical Diagnostics, Clinical Data management, clinical application of lasers, Maxofaciallary augmentation, MOSFET Biosensors

Total: 45 Hours

Reference(s)

1. Joseph D Bronzino (ed), "The Biomedical Engineering Handbook", Volume I & II, CRC Press, Florida USA, 2000
2. Enderle, J Blanchard, S Bronzino, J (Eds), "Introduction to Biomedical Engineering", Academic Press UK, 2000.

15BT66 ENVIRONMENTAL BIOTECHNOLOGY

3 0 0 3

Course Objectives

- To know the effects of industrial activities on global issues
- To understand the principles involved in the various analytical process
- To get exposed to the ideas of Bioremediation techniques

Course Outcomes (COs):

1. Isolation and Identification of microorganisms from contaminated sites
2. Biological treatment of different wastes
3. Production of biogas from multiple wastes

Unit I

Global Issues

Climate system, Greenhouse gases and their sources, ozone. Effects of industrial activity- acid rain, smog, global warming and eutrophication, Radiation hazards.

9 Hours

Unit II

Aerobic treatment of Water

Nature of water pollutants, BOD, COD, TOC, ThOD, Preliminary and primary treatments. Secondary treatment – Aerobic – lagoons or ponds, trickling filters, activated sludge process, fluidized bed.

9 Hours

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit III

Anaerobic treatment of Water

Anaerobic treatment- Anaerobic ponds, anaerobic reactors, UASB, Tertiary treatment – suspended solids removal, oil and grease, biological nitrogen removal – nitrification and denitrification, biological phosphorus removal.

9 Hours

Unit IV

Biodegradation

Biodegradation of macromolecules; genobiotics; Bioremediation of metal contaminated soils, spilled oil and grease deposits, synthetic pesticides. Phytotechnology-terrestrial phytosystems, metal phytoremediation, Phytotechnology-aquatic photosystems, algal treatment system.

9 Hours

Unit V

Solid Waste Management

Sources, generation, classification and composition of solid wastes. Solid waste management methods - Sanitary land filling, Recycling, composting, Incineration, energy recovery from organic waste. Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment. Hospital Waste Management, Disaster Management.

9 Hours

Unit VI[$]

Pollution monitoring, Membrane bioreactors, Nutrient film techniques, Fly ash generation and utilization, Biofuel generation.

Total: 45 Hours

Reference(s)

1. Alan Scragg, *Environmental Biotechnology*, Oxford University Press Inc., 2007.
2. Bimal C. Bhattacharyya and B. Rintu, *Environmental Biotechnology*, Oxford University Press Inc., 2007.
3. P. R. Yadav, and Rajiv Tyagi, (2006). .*Environmental Biotechnology*, Discovery Publishing house,
4. InduShekhar Thakur, (2006) *Environmental Biotechnology- Basic concepts and application*, I.K International, Pvt. Ltd., 2006.

15BT67 SYSTEMS BIOLOGY

3 0 0 3

Course Objectives (CO):

- 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 Outcomes (COs):

1. Advanced biological analysis towards biological networks
2. Signalling, metabolism and gene regulation of cell is studied at advanced level

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

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

Unit II

Signalling networks

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

9 Hours

Unit III

Gene regulatory networks

Gene regulatory circuits, Modelling gene regulatory network, Robustness/sensitivity analysis, Discrete modelling of biological systems, Boolean network modelling.

9 Hours

Unit IV

Metabolic networks

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 V

Applications of Systems Biology

Applications of systems-level modelling: metabolic engineering; diseases and drug discovery, Synthetic biology, integrative biology, Pathway Modelling.

9 Hours

Unit VI[$]

Bioinformatics for Systems Biology, Protein interaction maps, Gene Expression Data and Analysis, Principles of metabolism, Perspectives and challenges in systems biology

Total: 45 Hours

Reference(s)

1. EddaKlipp, 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.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BT68 CELLULAR BIOPHYSICS

3 0 0 3

Course Objectives

- 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 Outcomes (COs)

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

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

Unit VI[$]

Voltage Clamp, Patch Clamp, Electrophysiology, Current Clamp, EKG, Single channel and whole cell experiments.

Total: 45 Hours

Reference(s)

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.
3. BertiHille, Ion channel of Excitable Membranes, Sinauer Associates, 3rd edition edition, 2001.

$ Includes Self Study topics of all 5 units and considered for Continuous Assessment only.

15BTXA MOLECULAR MARKER TECHNOLOGIES

1 0 0 1

Course Objectives

- To understand the role of molecular marker technology in breeding of animals and Plants
- To understand the sequencing and mapping techniques

Course Outcomes (COs):

1. The course will expose the students on different marker system which will build their carrier on DNA finger printing
2. The mapping technique will help for working in genomics and bioinformatics research filed which is fast developing in the animal and agricultural science

Organization & Molecular dissection of different genomes (Nuclear, Chloroplast and Mitochondrial) – Morphological, Physiological and Genetic markers and their role in evolution and Taxonomy – Merits and demerits - History of Molecular markers and Types of Molecular markers - Hybridization based markers – RFLP and it's applications - PCR based markers – RAPD, AFLP, SSR and STS markers, new generation marker and their application - Development of new DNA markers - Principles of genetic linkage - Linkage relationship among different markers - Construction of linkage maps with different markers - Microarray technology and application - Synteny among different genome with respect to markers -QTL mapping with molecular markers and related software - Finger printing of fungi, insects and other organisms - Tagging of economic importance using molecular markers – MAS success story

Total: 16 Hours

Reference(s)

1. Brown. T. A. Genomes, 3rd edition. University of Manchester, U.K. Garland Sciences. 2006.
2. Phillips and I.K. Vasil. DNA based markers in plants. Second Edition, Klewer academic Publishers, and London. 2001.
3. Henry, R. J. Plant genotyping – The DNA finger printing of plants. CABI Publications. New York. 2001.
4. Patterson, Molecular dissection of complex traits. CRC Publication. Washigton. 1998
5. Rastogi, S.C. N. Mendiratta, and P. Rastogi. Bioinformatics – Methods and application Pretice Hall Pvt. New Delhi. 2006.

15BTXB TRANSLATIONAL RESEARCH

1 0 0 1

Course Objectives

- To enable students to get an insight of translating Ideas and to evaluate and predict the role of technology in creating wealth or value.
- To empower graduates and researchers to distinguish between Abrasive/Breakthrough technologies and lay a foundation for productive research for societal transformation.

Course Outcomes (COs):

1. The student/researcher will know how to value his invention/idea. One will know how his invention/invention will address the questions/challenges/problems/ pain statements of the society or demand area.
2. One shall be aware of the tools (Software and Legal instruments) for evaluating the technology to build and stimulate a business model around ones idea/invention, which will enable to decide the best mode of translating idea/invention to value or wealth.

Technology Transfer as a process – Stages of Technology Transfer – Translational Research defined- Basic Components of Translational Research - Stages of invention and where does Translational research fit – Classifications of Inventions – overview of protecting technology –

Strategies of Transferring technology – Technology Valuation Methods – Communication in Technology Transfer -Documentation for Technology Transfer – Technology Landscaping-Technology Presentation for Marketing – Legal Instruments Involved in Technology Transfer.

Total :16 hours

Reference(s)

1. Technology Transfer: A Communication Perspective (1990), Eds. Frederick Williams and David V. Gibson, SAGE Publications (ISBN:0-8039-3741-5
2. Biotechnology Intellectual Property Manual (2001) Spruson and Ferguson Patent Attorneys. (ISBN:0-642-72129-7)
3. Journal of Commercial Biotechnology http://www.palgrave-journals.com/jcb/index.html.
4. Intellectual Property in Health and Agricultural Innovations A Hand Book of Best Practices

15BTXC MARINE FOOD TECHNOLOGY

1 0 0 1

Course Objectives (CO):

- To provide a concise and unified approach to marine flora, fauna and molecular properties
- To impart knowledge on various sea foods and its medicinal and nutritional values

Course Outcomes (COs):

1. To get an knowledge about marine environment
2. To understand different techniques followed for marine resource assessment and evaluation.

Marine environment - Marine Bioresources, Biodiversity - Marine Flora and fauna - Phytoplankton, seaweeds, sea grasses and mangroves - Ocean Technology – Tides, Currents and remote sensing techniques - Marine resource assessment and evaluation - Marine pharmacology – Terms and definitions, medicinal compounds from marine flora and fauna, toxins, antiviral and antimicrobial agents - Sea foods – shrimps, prawns, skewers, octopus, crabs, fish, squid and its processing with nutritional values – Certifications like HACCP, EU, USFDA, ISO, BRC, ACC for sea foods

Total: 15 Hours

Reference(s)

1. M. Fingerman, *Recent advances in Marine Biotechnology*, Science Publishers, 2000.
2. D. L. Krichman, *Microbial Ecology of the Oceans*, Wiley - Liss, 2000.