CURRICULUM & SYLLABI FOR B.TECH- BIOTECHNOLOGY

B.TECH 2010-2014 BATCH- Subject Components of Curriculum

<table>
<tr><th>Subject Components</th><th>Credits to be allotted</th><th>Credits allotted</th></tr>
<tr><td>General : Language, Humanities, Economics, Management, NSS, NCC, NSO & Rural Development</td><td>10-20 credits
(5-10%)</td><td>19*</td></tr>
<tr><td>Basic Sciences: Mathematics, Physics, Chemistry, Computer Literacy with Numerical Analysis</td><td>30-50 credits
(15-25%)</td><td>37</td></tr>
<tr><td>Engineering Sciences and Technical Arts: Engineering Graphics, Work Workshop Practice, Engineering Mechanics, Basic Electrical Engineering, Thermodynamics and Heat Transfer, Material Science and Engineering, Electronics and Instrumentation, Engineering Systems Design, Building Materials, Surveying, Transport Phenomena</td><td>30-50 credits
(15-25%)</td><td>32</td></tr>
<tr><td rowspan="5">Professional Subjects
110-130 credits
(55-65%)</td><td>Professional Core</td><td>78</td></tr>
<tr><td>Professional Electives</td><td>12</td></tr>
<tr><td>Free Electives
(Interdisciplinary Electives)</td><td>9</td></tr>
<tr><td>IPT (optional)</td><td>1**</td></tr>
<tr><td>Project (Half semester)</td><td>12/20</td></tr>
<tr><td colspan="2">Total : 200/208</td></tr>
<tr><td colspan="3">Total credits: 200/208</td></tr>
</table>

***-** 20 credits reduced to 19 credits

****-** Implant Training compulsory for students choosing half semester project

Sl.No.	Subject Code	I. GENERAL (5-10%)	Min/ Max Credits
		SUBJECTS	**10 / 20**
1	10EN201/EN214/ EN216	Professional English/French/German	2:0:0
2	10EN202	Professional English II	2:0:0
3	10EN203	Advanced English	2:0:0
4	10EN211	English Language Lab*	0:0:2
5	10MS 202	Business Environment	2:0:0
6	10MS201	Engineering Project Costing	2:1:0
7	09DE101	Introduction to National Youth Programmes	2:0:0
7	09MS209	Managerial Skills	2:0:0
8	10VE201/202	Value Education**	2:0:0
		Total	19

*10EN204 Professional Communication Lab (0:0:2) is replaced by 10EN211 English Language Lab (0:0:2)
**09VE101/102Value Education (1:0:0) , 09VE201/202Value Education (1:0:0), 09VE203/204Value Education (1:0:0) subjects are replaced by 10VE201/202 Value Education (2:0:0)

Sl.No.	Subject Code	II. Basic Sciences (15-25%)	Min/ Max Credits
		SUBJECTS	**30 / 50**
1	CS101	Programming in C	4:0:0
2	09CS217	Programming in C Lab	0:0:2
3	MA244	Algebra, Differential Calculus and Analytical Geometry	3:1:0
4	MA245	Multiple Integrals, Differential equations & Laplace Transforms	3:1:0
5	10MA201	Partial Differential Equations and Transforms	3:1:0
6	10MA202	Biostatistics	3:1:0
7	PH105	Applied Physics	3:0:0
8	09PH101	Applied Physics lab	0:0:2
9	10PH201	Engineering Physics	2:0:0
10	CH106	Applied Chemistry	3:0:0
11	09CH104	Applied Chemistry lab	0:0:2
12	09CH201	Environmental Studies	3:0:0
		Total	37

Sl. No	Subject Code	**III. III-ENGINEERING SCIENCE AND TECHNICAL ARTS (15-25%)**	**Min/ Max Credits**
		SUBJECTS	**30 / 50**
1	ME110	Basic Engineering Drawing	0:0:2
2	10ME101	Workshop Practice	0:0:2
3	09EE101	Basic Electrical Engineering	3:0:0
4	ME109	Computer Aided Graphics	0:0:2
5	09ME101	Basic Mechanical Engineering	2:0:0
6	09EC218	Basic Electronics	3:0:0
7	09BT201	Basic Industrial Biotechnology	4:0:0
8	09BT202	Instrumental Methods of Analysis	4:0:0
9	09BT203	Principles of Chemical Engineering	4:0:0
10	09BT204	Chemical Engineering Lab	0:0:2
11	09BT205	Unit Operations	4:0:0
		Total	**32**

Sl. No.	Subject Code	IV. PROFESSIONAL CORE	Total Credits 82
1	09BT206	Mass Transfer Operations	4:0:0
2	10BT201	Basic Engineering Biochemistry	4:0:0
3	09BT208	Analytical Biochemistry Lab	0:0:2
4	09BT209	Bio Organic Chemistry	4:0:0
5	09BT210	Cell Biology	4:0:0
6	09BT211	Microbiology	4:0:0
7	09BT212	Microbiology Lab	0:0:2
8	09BT213	Molecular Biology	4:0:0
9	10BT202	Genetic Engineering & Bioethics	4:0:0
10	09BT215	Molecular Biology & Genetic Engineering Lab	0:0:2
11	09BT216	Immunology & Immunotechnology	4:0:0
12	09BT217	Cell Biology and Immunology lab	0:0:2
13	09BT218	Bioprocess Principles	4:0:0
14	09BT219	Bioprocess Lab	0:0:2
15	09BT220	Enzyme Engineering & Technology	4:0:0
16	09BT221	Bioprocess Engineering	4:0:0
17	09BT222	Downstream Processing	4:0:0
18	09BT223	Downstream Processing Lab	0:0:2
19	09BT229*	Chemical Thermodynamics and Bio Thermodynamics	4:0:0
20	09BT230*	Bio Reaction Engineering	4:0:0
21	09BT232	Protein Engineering	4:0:0
22	09BT227	Basics of Bioinformatics	4:0:0
24	09BT228	Bioinformatics Lab	0:0:2
		Total	**78**

***Shifted from Professional Elective to Professional core**

V.PROFESSIONAL ELECTIVES (2010-2014 Batch)

Subject Code	V. PROFESSIONAL ELECTIVES	Total Credits 12
09BT239*	Bio Pharmaceutical technology	4:0:0
09BT225*	Applied Plant & Animal Biotechnology	4:0:0
09BT231	Advanced Bioprocess Lab	0:0:2
09BT233	Plant Biotechnology	4:0:0
09BT234	Animal Biotechnology	4:0:0
09BT235	Cancer Biology	4:0:0
09BT236	Bioprocess Economics and Plant Design	4:0:0
09BT237	Applied Environmental Biotechnology	4:0:0
09BT238	Introductory Genomics and Proteomics	4:0:0
09BT240	Nano Biotechnology	4:0:0
09BT241	Analytical Techniques in Biotechnology Lab	0:0:2
09BT224	Metabolic Engineering	4:0:0
09BT254	Basic Research Methodology	2:0:0
09BT255	Animal and Plant Tissue Culture Lab	0:0:2
	Total [Required]	**12**

***-Shifted from Professional Core to Professional Elective**

VI. FREE ELECTIVES (2010-2014 Batch)

Code	Subject Name	Credits
09BT242	Introductory Biotechnology	3:0:0
09BT243	Applied Microbiology	3:0:0
09BT244	Introductory Cell Biology	3:0:0
09BT245	Introductory Genetic Engineering	3:0:0
09BT246	Role of Biotechnology in Environment	3:0:0
09BT247	Basics of Biomolecules	3:0:0
09BT248	Gene and Gene Expression	3:0:0
09BT249	Introductory Microbial Biotechnology	3:0:0
09BT250	Applied Biotechnology	3:0:0
09BT251	Instrumental Methods of Analysis	3:0:0
09BT252	Nanobiotechnology	3:0:0
10BT203	Cancer Biology	3:0:0
09BT256	Industrial Safety	3:0:0
09BT257	Renewable Energy System	3:0:0
09BT258	Bioremediation for Industrial Sectors	3:0:0
	Total [Required]	**9**

SEMESTERWISE CURRICULUM

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	1	PH105	Applied physics	3	0	0	3
2	1	MA244	Algebra, Differential Calculus and Analytical Geometry	3	1	0	4
3	1	09CH201	Environmental Studies	3	0	0	3
4	1	10EN201/ EN214/EN216	Professional English / French / German	2	0	0	2
5	1	09EC218	Basic Electronics	3	0	0	3
6	1	09DE101	Introduction to National Youth Programmes	2	0	0	2
7	1	09ME101	Basic Mechanical Engineering	2	0	0	2
Practical							
1	1	09PH101	Applied Physics Lab	0	0	2	2
2	1	ME110	Basic Engineering Drawing	0	0	2	2
3	1	**10ME101**	Workshop Practice	0	0	2	2
						Total	**25**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	2	10EN202	Professional English II	2	0	0	2
2	2	MA245	Multiple Integral, Differential Equation and Laplace Transform	3	1	0	4
3	2	CS101	Programming in C	4	0	0	4
4	2	CH106	Applied Chemistry	3	0	0	3
5	2	09EE101	Basic Electrical Engineering	3	0	0	3
6	2	10PH201	Engineering Physics	2	0	0	2
Practical							
1	2	09CS217	Programming in C Lab	0	0	2	2
2	2	09CH104	Applied Chemistry Lab	0	0	2	2
3	2	ME109	Computer Aided Graphics	0	0	2	2
	2	10EN211	English Language Lab	0	0	2	2
					Total		**26**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	3	10MA201	Partial Differential Equations and Transforms	3	1	0	4
2	3	09BT210	Cell Biology	4	0	0	4
3	3	09BT202	Instrumental Methods of Analysis	4	0	0	4
4	3	09BT211	Microbiology	4	0	0	4
5	3	09BT203	Principles of Chemical Engineering	4	0	0	4
6	3	09BT201	Basic Industrial Biotechnology	4	0	0	4
Practical							
1	3	09BT204	Chemical Engineering lab	0	0	2	2
2	3	09BT212	Microbiology Lab	0	0	2	2
					Total		**28**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	4	10MA202	Biostatistics	3	1	0	4
2	4	09BT218	Bioprocess Principles	4	0	0	4
3	4	10BT201	Basic Engineering Biochemistry	4	0	0	4

4	4	09BT205	Unit operations	4	0	0	4
5	4	09BT213	Molecular biology	4	0	0	4
6	4	10EN203	Advanced English	2	0	0	2
7	4	10VE201/202	Value Education	2	0	0	2
Practical							
1	4	09BT208	Analytical Biochemistry Lab	0	0	2	2
2	4	09BT219	Bioprocess Lab	0	0	2	2
Total							**28**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	5	09MS209	Managerial Skills	2	0	0	2
2	5	10MS 202	Business Environment	2	0	0	2
3	5	09BT221	Bioprocess Engineering	4	0	0	4
4	5	09BT229	Chemical Thermodynamics and Bio-Thermodynamics	4	0	0	4
5	5	09BT206	Mass Transfer Operations	4	0	0	4
6	5	09BT216	Immunology and Immunotechnology	4	0	0	4
7	5	10BT202	Genetic Engineering and Bioethics	4	0	0	4
Practical							
1	5	09BT215	Molecular Biology and Genetic Engineering Lab	0	0	2	2
2	5	09BT217	Cell Biology and Immunotechnology Lab	0	0	2	2
Total							**28**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	6	10MS201	Engineering Project Costing	2	1	0	3
2	6	09BT222	Downstream Processing	4	0	0	4
3	6	09BT227	Basics of Bioinformatics	4	0	0	4
4	6	09BT230	Bio Reaction Engineering	4	0	0	4

5	6		Free Elective 1	3	0	0	3
6	6		Free Elective 2	3	0	0	3
Practical							
1	6	09BT223	Downstream Processing Lab	0	0	2	2
2	6	09BT228	Bioinformatics Lab	0	0	2	2
Total							**25**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Theory							
1	7	09BT209	Bioorganic Chemistry	4	0	0	4
2	7	09BT220	Enzyme Engineering & Technology	4	0	0	4
3	7	09BT232	Protein Engineering	4	0	0	4
4	7		Free Elective-3	3	0	0	3
5	7	Elective-1		4	0	0	4
6	7	Elective-2		4	0	0	4
Practical							
1	7	Elective-3		0	0	2	2
2	7	Elective-4		0	0	2	2
Total							**27**

Sl.No.	Semester No.	Subject Code	Title	Credits			Total
				L	T	P	
Practical							
1	8	BT999/BT998	Half / Full Semester Project	-	-	12/20	12/20
Total							**12/20**

Total credits:

For Half Semester project, Total =199 + 1 IPT **= 200 Credits**

For Full Semester project, Total = 207 Credits + 1 IPT (optional) **= 208 Credits**

SYLLABI– B.TECH BIOTECHNOLOGY 2010 BATCH

09BT210 CELL BIOLOGY

Credit: 4:0:0

Objective:
To know the morphology and functional aspects of cell
Outcome:
The students will be able to understand type of cell, its morphology, signaling, cell culture and transport of various nutrients across the cell wall

Unit – I Structure and Function of the Cell and Its Organelles (13)
Eukaryotic and prokaryotic cells: principles of membrane organization - Micelles, membrane proteins, cytoskeletal proteins, contractile proteins – actin & myosin, extra cellular matrix. Cell division: mitosis & meiosis, cell cycle, molecules that control cell cycle.

Unit – II Transport Across Cell Membranes (13)
Passive & active transport, permeases, sodium potassium pump, Ca2+ ATPase pump, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport, symport, antiport, transmembrane potential coupled ATP generation, ion-selective gated channel against neuronal cellmembrane, Transport into prokaryotic cells, endocytosis and exocytosis. Entry of virus and toxins into cells.

Unit – III Receptors and Models of Extra Cellular Signalling (13)
Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, quantitation and characterisation of receptors.

Unit – IV Signal Transduction (13)
Signal amplification, different models of signal amplifications, role of cyclic AMP, cyclic GMP and G proteins in signal transduction, biosynthesis of inositol tri phosphates and their role as messengers, calcium ion flux and its role in cell signaling, phosphorylation and regulation of protein kinases in signalling, serine – threonine kinases in signalling.

Unit – V Cell Culture (13)
Techniques for the propagation of eukaryotic and prokaryotic cells. Cell line: generation of cell lines, maintenance of stock cells, characterization of cells, immunochemistry, morphological analysis, techniques in cell culture, explant cultures, primary cultures, contamination, differentiation, three dimensional cultures, role of matrix in cell growth.

Total:65 Hours

Text Books:
1. Geoffrey M. Cooper and Robert E. Hausman ***The Cell: A Molecular Approach***, Fourth Edition, ASM Press and Sinauer Associates, Inc.,USA,2007
2. Ian Freshney R, Culture of Animal Cells. Alan R. Liss, Inc., New York. 4nd edition, 2005
Reference Books:
1. Kimball T.W., Cell Biology, Wesley Publishers; 3rd Edition, 2007
2. De Robertis & De Robertis, Cell Biology; 4th Edition, 2006
3. James D.Watson, Molecular Biology of the Cell. 2005

09BT202 INSTRUMENTAL METHODS OF ANALYSIS

Credit: 4:0:0

Objective

To develop skills of students in instrumentation and biological techniques.

Outcome

At the end of this course, the students would have learnt about principles of spectroscopy, nephelometry & chromatography and all biotechniques

Unit I Centrifugation and pH Measurement: (13)

Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H2 electrode and glass electrode. calibration of instrumental methods, Centrifugation- Principle and Types.

Unit II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer (13)

Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

Unit III Chromatography and Electrophoresis (18)

Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC. Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis, supporting materials-paper, starch, agarose, polyacrylamide.

Unit IV Radio active techniques (13)

Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Autoradiography, Applications in Medicine & Diagnosis.

Unit V Thermo Analytical Techniques (8)

Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC) Total: 65 Hours

Text Book:

1. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 2002.

2. Instrumental Methods of Analysis, D. Skoog, 2000.

Reference Books:

1. Ewing GW, Instrumental methods of Chemical Analysis, McGraw Hill Book Company, 1989.

2. Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987

09BT211 MICROBIOLOGY

Credit: 4:0:0

Objective

This paper enables the students to identify any microorganisms and its applications.

Outcome

To impart knowledge on classification of microbes and to improve the knowledge on genomic structure of microbes and applications of genetic engineering. This paper deals with various types of classification of microbes. The paper also throws light on multifarious habitats of microbes.

Unit – I Introduction (13)

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

Unit – II Microbes-Structure and Multiplication (13)

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

Unit – III Microbial Nutrition, Growth And Metabolism (13)

Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics, utilization of energy for biosynthesis of important molecules.

Unit – IV Control of Microorganisms (13)

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, antifungal
and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

Unit – V Industrial and Environmental Microbiology (13)

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, Vit.B12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers rhizobia, cyanobacteria, mycorrhizae (AMFungi) and biopesticides; microorganisms and pollution control; biosensors.

Total:65 Hours

Text Book

1. Pelczar MJ, Chan ECS And Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.2007

2. Prasad B.N., “A Text Book of Biotechnology”, Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal. 2003.

3. Reference Books:

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 2001.

2. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 2001.

3. Prasad B.N., “Biotechnology in Sustainable Biodiversity and Food Security”, Oxford & IBH, New Delhi. 2003.

09BT202 INSTRUMENTAL METHODS OF ANALYSIS

Credit: 4:0:0

Objective

To develop skills of students in instrumentation and biological techniques.

Outcome

At the end of this course, the students would have learnt about principles of spectroscopy, nephelometry & chromatography and all biotechniques

Unit I Centrifugation and pH Measurement: (13)

Definitions, preparations, derivation of Henderson-Hasselbalch equation and its application, buffering systems of blood, determination of pH using H2 electrode and glass electrode. calibration of instrumental methods, Centrifugation- Principle and Types.

Unit II Colorimeter, Flourimeter, Flame Photometer and Spectrophotometer (13)

Beer - Lambert's law, Principle, description and application of Colorimeter, Flourimeter, Flame photometer and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

Unit III Chromatography and Electrophoresis (18)

Chromatography- principles, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC. Electrophoresis – principles, types – disc, Isoelectric focussing, immuno-electrophoresis, supporting materials-paper, starch, agarose, polyacrylamide.

Unit IV Radio active techniques (13)

Radioactive isotopes, radioactive decay and their types, radioactive techniques-RIA, GM counter, Scintillation counter, Autoradiography, Applications in Medicine & Diagnosis.

Unit V Thermo Analytical Techniques (8)

Theory of thermal analysis- thermo gravimetric- Basic theory, construction and working of Differential Thermal Analysis (DTA) and Differential Scanning Calorimeter (DSC)

Total: 65 Hours

Text Book:

1. Willard and Merrit, Instrumental Methods and Analysis. VI Edition, CBS Publishers & Distributors; 2002.

2. Instrumental Methods of Analysis, D. Skoog, 2000.

Reference Books:

1. Ewing GW, Instrumental methods of Chemical Analysis, McGraw Hill Book Company, 1989.

2. Braun. H, Introduction to Chemical Analysis, McGraw Hill, 1987

09BT211 MICROBIOLOGY

Credit: 4:0:0

Objective

This paper enables the students to identify any microorganisms and its applications.

Outcome

To impart knowledge on classification of microbes and to improve the knowledge on genomic structure of microbes and applications of genetic engineering. This paper deals with various types of classification of microbes. The paper also throws light on multifarious habitats of microbes.

Unit – I Introduction (13)

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

Unit – II Microbes-Structure and Multiplication

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

Unit – III Microbial Nutrition, Growth And Metabolism (13)

Nutritional requirements of bacteria and different media used for bacterial culture, growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics, utilization of energy for biosynthesis of important molecules.

Unit – IV Control of Microorganisms (13)

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, antifungal
and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

Unit – V Industrial and Environmental Microbiology (13)

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, Vit.B12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers rhizobia, cyanobacteria, mycorrhizae (AMFungi) and biopesticides; microorganisms and pollution control; biosensors.

Total:65 Hours

Text Book

1. Pelczar MJ, Chan ECS And Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.2007

2. Prasad B.N., “A Text Book of Biotechnology”, Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal. 2003.

3. Reference Books:

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 2001.

2. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 2001.

3. Prasad B.N., “Biotechnology in Sustainable Biodiversity and Food Security”, Oxford & IBH, New Delhi. 2003.

09BT203 PRINCIPLES OF CHEMICAL ENGINEERING

Credits: 4:0:0

Objective

To develop skills of students in principles and basic calculations of chemical Engineering.

Outcome

To familiarize

- Units and Basic calculation
- Conservation and application
- Study of fluids
- Mechanism of Fluidization and Transportation of fluids

Unit-I Importance of units and Basic Calculation (13)

Conversion factors- Atomic, molecular & equivalent weights- Molar concept- moles, mole fraction, weight fraction, mixtures and solutions. Morality, modality and normality- density, specific gravity. Ideal gas law-Ideal mixtures and solution-Dalton aw of additive volumes, Concept of Simpson rules and its application

Unit – II. Material Balance with and without chemical reaction (13)

Laws of conservation of mass- meaning of material balance and its applications-like distillation ,evaporation, crystallization, drying etc Material balance with Chemical reactions, limiting and excess reactant, recycle , bypass and purging, problems. Conservation of energy- Meaning of energy balance and its applications

Unit- III. Fluid mechanics (13)

Nature of fluids - properties of fluids- Types of fluids, fluid static's- pressure measurements- Dimensionless analysis and similitude- Velocity potential ,continuity And mechanical energy equations, velocity profile and friction factor for smooth and rough surface pipes, Heads losses for various stations..

UNIT –IV. Fluid flow measurement (13)

Measurements of fluid flow – orifice meter, venturimeter, pitot tube, Rota meter, wires and notechs. Flow controls - gate valve , needle valve , butterfly valve, globe and ball valve.. Fluidization- mechanism , types, its application. Friction factor for packed beds, Ergun equations.

Unit- V Transportation of Fluid (13)

Transportation of fluids – fluids moving machinery performance, Selection and specification , Air lift and diaphragm pumps positive displacement pumps, reciprocating pumps, centrifugal pumps , pump characteristics. Concepts of compressors , fans and blowers.

Total : 65 hours

Text Books:

1.BI Bhatt &SM vora " Stoichiometry" Tata Mcgraw- Hill, Fourth Edition. 2004.
2.Chemical process calculation –by Ghavene – Delhi publications.2007

Reference Books:

1.Unit Operation of Chemical Engineering by McCabe and Smith- Harriot- Tata McGraw hill – 2001.
2.Unit operation of Chemical Engg " Chattopathya" Khanna publication- volume -1,2002
3. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.
4. Felder R.M. and Rousseau R.W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley and Sons, Inc., 2000.
5. V. Venkataramani and N.Anantharaman., Process Calculations., 2003

09BT201 BASIC INDUSTRIAL BIOTECHNOLOGY

Credit : 4:0:0

Objective

To impart the knowledge on Historical overview of Biotechnology, production of some commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures. Production of recombinant proteins

Outcome

At the end of the course, the students would have learnt about the steps involved in the production of bioproducts and methods to improve modern biotechnology

Unit – I Introduction to Industrial Bioprocess (13)

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

Unit – II Production of Primary Metabolites (13)

A brief outline of processes for the production of some commercially important Organic acids: citric acid, lactic acid, acetic acid; Amino acids: glutamic acid, lysine, phenyalanine, aspartic acid and Alcohols: ethanol, butanol.

Unit – III Production of Secondary Metabolites (13)

Study of production processes for various classes of secondary metabolites: Antibiotics-Betalactams:
penicillin, cephalosporin, Aminoglycosides: streptomycin, Macrolides: erythromycin, Vitamins: Vit.B12, B2, Vit.A and Steroids.

Unit – IV Production of Enzymes and Other Bioproducts (13)

Production of Industrial Enzymes: proteases, amylases, lipases, cellulases and Enzyme Inhibitors: inhibitors of cholesterol synthesis. Production of Biopesticides, Biofertilisers, Biopreservatives: Nisin, Cheese, Biopolymers: xanthan gum, PHB and Single cell protein.

Unit – V Production of Modern Biotechnology Products (13)

Production of recombinant proteins having therapeutic and diagnostic applications: vaccines, monoclonal antibodies. Products of plant and animal cell cultures.

Total : 65 hours

Text Book:

1. Casida Jr, L.E., Industrial Microbiology, New Age International (P) Ltd. (2000).
2. Wulf Cruger and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation. (2003)

Reference Books:

1. Presscott, Dunn, Industrial Microbiology, Agrobios (India).2006
2. Murrey Moo & Young, Comprehensive Biotechnology, Pergamon.2007
3. Ratledge & Kristiansen, Basic Biotechnology, IInd edition,; Cambridge University press. 2004.

09BT204 CHEMICAL ENGINEERING LAB

Credit: 0:0:2

List of Experiments:

1. Flow measurement through orifice meter
2. Flow measurement through venture meter
3. Head loses in pipe fitting
4. Pressure drop in fluidized bed column
5. Pressure drop in packed bed column
6. Flow through helical coil of different diameter pipe
7. Over all heat transfer coefficient in plate heat exchanger
8. Over all heat transfer coefficient in shell& tube heat exchanger
9. Over all heat transfer coefficient in double pipe heat exchanger
10. Screening Analysis

09BT212 MICROBIOLOGY LAB

Credit: 0:0:2

List of Experiments

1. Microscopy
2. Sterilization and Disinfection
3. Culture Media – Types & Preparation of Agar medium and Nutrient Broth
4. Inoculation of microorganisms
5. Isolation of pure culture by streak plate technique
6. Gram staining
7. Spore staining
8. Negative staining
9. Phenol coefficient test
10. Motility test- Hanging drop method and soft agar inoculation
11. Enumeration of microorganisms from soil
12. Enumeration of microorganisms from water

09BT218 BIOPROCESS PRINCIPLES

Credit : 4:0:0

Objective

To develop skills of the students in the area of Bio process Technology with emphasis on Bioprocess principles. This is a pre-requisite for courses on Bioprocess Engineering offered in the subsequent semesters.

Outcome

At the end of the course, the students would have learnt about fermentation processes, Metabolic stoichiometry, Energetics, Kinetics of microbial growth etc. This will serve as an effective course to understand certain specialized electives in Bioprocess related fields.

UNIT – I Overview of Fermentation Processes (13)

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT – II Raw Materials and Media Design for Fermentation Process (13)

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

UNIT – III Sterilization Kinetics (13)

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of depth filters, design of sterilization equipment - batch and continuous.

UNIT – IV Metabolic Stoichiometry and Energetics (13)

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 coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures,

UNIT – V Kinetics of Microbial Growth and Product Formation (13)

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

Total : 65 hours

Text books:

1 Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts – Second Edition Prentice Hall of India Pvt. Ltd., 2002

2 Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Second Edition, Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 1999.

Reference Books:

1 Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.),1986.

2 Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications,2005.

3 Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc,2007.

10BT201 BASIC ENGINEERING BIOCHEMISTRY

Credit : 4:0:0

Objective

To study about the structure, composition and function of various biomolecules

Outcome

At the end of the semester the students will enable to understand the metabolism of carbohydrates, lipids, proteins and the bioenergetics.

Unit - I :Introduction to Biomolecules

Biomolecules-functional groups, 3D structure, stereospecificity, chemical reactivity, macromolecules.

Water- Effects on dissolved biomolecules, Ionization of water, pH scale.

Buffer-definition, buffering in biological system, important biological buffers, buffer preparation

Vitamins-occurance, classification, properties and functions.

Enzymes- as catalyst, enzyme activity and specific activity, properties and functions.

Unit II: Carbohydrates and Bioenergetics

Classification of carbohydrates. Structure and properties of mono, di, oligo and polysaccharides, Carbohydrate Metabolism: Glycolysis-fate of pyruvate, pentose phosphate pathway, TCA cycle, glyoxylate cycle, gluconeogenesis, glycogenesis and glycogenolysis. Inborn errors of metabolism, triose phosphate cycle in plants. Bioenergetics: redox biochemistry, energy rich compounds, respiratory chain and oxidative phosphorylation

Unit – III : Proteins

Structure and properties of amino acids, modified amino acids, peptides and proteins

Metabolism Of Proteins- Biodegradation of proteins, Biosynthesis and biodegradation of important amino acids- Leu, Thr, Met, Lys, Tyr, Phe, Trp, Glutamate and Cys, Urea Cycle,- ,transamination. Inborn errors of their metabolism

Unit – IV : Lipids

Classification of lipids, Structure and properties of fatty acids, storage lipids, structural lipids, sphingolipids, glycolipids and cholesterol, lipid aggregates.

Lipid Metabolism: Biosynthesis and biodegradation of fatty acids and cholesterol.

Unit-V : Nucleic Acids

Structure, properties and functions of purines, pyrimidines, nucleosides, nucleotides, polynucleotides- ribonucleic acids and deoxy ribonucleic acids, chemistry of nucleic acids, nucleoprotein complexes.

Metabolism of Nucleic Acids- Biodegradation of nucleic acids, Biosynthesis and Biodegradation of purines and pyrimidines. Inborn errors of their metabolism.

Text book:

1. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2000). Principles of Biochemistry Third Edition (Freeman Publishers), New York.
2. Jain and Jain (2008). Biochemistry, Chand publication.

References:

1. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.
2. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.

Murray, R.K., Granner, B.K., Mayes, P.A., Rodwell. V.W., (2000) Harper's Biochemistry, Prentice Hall International.

09BT205 UNIT OPERATIONS

Credits: 4:0:0

Objective

This course aims at making the students understand the fundamental principles and concepts of heat transfer and mechanical operation in biochemical processes

Outcome

To expose the students of biotechnology to

- Principles and mechanism of heat transfer
- Fundamentals of convectional heat transfer
- Basic principles of heat exchanger design
- Concepts of drying and thermal processing of biological materials

Unit–I Heat Transfer. Basic considerations and conduction (13)

Importance of heat transfer in chemical and biotech operations , modes of heat transfer, mean temperatures. Concept of heat conduction, Fourier's law of heat conduction, Thermal conductivity, Heat conduction thro the composite wall , hallo spheres and hallo cylinder- steady state – unsteady state heat conduction. individual and overall heat transfer coefficients.

Unit – II. Convection and Radiations (13)

Concept of heat transfer by convection, Types of convection, application of dimensional analysis for convection: Derive the equation for laminar , Transition and Turbulent conditions. Heat transfer from condensing Vapours, Heat transfer to boiling liquids. Heat transfer in packed and fluidized beds. Concept of Radiation- Laws of radiations, Grey and Block bodies.

Unit-III. Heat Exchanger (13)

Heat exchanger – Types of flow- parallel and counter flow heat exchanger , LMTD, application of LMTD, Fouling factor - how to prevent the dirt factor. Types of heat exchanger , design of heat exchanger. Evaporator- Types of evaporators, Types of feeding, Calculations of Material and Energy balances ,concept of Evaporator capacity, Steam economy.

Unit-IV. Mechanical separation (13)

Filtration - Types of filtration , Filter media , selection of medium, Filter aids – Filter theory , Types of filter – Constant pressure filtration, constant volume filtration. Industrial filtrations. Sedimentation, Batch sedimentation, free settling and Hindered settling. Centrifugal and centrifuge.

Unit – V. Mixing and Agitation (13)

Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas-solid suspensions, mixing of Powder, Viscous material and pastes. Agitator scale up, Particle Size, Stability, Visual Density, Stabilizers, Emulsifying – rpm, temperature, Reduction, Gear motor system.

Total : 65 hours

Text Books:

1.Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.
2.McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition.Mcgrawhill.1993.

09BT213 MOLECULAR BIOLOGY

Credit : 4:0:0

Objective

Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation, repair in eukaryotes and prokaryotes and in cancer.

Outcome

The major objective of the paper is to provide knowledge of molecular biology and genetics of prokaryotic and eukaryotic organisms to the students. This paper provides insight on replication, transcription and translation processes in prokaryotes and eukaryotes, various mutations, their repair mechanisms and cancer genetics.

UNIT – I Classical Genetics (13)

Mendelian genetics, linkage, crossing over, classical experiments – Hershey and chase; Avery McLeod & McCarty. Bacterial conjugation, transduction and transformation.

UNIT – II DNA Replication (13)

Replication in prokaryotes and eukaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organization of eukaryotic chromosome – cot value, replication of telomeres in eukaryotes, DNA repair.

UNIT – III Transcription (13)

Prokaryotic and eukaryotic transcription, features of promoters and enhancers, transcription factors, inhibitors, post-transcriptional modification - RNA splicing, ribozyme. RNA editing.

UNIT – IV Translation (13)

Elucidation of genetic code, process of translation in prokaryotes and eukaryotes, suppressor mutation, post-translational modifications, inhibitors of protein synthesis.

UNIT – V Regulation of Gene Expression (13)

Regulation at various stages of gene expression in eukaryotes and prokaryotes - Lac and trp operons.

Total: 65 Hours

Text Books

1.David Friefelder, Molecular Biology, Narosa Publ. House. 1999

2. Gardner / Simmons / Snustad, Principles of Genetics, Eighth Edition, John Wiley,2005

Reference books

Benjamin Lewin, Gene IX, Oxford University Press. 2008

Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM,. Molecular Biology of the Gene. 1987

09BT208 ANALYTICAL BIOCHEMISTRY LAB

Credit: 0:0:2

1. Study of Biochemical Units And Measurements
2.Qualitative Analysis of Carbohydrates
3.Estimation of Glucose by Glucose Oxidase Method
4. Qualitative Analysis of Amino Acids
5. Estimation of Protein By Lowry's Method
6. Estimation of Amino Acid By Ninhydrin Method
7. Assay of Acid Phosphatase enzyme in Potato Extract
8. Estimation of DNA By Burton's Colorimetric Method
9. Estimation of Cholesterol By Zak's Method
10. Estimation of Ascorbic Acid By Titration Method
11. A. Extraction of Total Lipids
B. Saponification Characteristic of Lipids
12. Dry Ashing of Food Materials And Colorimetric estimation of Phosphorus

09BT219 BIOPROCESS LAB

Credit : 0:0:2

Title of the Experiments:

1. Culturing of Different Types of Microorganism
2. Estimation of Biomass Production
3. Effect of Substrate Concentration on Growth Of E-coli
4. Effect of pH on Enzyme Activity
5. Effect of Temperature on Enzyme Activity
6. Immobilization of ∞ - Amylase Enzyme
7. Components of Fermentor
8. Determination of Volumetric Mass Transfer Coefficient
9. Enzyme Assay- Starch Plate Assay
10. Quantitative Enzyme Assay
11. Production of Wine
12. Production of Amylase From Bacillus subtilis and Assaying for its Activity

09BT221 BIOPROCESS ENGINEERING

Credits: 4:0:0

Objective

To develop skills of the students in the area of Bio process Engineering with emphasis on Bioreactor operation and design.

Outcome

At the end of the course, the students would have learnt about Bioreactor operation and design, scale-up, modeling and simulation . This will serve as an effective course to understand certain specialized electives in Bioprocess related fields

UNIT I DESIGN AND ANALYSIS OF BIOREACTORS (13)

Design and operation of novel bioreactors-Air-lift loop reactors; Fluidized bed-bioreactors; packed bed reactor, Bubble column reactor, RTD and stability analysis of bioreactors

UNIT II BIOREACTOR SCALE-UP (13)

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed

UNIT III MONITORING OF BIOPROCESSES (13)

On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry ; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes

UNIT IV MODERN BIOTECHNOLOGICAL PROCESSES (13)

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures

UNIT V MODELLING AND SIMULATION OF BIOPROCESSES (13)

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

Total : 65 hours

Text Books:

1. Michael Shuler, Fikret Kargi, “Bioprocess Engineering Principles”,Second edition, Prentice Hall,2002

2. P.Stanbury, A.Whitaker,SJ Hall “Principles of fermentation technology”,Second edition, Elsvier Pergamon Press,1999

Reference Books:

1. Pauline Doran,”Bioprocess Engineering Principles”, Academic Press,1995

2. Elmar Heinzle, Arno P.Biwer, “Development of Sustainable Bioprocess: Modelling and Assessment”, Wiley, 2007.

3. Bjorn K.Lyderson, Nancy Ade’lia and Kim Nelson,”Bioprocess engineering *(handcover)”,*Wiley Interscience,1994

09BT229 CHEMICAL THERMODYNAMICS AND BIOTHERMODYNAMICS

Credit: 4:0:0

Objective

The course aims at making the students understand the fundamental principles and concepts of chemical and biothermodynamics.

Outcome

The students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose, aim advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT – I Thermodynamic Properties of Fluids (13)

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT – II Solution Thermodynamics (13)

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT – III Phase and Chemical Reaction Equilibria (13)

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquidliquid
equilibria and solid-solid equilibria. Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT – IV Thermodynamic Analysis of Processes (13)

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

UNIT – V Biochemical Thermodynamics (13)

Energetics of metabolic pathways energy coupling (ATP and NADH), stochiometric and energetic analysis of cell growth and product formation-elemental balances, degree of reduction concepts-available –electron balance, yield coefficients, oxygen consumption and heat evolution in aerobic cultures, thermodynamics efficiency of growth.

Total: 65 Hours

Text Books

1. Narayanan K.V. A Text Book Of Chemical Engineering Thermodynamics, Prentice Hall India, 2001.

Reference books

1. Sandler S.I. Chemical And Engineering Thermodynamics, John Wiley,1989.
3. 2. Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics. 6th
4. Edition. McGraw-Hill, 2001.
5. 3. Royels, JA, Kinetics and Energetics in Biotechnology, Elseviers, 1983

09BT206 MASS TRANSFER OPERATIONS

Credits: 4:0:0

Objective

- To introduce the mass transfer principles
- To study the vapor liquid equilibrium
- To teach the concept s liquid - liquid equilibrium
- To study in detail the principles of adsorption
- To introduce the concept of membrane separation

Outcome

At the end of the course the students would have learnt about the basics of the mass transfer process in biotechnological process.

Unit-I Diffusion in fluids (13)

Molecular and Eddy diffusion in a gas and liquid , Steady state diffusion under stagnant and laminar flow condition. Diffusion measurement and calculations. Ordinary diffusion in multicomponents gaseous mixtures, diffusion in solids . Interface mass transfer , Theory of mass transfer , Concept of mass transfer coefficient, overall mass transfer coefficient , Analgies between momentum and mass transfer coefficients.

Unit-II Distillation (13)

Vapour – Liquid equilibrium diagram, Raoults law derivations from ideality , methods of distillation – Batch and continuous distillation. Types of distillation – Simple distillation , flash distillation, Fractional distillation. Design calculations of by McCabe –Thiele method and Ponchon Savarite methods. Various industrial distillation – Extractive distillation , molecular distillation, Azeotropic distillation, steam distillation.

Unit –III Absorption (13)

Theories of gas absorption, Desgn of absorption towers , absorption with chemical reaction, Types of packing and Characteristics , Concept of NTU and HTU.

Unit – IV Adsorption Ion-Exchange (13)

Theories of adsorption of gases and liquids : industrial adsorbents. Adsorption equipments for batch and continuous operation. Principles of Ion –Exchange, Industrial equipments .

Unit – V Leaching and Extraction (13)

Solid – liquid equilibrium, Leaching equipment- Batch and continuous types: Calculations of number of stages. Equlibrium in ternary systems , batch and continuous extractors. different contact Extractors.

Total : 65 hours

Text books:

1.R.E Treybal, " Mass Transfer Operations" McGraw Hill-2003
2. Mass transfer –II K.A.gavhane,Nirali publications,2007

Reference books:

1.Unit operation of Chemical Engineering – Chattophathya – Khanna publication-2005
2.W.L McCabe Smith and Harriot P " Unit Operations of Chemical Engineering" Sixth edition McGraw Hill , International edition, 2001
3.Unit operations of chemical engg,Mc Cabe & Smith, Tata McGraw Hill, 7th edn, 2005
4.Chemical engineering,coulsion Richardson,vol-2,2003
5.Introduction to chemical engineering,badger and banchero, Tata McGraw Hill, 7th edn, 2005

09BT216 IMMUNOLOGY AND IMMUNOTECHNOLOGY

Credits: 4:0:0

Objective

This course aims to develop the skills of the students in Immunotechnology, antigen antibody response, immunodiagonosis, immunopathology etc.

Outcome

At the end of the course would have learnt about the mechanisms by which a human body interacts with a pathogenic microbe & how it eliminates it. Students, also familiarize themselves with immunopathology and immunotherapy.

Unit I: Outlines of Immunology (13)

Types of Immunity - Innate and acquired immunity, Lymphoid Organs- Primary and Secondary ,

Unit II: Immue Response (13)

Cells of Immune system- Macrophages, T cells, B Cells, NK Cells, Mast cells. MHC and its significance. Subtypes of T Cells and their functions: Cytotoxic T cells, Helper T cells, Suppressor T cells and Regulatory T cells. Cytokines and Cytokines- their biological role; Phagocytosis;Humoral and Cell mediated Immune Response.

Unit III: Antigens, Antibodies and Complements (13)

Antigens- Types; Antigenicity and Immunogenicity; Immunoglobulins – Structure, function and biological properties of different classes of Immunoglobulins; Immunoglobulin Genes; Antigen Antibody Interaction; Complement activation – Classical and alternative pathways.

Unit IV: Immunopathology and Immunologic disorders (15)

Hypersensitivity: Types, mechanisms and disorders; Autoimmunity; Tumour Immunology- Tumour Associated antigens and Tumour Specific Antigens; Transplantation Immunology, Immunodeficiency diseases; Immunotherapy.

Unit V: Immunity to Infections and Immunotechnology (15)

Immunity to bacteria, virus, fungi and parasites. Active Immunization and Passive Immunization; Monoclonal and Polyclonal Antibody Production; Vaccines; Immunological Techniques – RIA, ELISA and Elispot Assay; Immunocytochemistry, Immunofluorescence.

Text Book:

1 Kuby, J. Immunology. W.H. Freeman and Company, New York. 2002

2 Abul K. Abbas, Andrew K. Lichtman & Jordan S. Pober (Eds.). Cellular and Molecular Immunolgy. 3rd Edn. W.B. Saunders Company, 2001

Reference Books:

1 Ivan Roitt,Essential Immunology, 10th Edn. Blackwell Scientific Publication, , 2002,

2 Weir DM and Stewart, J., Immunology, 10th Edn. Churchill Livingston, New York, 2000.

3 Brudce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D Watson (Eds.) Molecular Biology of the Cell (5th Edn), 2000,.

4 Ivan Roitt, Jonathan Brostoff, David Male (Eds.)., Immunolgy, 5th Edn., Mosby Publication, 2002.

10BT202 GENETIC ENGINEERING AND BIOETHICS

Credit : 4:0:0

Objective

Helps the student to understand and apply this knowledge in research to study the molecular mechanism of DNA and RNA synthesis and Protein synthesis, mutation,r-DNA technology.

Outcome

At the end of the semester the students would have learnt about r-DNA technology, genomic library,PCR and other applications of genetic engineering and also ethical issues relating to genetically manipulated products

UNIT – I Basics of Recombinant DNA Technology (15)

Overview of recombinant DNA technology - Steps, Restriction and modifying enzymes. Restriction mapping, design of linkers and adaptors. Cloning in plants, transgenic and knockout animals. Recombinant cytokines and antibodies, vaccines, gene-therapy, stem cell therapy. Invitro fertilization, embryo transfer technology.

UNIT – II Polymerase Chain Reaction & Construction of Libraries (15)

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing. Diagnostic importance of PCR. Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT – III Cloning Vectors (13)

Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT – IV Bioethics & IPR (11)

Bioethics: The legal and socioeconomic impacts of Biotechnology. Intellectual property rights, TRIPS, GATT, International conventions, Patents and methods application of patents, Legal implications, Biodiversity and farmers rights.

UNIT – V Biosafety and rDNA guidelines (11)

Biosafety regulation and National and international guidelines, r-DNA guidelines, Experimental protocol approvals, levels of containment. Definition of GMO & LMO; Roles of Institutional Biosafety committee, RCGM, GEAC etc for GMO applications in food and agriculture; Environmental release of GMOs- risk analysis and assessment.

Total : 65 hours

Text Book:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 2002.
2. Saleesha A.Stanely, “Bioethics”, Wisdom educational service, 2008.

Reference book:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology ", Greene Publishing Associates, NY, 1988.
2. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987
   Sambrook et al Vol. 1-3, "Molecular Cloning"

09BT215 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credit: 0:0:2

List of Experiments:

1. Isolation of genomic DNA from plant tissue
2. Isolation of genomic DNA from Micro-organisms
3. Isolation of genomic DNA from animal tissue
4. Isolation of DNA and spectrophotometric analysis
5. Agarose Gel Electrophoresis-genomic DNA
6. Isolation of plasmid DNA from E.coli
7. Restriction enzyme digestion
8. DNA Ligation
9. Molecular weight analysis using Agarose Gel electrophoresis
10. Transformation of cells
11. Competent Cell preparation
12. SDS-PAGE electrophoresis.

09BT217 CELL BIOLOGY LAB AND IMMUNOLOGY LAB

Credit: 0:0:2

List of Experiments:

1 Study of Microscopy
2 Microscopically Identification of Cells in Permanent Fixed Slides
3 Staining for Various Stages of Mitosis in Allium cepa (Onion)
4 Osmosis and Tonicity Studies Using Red Blood Corpuscles
5 Differentiation of Blood Cells Using Giemsa Staining
6 Separation of Peripheral Blood Mononuclear Cells and Trypan Blue Assay for Live Cell
7 Blood Grouping and Rh typing
8 Preparation of Plasma and Serum
9 Single Radial Immunodiffusion
10 Double Immunodiffusion – Ouchterlony Method
11 Immunoelectrophoresis
12 Counter Current Immunoelectrophoresis
13 Rocket Immunoelectrophoresis – Laurell method
14 Immunodiagnosis of Typhoid fever – Widal Test
15 Enzyme Linked Immunosorbent Assay

09BT222 DOWNSTREAM PROCESSING

Credit : 4:0:0

Objective

To develop skills of the students in the area of Downstream processing with emphasis on purification of products.

Outcome

At the end of the course, the students would have learnt about various methods of separation and purification of bioproducts.

UNIT – I Downstream Processing (13)

Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts

UNIT – II Physical Methods of Separation (13)

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT – III Isolation of Products (13)

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT – IV Product Purification (13)

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques

UNIT – V Final Product Formulation and Finishing Operations (13)

Crystallization, drying and lyophilization in final product formulation.

Total : 65 hours

Text book

1.. Bioseperations: Principles and Techniques, B. Sivasankar,Published by PHI Learning Pvt. Ltd., 2006

2.Bioseparation Technology,Mishra Neeraj,CRC Press,2008

Reference Books:

1.Bioseparations Science and Engineering ,Day, Trevor G, and Harrison, Roger G, and Rudge, Scott R, Publisher: Oxford University Press, USA, 2002

2..Handbook of Bioseparations**,**Satinder Ahuja,Published by Academic Press, 2000

3..HPLC of Biological Macromolecules,Karen M. Gooding, Fred E. Regnier, Contributor Karen M. Gooding, Fred E. Regnier,Published by CRC Press, 2002

4.. Isolation and Purification of Proteins,Rajni Hatti-Kaul, Bo Mattiasson,Published by CRC Press, 2003

5.. A Century of Separation Science, Haleem J. Issaq,Published by CRC Press, 2002

09BT230 BIO REACTION ENGINEERING

Credit : 4:0:0

Objective

This deal with the study of kinetics of chemical and bio chemical process and exposes the design of several types of reactions.

Outcome

To expose the fundamental of

- Kinetics of homogeneous reaction in batch reactors
- Design of ideal reactor
- Design principles in non isothermal reactions
- Non ideal flow reactor modules
- Design equation in biochemical reactors

Unit-1 Homogeneous Reactions (13)

Introduction, classification of chemical reactions, definition of reaction rate, variable affecting the rate of reaction, rate expression, molecularity & order of reaction, rate constants, temperature dependent term of a rate equation [Arrhenius law, Collision Theory], Homogeneous reactions, Batch reactor data / Kinetic data – Constant – volume reactor, variable – volume reactor [Integral method, Differential method], Half life time.

Unit-2 Ideal reactors (13)

Types of reactor – Batch, CSTR, PFR, reactor design, Multiple reactor.
CSTR, PFR connected in series & parallel, mixed reactors.

Unit-3 Non – Ideal reactors (13)

Non-ideal flow introduction & various models [Compartment model, Dispersion model, Tank in series model], RTD studies.

Unit-4 Multiple reactions (13)

Irreversible reaction & reversible reactions, series & parallel reactions, first-order followed by zero-order reaction, zero-order followed by first-order reaction, Denbigh reactions-Batch, CSTR and PFR.

Unit-5 Biochemical Reactions (13)

Biochemical Reactions - Cell growth - Rate equations - Stoichiometry - Mass Balance - Design Equations.

Total: 65 Hours

Text Books

1. Octave Levenspiel-"Chemical Reaction Engineering", Third edition – John Willey, 1999.

2. Bailey & ollis – "Biochemical Engineering Fundamentals", second edition – McGraw Hill, 1986.

Reference Books

1. Scott Fogler. H – " Elements of Chemical Reaction Engineering" – second edition – Prentice Hall of India Pvt. Ltd., 1995.
2. Charles D. Holland – "Fundamentals of chemical Reaction Engineering" Second edition – John willey & sons, 1990.
3. Smith J. M. – "Chemical Engineering Kinetics" – Second edition – McGraw Hill, 1981.
4. Shule & Karg – "Bioprocess Engineering" – Prentice Hall, 1992

09BT228 BIOINFORMATICS LAB

Credit : 0:0:2

List of Experiments:

1. NCBI - Viral and bacterial genome analysis
2. BLAST – Similar DNA sequences search
3. EMBL – Nucleotide sequence database
4. SWISSPROT/TREMBL – Protein sequence database
5. Analysis of Protein sequence using PIR database
6. Analysis of structural features of proteins using protein data bank and SWISS PDB viewer
7. Eukaryotic gene prediction
8. Identification of disease gene
9. Protein sequence analysis tools
10. Multiple sequence alignment and phylogenetic trees

09BT209 BIOORGANIC CHEMISTRY

Credit: 4:0:0

Objective

To impart knowledge about biocatalyst, proteins and kinetics of various biochemical reactions

Outcome

At the end of the semester the students will understand various biochemical synthesis, protein kinetics and the mechanism involved in biochemical reactions

Unit – I Concepts in organic chemistry (13)

Stereochemistry- R, S notation, E, Z Isomerism- Mechanism of SN1 and SN2 reactions. Mechanisms of E1 and E2 reactions. Enantiomers, Optical isomers, optical activity and optical rotation-polarimeter.

Unit – II Chemistry of enzymes (13)

Structure of atom, chemical bonding and its characteristics, Chemical bonding involved in protein structure, Specificity of enzymes. Concept of Free energy and its importance in biology. Chemistry of active oxygen species, free radicals systems.

Unit – III Case studies of enzyme structure and mechanism (13)

Acid base and covalent catalysis**,** Stereochemistry of amino acids, Structure and mechanism of pyruvate dehydrogenase, proteases, ribonucleases, Carboxy peptidase, lysozyme. NAD, Dependent oxidation and reduction reactions,

Unit IV: Hydrolysis in chemical synthesis (13)

Ester hydrolysis, Amide hydrolysis, peptide synthesis, structure and mechanism of FAD THF coenzymes, Application of enzymes in industry and medicine. .

UNIT V : Protein folding kinetics and folding pathways (13)

Structure of proteins- an overview, Basic methods of protein folding – two state kineticsmultistate kinetics-in protein folding**.** Protein folding, its dynamics, stability of proteins and molecular chaperones. NMR, Circular dichorism - Principles, types, components and applications in Biology.

Total: 65 Hours

Text books:

1. Text- H.Dugas , Bioorganic chemistry, Springer Verlag Publishers, 1999.
2. Biochemistry by Mathew , Van Holde, Athern , Pearson Publishers Ltd, New Delhi, 2000.

Reference Books:

1. Fundamental of Biochemistry by J.L. Jain & Sunjay Jain, 6th Edition, 2004.
2. Organic chemistry by Paula yurkaris Bruice, 3rd edition, Pearson P Ltd, New Delhi; 2002.
3. Trevor Palmer, Enzymes, East West Press P Ltd, New Delhi, 2005.
4. Organic Chemistry, Vol:2, 5th edition, I. L. Finar, , Pearson Education, 2007.
5. Text book of Bio-organic Chemistry, H. Dugas. Springer Verlay Publishers, 2002.

09BT220 ENZYME ENGINEERING AND TECHNOLOGY

Credits: 4:0:0

Objective

To develop skills of the students in the area of Enzyme Engineering with emphasis on Bioreactor operation and design.

Outcome

At the end of the course, the students would have learnt about classification of enzymes, immobilization, extraction and purification of enzymes and biosensors.

UNIT I INTRODUCTION AND APPLICATION OF ENZYMES (13)

Classification of enzyme; Types of enzymes-Constitutive enzyme, induced enzymes, Intracellular and Extracellular enzymes; Application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications.

UNIT II MECHANISMS AND KINETICS OF ENZYME ACTION (13)

Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action , kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multi substrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.

UNIT III PURIFICATION AND CHARACTERIZATION (13)

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

UNIT IV ENZYME IMMOBILIZATION (13)

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme system

UNIT – V ENZYME BIOSENSORS (13)

Types of Biosensors; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

Total : 65 hours

Text Books:

1. Enzymes by Palmer Horwood Publishing Series. 2001
2. Fundamentals of Enzymology by Price and Stevens Oxford University Press. 2002

Reference Books:

1. Biocatalysts and enzyme technology**,** Klaus Buchholz, Volker Kasche, Uwe Theo Bornscheuer ,Published by Wiley-VCH, 2005
2.Biotechnology for the Future**,** Jens Høiriis Nielsen, Sabine Arnold, Contributor Jens Høiriis Nielsen,Published by Springer, 2005
3.Enzymes in Industry: Production and Applications**,**Wolfgang Aehle Contributor Wolfgang Aehle,Edition: 2,Published by Wiley-VCH, 2004
4.Text ***book 'Enzyme Technology*****,** Martin Chaplin and Christopher Bucke, Cambridge University Press, Dec 2004

09BT232 PROTEIN ENGINEERING

Credits: 4:0:0

Objective

To develop skills of students in chemical bonds and their interactivity, protein architecture and its influence on protein function. Application of knowledge of protein in biotechnology.

Outcome

Upon successful completion of this course, the student should be well versed in the following: Chemical bonds and their influence in protein structure formation. Comprehensive knowledge of 3-D structure in relation to its functions. Appreciate the application of this knowledge in protein engineering.

UNIT I BONDS AND ENERGIES IN PROTEIN MAKEUP (13)

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II AMINO ACIDS AND THEIR CHARACTERISTICS (13)

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to posttranslational
modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and
peptide synthesis.

UNIT III PROTEIN ARCHITECTURE (13)

Primary structure, Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, Tertiary structure: Domains, folding, denaturation and renaturation, Quaternary structure: Modular nature, formation of complexes.

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP (13)

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes : Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase

UNIT V METHODS OF PROTEIN ENGINEERING *(13)*

Methods of Proteins engineering, Immunotoxins, Drug Designing

Total : 65 hours

Text Books:

1. Moody PCE and Wilkinson AJ “Protein Engineering” IRL Press, Oxford,1990
2. Branden C.Tooze, “Introduction to protein structure”, Garland,1993.

Reference books:

1. Creighton TE, “Proteins” Freeman WH Second edition,1993
2. Paul R.Carey,”Protein Engineering and Design”,Academic Press,1996
3. Lutz, Stefan/Bornschever, “Protein Engineering Handbook”,Wiley VCH,2009
4. Robert Murray, Daryl Granner,“Harpers’s Illustrated Biochemistry” 26th Edition, International Edition,2003