BIOTECHNOLOGY

B.Tech. (Biotechnology) – 2016 batch
COURSE COMPONENTS
Table 1

Sl. No.	Course Code	Basic Sciences – 12 credits Name of the Course	Credits
1	14BT2001	Basics of Biochemistry	3:1:0
2	14MA2012	Numerical Methods	3:1:0
3	14MA2008	Probability and Statistics	3:1:0
		Course Total	12

Table 2

Sl. No.	Course Code	Engineering Sciences & Technical Arts – 6 credits Name of the Course	Credits
1	16EN2006	Soft skills – I	2:0:0
2	16EN2007	Soft skills – II	2:0:0
3	17GA2001	General Aptitude I	1:0:0
4	14BT2003	Principles of Chemical Engineering	3:0:0
		Course Total	8

Table 3

Sl.No	Course Code	Programme Core – 75 credits & a full / part semester project Name of the Course	Credits
1	14BT2002	Biochemistry Lab	0:0:2
2	14BT2004	Cell Biology	3:0:0
3	14BT2005	Microbiology	3:0:0
4	14BT2006	Microbiology Lab	0:0:2
5	14BT2007	Basic Industrial Biotechnology	3:0:0
6	14BT2008	Metabolism and Bioenergetics	3:1:0
7	14BT2009	Bioprocess Principles	3:0:0
8	14BT2010	Bioprocess Lab	0:0:2
9	14BT2011	Molecular Biology	3:0:0
10	14BT2012	Genetic Engineering and Bioethics	3:0:0
11	14BT2013	Molecular Biology and Genetic Engineering Lab	0:0:2
12	14BT2014	Bioorganic Principles	3:0:0
13	14BT2015	Bioreactor Engineering	3:0:0
14	14BT2016	Enzyme Engineering	3:0:0
15	14BT2017	Immunology	3:0:0
16	14BT2018	Cell Biology and Immunology Lab	0:0:2
17	14BT2019	Chemical Reaction Engineering	3:0:0
18	14BT2020	Downstream Processing	3:0:0
19	14BT2021	Downstream Processing Lab	0:0:2
20	14BT2022	Mechanical Operations	3:0:0
21	14BI2001	Analytical Bioinformatics	3:0:0
22	17BT2027	Chemical and Biothermodynamics	3:0:0
23	17BT2013	Fluid Mechanics For Biotechnologists	3:1:0
24	14FP2005	Heat and Mass Transfer	3:0:0
25	14FP2003	Fluid Mechanics and Heat Transfer Lab	0:0:2
26	14BI2002	Instrumental Methods of Analysis	3:0:0
27	14BI2012	Instrumental Methods of Analysis Lab	0:0:2
		Total	**75**
	FSP2999/PSP2998	Full / Part Semester Project	18/12
		Total	**93/87**

Table 4

Course Code	Name of the Course	Credits
Soft Core – [Agricultural Biotechnology] (min of 21 credits to be earned)		
14BT2024	Plant physiology and Crop Improvement	3:0:0
14BT2025	Plant Tissue Culture	3:0:0
14BT2026	Plant Microbe Interactions	3:0:0
14BT2027	Molecular Plant Pathology and Entomology	3:0:0
14BT2028	Molecular Plant Breeding	3:0:0
14BT2029	Biotechnology of Biotic and Abiotic Stress Tolerance	3:0:0
14BT2030	Entrepreneurial Agriculture and Biomass Energy	3:0:0
14BT2031	Horticultural Crop Production, Management and Green House Technology	3:0:0
14BT2032	Food and Nutrition Security of GM Crops	3:0:0
14BT2033	Post-Harvest Technology	3:0:0
14BT2034	Mechanization and Post-Harvest Technology Lab	0:0:2
14BT2035	Gene manipulation lab	0:0:2
14BT2036	Plant breeding and Crop management Lab	0:0:2
Soft Core – [Medical Biotechnology] (min of 21 credits to be earned)		
14BT2037	Developmental Biology	3:0:0
14BT2038	Human Genetics and Genomics	3:0:0
14BT2039	Vaccine Biotechnology	3:0:0
14BT2040	Animal Biotechnology and Cell Culture Techniques	3:0:0
14BT2041	Molecular Forensics	3:0:0
14BT2042	Stem Cell Technology	3:0:0
14BT2043	Human Physiology	3:0:0
14BT2044	Cancer Biology	3:0:0
14BT2045	Biopharmaceutical Technology	3:0:0
14BT2046	Research Methodology	3:0:0
14BI2031	Clinical Database Management	3:0:0
14BI2038	Clinical Database Management Lab	0:0:2
Soft Core – [Industrial Bio- Engineering] (min of 21 credits to be earned)		
14BT2047	Biochemical Engineering	3:0:0
14BT2048	Metabolic Engineering	3:0:0
14BT2049	Process Equipment Design	3:0:0
14BT2050	Process Control Engineering	3:0:0
14BT2051	Pilot plant & Scale Up practice	3:0:0
14BT2052	Industrial Safety & Hazard Analysis	3:0:0
14BT2053	Industrial Effluent Treatment	3:0:0
14BT2054	Bioenergy and Biomaterials	3:0:0
14BT2055	Pollution Control and Engineering	3:0:0
14BT2056	Entrepreneurship	3:0:0
14BT2057	Mechanical Operation Lab	0:0:2
14BT2058	Process Control Lab	0:0:2

PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Name of the Course	Credits
1	17BT2047	Plant and Animal Tissue Culture Lab	0:0:2
2	17BT2048	Bioprocess Control and Instrumentation	3:0:0
3	17BI2051	Biological Big Data Analytics	3:0:0
4	17BI 2052	Python Programming	3:0:0

B.Tech (Biotechnology) – 2017 batch
COURSE COMPONENTS

Table 1

Sl. No.	Course Code	Basic Sciences – 12 credits Subject	Credits
1	17BT2001	Basics of Biochemistry	3:1:0
2	17MA2012	Numerical Methods	3:1:0
3	17MA2008	Probability and Statistics	3:1:0
		Subjects Total	**12**

Table 2

Sl. No.	Course Code	Engineering Sciences & Technical Arts – 7 credits Subject	Credits
1	17BT2003	Principles of Chemical Engineering	3:0:0
2	17SS2001	Soft skills – I	1:0:0
3	17SS2002	Soft skills – II	1:0:0
4	17GA2001	General Aptitude – I	1:0:0
5	17GA2002	General Aptitude– II	1:0:0
		Subjects Total	**7**

Table 3

Sl.No	Course Code	Programme Core – 75 credits & a full / part semester project Name of the Course	Credits
1	17BT2002	Biochemistry Lab	0:0:2
2	17BT2004	Cell Biology	3:0:0
3	17BT2005	Microbiology	3:0:0
4	17BT2006	Microbiology Lab	0:0:2
5	17BT2007	Instrumental Methods of Analysis	3:0:0
6	17BT2008	Instrumental Methods of Analysis Lab	0:0:2
7	17BT2009	Basic Industrial Biotechnology	3:0:0
8	17BT2010	Metabolism and Bioenergetics	3:1:0
9	17BT2011	Bioprocess Principles	3:0:0
10	17BT2012	Bioprocess Lab	0:0:2
11	17BT2013	Fluid Mechanics for Biotechnologists	3:1:0
12	17BT2014	Fluid Mechanics and Heat Transfer Lab	0:0:2
13	17BT2015	Molecular Biology	3:0:0
14	17BT2016	Genetic Engineering and Bioethics	3:0:0
15	17BT2017	Molecular Biology and Genetic Engineering Lab	0:0:2
16	17BT2018	Bioorganic Principles	3:0:0
17	17BT2019	Bioreactor Engineering	3:0:0
18	17BT2020	Enzyme Engineering	3:0:0
19	17BT2021	Immunology	3:0:0
20	17BT2022	Cell Biology and Immunology Lab	0:0:2
21	17BT2023	Chemical Reaction Engineering	3:0:0
22	17BT2024	Downstream Processing	3:0:0
23	17BT2025	Downstream Processing Lab	0:0:2
24	17BT2026	Mechanical Operations	3:0:0
25	17BT2027	Chemical and Bio-thermodynamics	3:0:0
26	17BT2028	Heat and Mass Transfer Operations	3:0:0

27	17BI2001	Analytical Bioinformatics	3:0:0
		Total	**75**
28	17BT2998 / 17BT2999	Part/ Full Semester Project	0:0:12/ 0:0:18
		Total	**87/93**

Table 4

List of Professional Electives – 27/21 Credits		
Course Code	**Name of the Course**	**Credits**
17BT2029	Plant physiology and Crop Improvement	3:0:0
17BT2030	Plant Genetic Engineering	3:0:0
17BT2031	Agriculture and Biomass Energy	3:0:0
17BT2032	Horticultural Crop Production, Management and Green House Technology	3:0:0
17BT2033	Developmental Biology	3:0:0
17BT2034	Human Genetics and Genomics	3:0:0
17BT2035	Vaccine Biotechnology	3:0:0
17BT2036	Animal Biotechnology and Cell Culture Techniques	3:0:0
17BT2037	Cancer Biology	3:0:0
17BT2038	Biopharmaceutical Technology	3:0:0
17BT2039	Biochemical Engineering	3:0:0
17BT2040	Metabolic Engineering	3:0:0
17BT2041	Process Equipment Design	3:0:0
17BT2042	Pilot plant and Scale Up Practice	3:0:0
17BT2043	Industrial Safety and Hazard Analysis	3:0:0
17BT2044	Industrial Effluent Treatment	3:0:0
17BT2045	Pollution Control and Engineering	3:0:0
17BT2046	Mechanical Operation Lab	0:0:2
17BT2047	Plant and Animal Tissue Culture Lab	0:0:2
17BT2048	Bioprocess Control and Instrumentation	3:0:0
17BI2041	Clinical Database Management	3:0:0
17BI2049	Clinical Database Management Lab	0:0:2
17BI2051	Biological Big Data Analytics	3:0:0
17BI2052	Python Programming	3:0:0
	Subjects offered to other Departments	
17BT2049	Applied Medical Biochemistry	3:0:0
17BT2050	Medical Biochemistry Lab	0:0:1
17BT2051	Human Physiology and Anatomy	3:0:0
17BT2052	Biomaterials and Artificial Organs	3:0:0
17BT2053	Occupational Safety Management	3:0:0
17BT2054	Medical Waste Treatment	3:0:0
17BT2055	Cell Biology and Immunology	3:0:0
17BT2056	Tissue Engineering	3:0:0
17BT2057	Techniques in Pathology and Microbiology	3:0:0
17BT2058	Microbiology and Immunology	3:0:0
MP2952	Mini Project	0:0:2
ITP2901	Industrial Training	0:0:1
ISP2997	Internship	0:0:8

Table 5

List of University Electives – 6 Credits		
Course Code	**Name of the Course**	**Credits**
17BT2059	Analytical Instrumentation	3:0:0
17BT2060	Biology in Everyday Life	3:0:0
17BT2061	Biotechnology and Environment	3:0:0

17BT2062	Entrepreneurship in Bioengineering	3:0:0
17BT2063	Pollution Control	3:0:0

M.Tech (Biotechnology) – 2017 Batch

COURSE COMPONENTS

Table 1

Sl.No	Course Code	Programme core – 36 credits, a full & part semester project Name of the Course	Credits
1	14MA3003	Foundations of Mathematics and Statistics	3:0:0
2	14BT3001	Applied Biochemistry	3:0:0
3	14BT3002	Analytical Techniques and Biochemistry Lab	0:0:2
4	14BT3003	Advanced Bioprocess Engineering	3:0:0
5	14BT3004	Bioprocess Engineering and Downstream Processing Lab	0:0:2
6	14BT3005	Computational Biology	3:0:0
7	14BT3006	Advances in Recombinant DNA Technology	3:0:0
8	14BT3007	Recombinant DNA Technology Lab	0:0:2
9	14BT3008	Biopharmaceutical Technology	3:0:0
10	14BT3009	Advanced Process Equipment Design	2:0:0
11	14BT3010	Process Equipment Drawing Lab	0:0:2
12	14BT3011	Sustainable Bioprocess Development	3:0:0
13	14BT3012	Advanced Environmental Biotechnology	3:0:0
14	14BT3013	Entrepreneurship, IPR and Biosafety	2:0:0
		Total Credits	**36**
15	17VE3002	Value Education	0:0:2
16	FSP3999	Full Semester project	20
17	PSP3998	Part Semester Project	12
		Total	**70**

Table 2

Sl.No	Course Code	Soft Core – Biochemical Engineering (min of 12 credits to be earned) Name of the Course	Credits
1	14BT3014	Research Methodology	2:0:0
2	14BT3015	Industrial Safety	3:0:0
3	14BT3016	Enzyme Technology and Industrial Applications	3:0:0
4	14BT3017	Advanced Bioreactor Engineering	3:0:0
5	14BT3018	Chemical Process Technology	3:0:0
6	14BT3019	Chemical and Biochemical Engineering Lab	0:0:4
		Total	**18**

Sl.No	Course Code	Soft Core – Health Care Biotechnology (min of 12 credits to be earned) Name of the Course	Credits
1	14BT3014	Research Methodology	2:0:0
2	14BT3020	Immunotechnology	3:0:0
3	14BT3021	Microbial Pathogenesis	3:0:0
4	14BT3022	Clinical Trials and Bioethics	3:0:0
5	14BT3023	Advanced Animal Biotechnology and Tissue Culture	3:0:0
6	14BT3024	Immunotechnology and Clinical Biotechnology Lab	0:0:4
		Total	**18**

Sl.No	Course Code	Soft Core – Food & Agriculture Biotechnology (min of 12 credits to be earned) Name of the Course	Credits
1	14BT3014	Research Methodology	2:0:0
2	14BT3025	Advanced Plant Biotechnology & Tissue culture	3:0:0
3	14FP3024	Food Processing and Biotechnology	3:0:0
4	14FP3025	Advances in Processing of Horticulture Products	3:0:0
5	14FP3017	Food Industry Waste Management	3:0:0
6	14FP3026	Food Analysis and Agrobiotechnology Lab	0:0:4
		Total	**18**
	SIP3997	***Summer Internship Program**	**0:0:2**

*Common for all specialization soft core

M.Sc Microbiology - 2017 Batch

COURSE COMPONENTS

Table 1

Sl.No	Course Code	PROGRAMME CORE 36 credits, a full & part semester project Name of the Course	Credits
1.	14BT3020	Immunotechnology	3:0:0
2.	15BT3001	Cell Biology and Molecular Signaling	3:0:0
3.	15BT3002	Cell Biology and Immunology Lab	0:0:2
4.	15MA3022	Research Methodology and Biostatistics	3:0:0
5.	15BT3003	Biotechniques and Instrumentation	3:0:0
6.	15BT3004	Molecular Biology Lab	0:0:2
7.	15BT3005	Microbial Taxonomy and Phylogeny	3:0:0
8.	15BT3006	Molecular Microbiology	3:0:0
9.	15BT3007	Bacteriology, Mycology and Parasitology	3:0:0
10.	15BT3008	Virology	3:0:0
11.	15BT3009	Microbial Physiology and Metabolism	3:0:0
12.	15BT3010	Microbial Genetics	3:0:0
13.	15BT3011	Clinical Microbiology Lab	0:0:2
		Total Credits	**36**
15	17VE3002	Value Education	0:0:2
16	FSP3999	Full Semester project	20
		Other Electives	12
		Total	**70**

Table 2

Sl.No	Course Code	Soft Core - Marine and Environmental Microbiology (min of 12 credits to be earned) Name of the Course	Credits
1	15BT3012	Biosafety, Bioethics and IPR	3:0:0
2	15BT3013	Marine Microbiology	3:0:0
3	15BT3014	Environmental Microbiology	3:0:0
4	15BT3015	Pharmaceutical Microbiology	3:0:0
5	15BT3016	*Entrepreneurship in Biotechnology	3:0:0
6	15BT3017	Marine and Environmental Microbiology Lab	0:0:2
	ITP3901	***Industry Training Program	0:0:1

*Common for all specialization soft core

Table 3

Sl.No	Course Code	Soft Core - Food and Agricultural Microbiology (min of 12 credits to be earned)	Credits
		Name of the Course	
1	15BT3018	Food and Dairy Microbiology	3:0:0
2	15BT3019	Soil and Agricultural Microbiology	3:0:0
3	15BT3020	Industrial Microbiology	3:0:0
4	15BT3021	Biomass, Bioenergy and Biofuels	3:0:0
5	15BT3016	*Entrepreneurship in Biotechnology	3:0:0
6	15BT3022	Food and Agricultural Microbiology Lab	0:0:2
	ITP3901	*****Industry Training Program	0:0:1

*Common for all specialization soft core

Table 4

Sl.No	Course Code	Other Electives	Credits
		Name of the Course	
1.	14BT3006	Advances in Recombinant DNA Technology	3:0:0
2.	14BT3021	Microbial Pathogenesis	3:0:0
3.	15BT3023	Plant and Animal Tissue Culture	3:0:0
4.	15BI3023	Microbial Genomics	3:0:0
5.	15BT3024	Microbial Nanotechnology	3:0:0
6.	15BT3025	Pharmaceutical and Industrial Microbiology Lab	0:0:2

LIST OF COURSES

Sl.No	Course Code	Name of the Course	Credits
1.	17BT2001	Basics of Biochemistry	3:1:0
2.	17BT2002	Biochemistry Lab	0:0:2
3.	17BT2003	Principles of Chemical Engineering	3:0:0
4.	17BT2004	Cell Biology	3:0:0
5.	17BT2005	Microbiology	3:0:0
6.	17BT2006	Microbiology Lab	0:0:2
7.	17BT2007	Instrumental Methods of Analysis	3:0:0
8.	17BT2008	Instrumental Methods of Analysis Lab	0:0:2
9.	17BT2009	Basic Industrial Biotechnology	3:0:0
10.	17BT2010	Metabolism and Bioenergetics	3:1:0
11.	17BT2011	Bioprocess Principles	3:0:0
12.	17BT2012	Bioprocess Lab	0:0:2
13.	17BT2013	Fluid Mechanics for Biotechnologists	3:1:0
14.	17BT2014	Fluid Mechanics and Heat Transfer Lab	0:0:2
15.	17BT2015	Molecular Biology	3:0:0
16.	17BT2016	Genetic Engineering and Bioethics	3:0:0
17.	17BT2017	Molecular Biology and Genetic Engineering Lab	0:0:2
18.	17BT2018	Bioorganic Principles	3:0:0
19.	17BT2019	Bioreactor Engineering	3:0:0
20.	17BT2020	Enzyme Engineering	3:0:0
21.	17BT2021	Immunology	3:0:0
22.	17BT2022	Cell Biology and Immunology Lab	0:0:2
23.	17BT2023	Chemical Reaction Engineering	3:0:0
24.	17BT2024	Downstream Processing	3:0:0
25.	17BT2025	Downstream Processing Lab	0:0:2

26.	17BT2026	Mechanical Operations	3:0:0
27.	17BT2027	Chemical and Bio-thermodynamics	3:0:0
28.	17BT2028	Heat and Mass Transfer Operations	3:0:0
29.	17BT2029	Plant physiology and Crop Improvement	3:0:0
30.	17BT2030	Plant Genetic Engineering	3:0:0
31.	17BT2031	Agriculture and Biomass Energy	3:0:0
32.	17BT2032	Horticultural Crop Production, Management and Green House Technology	3:0:0
33.	17BT2033	Developmental Biology	3:0:0
34.	17BT2034	Human Genetics and Genomics	3:0:0
35.	17BT2035	Vaccine Biotechnology	3:0:0
36.	17BT2036	Animal Biotechnology and Cell Culture Techniques	3:0:0
37.	17BT2037	Cancer Biology	3:0:0
38.	17BT2038	Biopharmaceutical Technology	3:0:0
39.	17BT2039	Biochemical Engineering	3:0:0
40.	17BT2040	Metabolic Engineering	3:0:0
41.	17BT2041	Process Equipment Design	3:0:0
42.	17BT2042	Pilot plant & Scale Up practice	3:0:0
43.	17BT2043	Industrial Safety & Hazard Analysis	3:0:0
44.	17BT2044	Industrial Effluent Treatment	3:0:0
45.	17BT2045	Pollution Control and Engineering	3:0:0
46.	17BT2046	Mechanical Operation Lab	0:0:2
47.	17BT2047	Plant and Animal Tissue Culture Lab	0:0:2
48.	17BT2048	Bioprocess Control and Instrumentation	3:0:0
49.	17BT2049	Applied Medical Biochemistry	3:0:0
50.	17BT2050	Medical Biochemistry Lab	0:0:1
51.	17BT2051	Human Physiology and Anatomy	3:0:0
52.	17BT2052	Biomaterials and Artificial Organs	3:0:0
53.	17BT2053	Occupational Safety Management	3:0:0
54.	17BT2054	Medical Waste Treatment	3:0:0
55.	17BT2055	Cell Biology and Immunology	3:0:0
56.	17BT2056	Tissue Engineering	3:0:0
57.	17BT2057	Techniques in Pathology and Microbiology	3:0:0
58.	17BT2058	Microbiology and Immunology	3:0:0
59.	17BT2059	Analytical Instrumentation	3:0:0
60.	17BT2060	Biology in Everyday Life	3:0:0
61.	17BT2061	Biotechnology and Environment	3:0:0
62.	17BT2062	Entrepreneurship in Bioengineering	3:0:0
63.	17BT2063	Pollution Control	3:0:0

17BT2001 BASICS OF BIOCHEMISTRY

Credits: 3:1:0

Course Objectives:

- To ensure students to having strong foundation in structure, composition and function of various biomolecules.
- To introduce them to the basic nature and properties of biomolecules which are involved in metabolic pathways and bioprocesses
- To understand the significance of these biomolecules and to apply these fundamentals in biotechnology

Course Outcomes:

The students will be able to

- Acquire knowledge on structure, properties and biological functions of Primary metabolites which help them to understand the significance of biomolecules in bioprocesses and biotechnology
- Acquire knowledge on nucleic acids structure and interactions which help them to understand genetic composition and to apply in genetic engineering

- Assess the significance of vitamins and minerals in the proper functioning of living cells which help them to enrich the biotechnology products
- Relate biomolecules with the scope of biotechnology
- Justify the clinical and biological significance of these biomolecules
- Understand the conjugates of different biomolecules and their importance

Unit-I: Classification, structure, properties and functions of carbohydrates: Monosaccharides –classes, examples, structural and stereo isomers, ring structure and mutarotation; Disaccharides – classes- homo and hetero, examples. Oligosaccharides-examples; Polysaccharide – classes, examples; complex and conjugated carbohydrates- proteoglycan, glycoprotein, glycolipid. Review on industrial significance of carbohydrates-examples, Clinical and biological significance of carbohydrates-examples.
Unit-II: Fatty acids- basic structure, types, isomers, properties, functions and essential fatty acids; ketone bodies, Classes, structure, properties and functions of lipids: Simple lipid- examples, Compound lipid- examples, ether lipid, Derived lipid – sterols like cholesterol; Review on industrial, biological and clinical significance of fatty acids and lipids –examples.
Unit-III: Amino acids- basic structure, isomers, classification, properties; Essential amino acids; Peptide bond, significant natural and artificial peptides –examples; Proteins- structure / conformation levels, Ramachandran plot, classification, properties and functions of proteins-examples, significance of proteins in biotechnology.
Unit-IV: Nucleotides- composition, structure, properties and functions; Nucleic acids- types (RNA, DNA), DNA structure-composition, stabilizing bonds, protein –DNA interactions; RNA types, structure and functions, nucleoproteins – nucleosome, ribosome; properties of nucleic acids
Unit-V: Vitamins: classification, source, daily requirement, functions and deficiency symptoms, review on nutraceuticals and Vitamin supplementations; Minerals: classification, specific function and deficiency disorders, review on mineral supplementations.

Text Books

1. Lehninger, A.L, Nelson D.L and Cox, M.M, "Principles of Biochemistry", Freeman Publishers, New York, 4th edition, 2005.

References Books

1. Murray R.K, Granner B.K, Mayes P.A, Rodwell V.W. "Harper's Biochemistry", Prentice Hall International, 2008.
2. Lubert Stryer, "Biochemistry", WH Freeman & Co., 4th edition, 2000.
2. Voet and Voet, "Biochemistry", John Wiley & Sons Inc., 2nd Edition, 2013.
3. Jain and Jain "Biochemistry", Chand publication, 4th edition, 2008.

17BT2002 BIOCHEMISTRY LAB

Credits: 0:0:2
Co-requisite: 17BT2001-Basics of Biochemistry

Course Objectives:

- To understand the basic units and measurements of biochemical solutions
- To develop the skills in identifying the various biomolecules
- To develop the skills of quantifying various biomolecules

Course Outcomes:

The students will be able to

- Know the basic units, calculations and different measurements tools used in biomolecule evaluations
- Develop the basic lab skill in preparing different solutions of different concentrations and their measurement tools with representing units
- Acquire knowledge in estimation of different carbohydrates using suitable method
- Analyze through tests and identify the different carbohydrate, amino acid and lipid molecules present in the given sample solution.
- Apply the reaction principle to quantify the proteins, amino acids, cholesterol and nucleic acids using colorimeter
- Apply basic knowledge on the properties of biomolecules for the extraction of minerals and vitamins from food sources and quantify them.

List of experiments:

1. Study of biochemical solutions, units and measurements

2. Estimation of total carbohydrate by Anthrone method
3. Qualitative analysis of carbohydrates
4. Estimation of reducing sugars by Di Nitro Salicylic acid method
5. Tests for lipids: - Fats and cholesterol
6. Estimation of cholesterol by Zak's method
7. Estimation of protein by Lowry's/ Bradford's method
8. Qualitative analysis of amino acids
9. Estimation of amino acid by Ninhydrin method
10. Estimation of DNA by diphenylamine method
11. Dry ashing of food materials and colorimetric estimation of phosphorus
12. Estimation of ascorbic acid content in foods

17BT2003 PRINCIPLES OF CHEMICAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To develop skills of students in principles and basic calculations
- To familiarize in material balance for non-reactive systems and simple reactive systems
- To conceptualize energy balance for non-reactive systems and simple reactive systems in chemical process engineering.

Course Outcomes:

The students will be able to

- Understand the importance and interconversion of different units
- Apply concept of mass balance approach in unit operations
- Adapt appropriate system boundary to resolve multiunit chemical process
- Demonstrate vapor-liquid equilibrium calculations for ideal multicomponent system.
- Apply concepts of liquid-vapour equilibrium in two phase systems
- Classify different form of energy and their implication
- Enable to assess energy expenditure on chemical process system

UNIT I - Units systems, basic units, derived units, dimension analysis, force, pressure, work, heat, conversion to SI units, Mass and volumetric flux, Avogadro number, molarity, molality and normality, molecular weight, equivalent weight, mass fraction, mole fraction.

UNIT II - Fundamental of material balance, Basics of calculation, approach of solving material balance problems, Mixing, Crystallization, Evaporator, Distillation, Absorption Column, Drier, Liquid - Liquid and Solid - Liquid Extraction

UNIT III - Stoichiometry, limiting & excess reactants, fractional conversion, yield, Material balance in sequential multi-unit and recycle Systems, Material Balance of Unsteady State Reaction systems

UNIT IV - Ideal Gases, Standard temperature and pressure, partial pressure, Gas laws: Amagat's law and Daltons law, Single component two phase system, vapor pressure, vapor liquid equilibrium, saturation, condensation, relative humidity

UNIT V - Elements of energy balance calculations, types of Energy, Internal energy, Enthalpy changes, Heat capacities, Procedure for energy balance calculations, Closed/open unsteady state system, closed/open steady state systems.

Text Book:

1. David Mautner Himmelblau, James B. Riggs., « Basic Principles and Calculations in Chemical Engineering »Prentice Hall of India, 4th editon. 2004

Reference Books:

1. Felder, R.M., Rousseau R.W., "Elementary Principle of Chemical Processes", John Wiley and Sons Publication 3rd edition, 2000.
2. BI Bhatt & SM Vora "Stoichiometry", Tata Mcgraw- Hill, 4th edition, 2004.
3. Venkataramani.V and Anantharaman.A., "Process Calculations", PHI learning Pvt. Ltd, 2003.

17BT2004 CELL BIOLOGY

Credit: 3:0:0

Course Objectives:

- To acquaint students with the concepts in Cell Biology.
- To understand structure and function of the organelles of cells
- To learn the cell-cell interactions, transport mechanism and signaling pathways of cell

Course Outcomes:

The students will be able to

- Acquire knowledge on the structure and function of cellular organelles and components
- Analyze the behavior of cells in their microenvironment in multicellular organisms (i.e. a cell within its social context) with emphasis on cell-cell interactions, cell-extra cellular matrix interactions
- Illustrate specific processes and proteins involved in membrane transport.
- Understand receptor subclasses and their possible uses in cell signaling
- Determine the Mode of action and regulation of signaling molecules for signal transduction
- Outline the mechanisms by which different messenger-receptor interactions bring about long or short-term changes in cell state.

UNIT I - Brief history of cytology and cell theory, Prokaryotes and Eukaryotes (plant cell and animal cell), Membranes of the cell: Plasma membrane, Nuclear membranes, Organelle membranes. Brief outline of organelles; Nucleus, nucleolus, ribosome, mitochondria, chloroplast, vacuole, endoplasmic reticulum, golgi apparatus, peroxisome, glyoxisome, lysosome, centriole, cilia and flagella. Cell cycle and molecules that control cell cycle, Regulation of cell cycle.

UNIT II - Microtubules, microfilaments, intermediate filaments and their binding proteins. Cell- cell communication: Cell junction, Cell adhesion, Extra Cellular Matrix, Basal Lamina.

UNIT III - Passive and active transport, permeases, osmosis, pumps and gated channels, co transport: symport, antiport. Vesicular transport: Endocytosis, Exocytosis, Protein glycosylation in eukaryotes and protein sorting. Transport in prokaryotic cells, entry of viruses and toxins into the cell.

UNIT IV - Signaling molecules: autocrine, paracrine and endocrine and its mode of action in cell signaling. Cytosolic, nuclear and membrane bound receptors: G-protein coupled receptor, protein tyrosine kinases receptor and cytokine receptors for cell signaling.

UNIT IV - Signal amplification, different models of signal amplifications: role of cyclic AMP, cyclic GMP and G proteins in signal transduction, phosphorylation and regulation in signaling: serine – threonine kinases in signaling. Role of Inositol triphosphate (IP_3) in signal transduction, calcium ion flux and its role in cell signaling.

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman, The Cell: A Molecular Approach, Fifth Edition, ASM Press and Sinauer Associates, Inc., USA, 2015.
2. Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff, Molecular Biology of the cell, fifth edition, Taylor and Francis group, 2012.

Reference:

1. De Robertis & De Robertis, Cell Biology, 4th Edition, 2010.

17BT2005 MICROBIOLOGY

Credits: 3:0:0

Course Objectives:

- To highlight the roles and characteristics of microorganisms
- To study in detail the growth of microorganisms and impact of environment on their growth
- To evaluate explicitly, the metabolic pathways, role of microbes in public health; insight into the physical and chemical control of microorganisms

Course Outcomes:

The students will be able to

- Acquire basic knowledge on the history and development of microbiology
- Recognize the fundamental concepts in the structure and functions of microbes
- Understand the classification and nomenclature of microorganism, staining, microscopic and sterilization techniques
- Understand the controlling of microbes using physical and chemical methods

- Demonstrate the microbial nutritional requirements for growth and metabolism
- Explain the dynamics of commensal, opportunistic and pathological relationships between microbes and humans

UNIT I - An overview of microbiology including a historical perspective of microbiology-classification, and nomenclature of microorganisms-Basics of Microscopy – light, phase, fluorescent and electron microscopy- principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining
UNIT II - Morphology, Structure and Functions of Prokaryotic- and Eukaryotic Cells. Multiplication of bacteria, viruses, algae, protozoa and fungi with a special mention of life history of actinomycetes, yeast and bacteriophage
UNIT III - Nutritional requirements of bacteria: Growth curve and Different methods to quantitative bacterial growth. Aerobic and Anaerobic: Mathematics of growth generation time and growth rate constant, factors affecting growth. Microbial metabolism- Entner– Doudoroff and Phosphoketolase pathway.
UNIT IV - Physical and chemical control of microorganisms – sterilization: Moist heat, dry heat, radiation and filtration. Disinfection: phenol, alcohol and detergents; Chemotherapy and antibiotics- antibacterial, anti-fungal agents, anti-viral agents
Unit V: Interaction between Microorganisms – Commensalism, Synergism, Mutualism (symbiosis). Lichen symbiosis. Normal flora of human healthy host, importance of nosocomial infections, mode of transmission of airborne pathogens, food and water borne infections caused by bacteria and virus, Significations of microbes in food; Industrial microbial products and processes

Text Books:

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.

Reference Books:

3. Talaron K, Talaron A, Casida, Pelczar and Reid. Foundations in Microbiology, W.C.Brown Publishers, 2001.
1. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 2001.
2. Lim D, "Microbiology", Second Edition, WCB-Mc Graw Hill, 2001.

17BT2006 MICROBIOLOGY LAB

Credits: 0:0:2
Co-requisite: 17BT2005- Microbiology

Course Objectives:

- To enable the students to understand the basic concepts involved in the isolation of different kinds of microorganisms and proper handling experience of microorganisms
- Students will be taught the parts of microscopes and the functions
- The students will learn to identify the microorganisms using various staining techniques and biochemical tests

Course Outcomes:
The students will be able to

- Acquire basic knowledge on lab safety guidelines in a microbiology laboratory
- Demonstrate proper usage, identify the parts/functions of microscopes
- Experiment with transfer of living microbes using aseptic technique
- Demonstrate proficiency and use of microbial isolation technique and staining techniques
- Build the skill to prepare media for experiment on media preparation for microbial growth and cultivation techniques of microorganisms
- Culture, identify, and explain microorganisms present in environmental samples

List of Experiments:

1. Lab safety method and Regulations, Principles and methods of sterilization and Study of instruments: Compound microscope, Autoclave, Hot air oven, Laminar Airflow
2. Media preparation- Nutrient broth, Nutrient agar, slants, soft agar
3. Culturing of microorganisms– in broth and in plates (pour plates, streak plates)
4. Enumeration of microorganisms from Soil
5. Enumeration of microorganisms from Water
6. Staining Techniques (Simple, Gram staining, and spore staining)
7. Staining of fungus – Lacto phenol cotton blue staining

8. Measurement of microbial Size – Micrometry
9. Motility test by Hanging drop method and soft agar inoculation
10. Biochemical Characterization of Bacteria-. IMViC test, Catalase, Casein and Starch Hydrolysis
11. Anaerobic Cultivation – Fluid Thioglycolate broth
12. Antibiotic sensitivity assay – Disc and Well diffusion method

17BT2007 INSTRUMENTAL METHODS OF ANALYSIS

Credit: 3:0:0

Course Objectives:

- To enable the students to understand the principles of instrumentation
- To impart the knowledge of different techniques and methods in biotechnology
- To improve the understanding of applications of techniques in the field of biotechnology

Course Outcomes:

The students will be able to

- Understand the basic measurement methods, different extraction methods and its applications in biotechnology
- Describe the instrumentation and applications of different spectroscopic techniques
- Demonstrate the principles, techniques and applications of chromatography.
- Explain the various electrophoretic techniques and their applications in biotechnology
- Understand and interpret various structural elucidation process and radioisotopes methods
- Apply the principle on various techniques and perform research in biotechnology

UNIT I - Classification of instrumental methods; Concepts of accuracy, precision and limits of detection (LOD); Types of errors–random and systematic; Calibration of instrumental methods comparison with standards, Buffers, pH – pH meter and applications, Solvent extraction –introduction and principle; Extraction techniques–batch, stripping or back, continuous and counter-current; Principle of solid extraction (Soxhlet); Types -Temperature assisted, pressurized hot water and supercritical fluids based extraction.

UNIT II - Basic principle of Spectroscopy -Beer-Lambert's law, Principle, Instrumentation and applications of Colorimeter, Flame photometry, nephelometry,spectrofluorimetry and Spectrophotometer: types– UV – visible – IR – Raman spectroscopy.

UNIT III - Principle, types and applications of Chromatography- Thin layer, Adsorption, Ion-exchange, Affinity, Gelfiltration, GC, UPLC and HPLC.

UNIT IV - Principle, Types and applications of Electrophoresis– agarose gel, polyacrylamidegel (PAGE), SDS-PAGE–principle, instrumentation and applications; Immuno, pulse field and capillary electrophoresis, and isoelectric focusing–principle and applications; Thermo gravimetricanalysis (TGA)-Principle, instrumentation and applications

UNIT V - Mass spectrometry–principle, instrumentation (electron spray ionization [ESI] & chemical ionization [CI]) and applications; MALDI-TOF–principle and instrumentation; x-ray diffraction and nuclear magnetic resonance (NMR) – principle, instrumentation and applications; Radioactive isotopes, radioactive decay and their types, radioactive techniques - RIA, GM counter, Scintillation counter, Applications in Medicine & Diagnosis.

Text Books

1. Willard and Merrit, "Instrumental Methods and Analysis" 6th edition, CBS Publishers & Distributors, 2002.

Reference Books

1. Gurdeep R. Chatwal and Sham K. Anand. Instrumental Methods of Chemical Analysis. 5th Edition. Himalaya Publishing House, India. (2012).
2. B.K.Sharma. Instrumental Methods of Chemical Analysis. 24th revised and enlarged edition. GOEL Publishing House, India. (2014).
3. Keith Wilson and John WalkerPrinciples and Techniques of Practical Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press, U.K. (2010).
4. Douglas A. Skoog, F.James Holler and Stanley R. Crough. Instrumental Analysis. 6th Edition. Brooks Cole Publishing Company. USA, (2007).

17BT2008 INSTRUMENTAL METHODS OF ANALYSIS LAB

Credit: 0:0:2

Course Objectives:

- To impart technical knowledge about the working principle and applications of different equipments related to biotechnology experiments.
- To enable the students to understand the principles of instrumentation
- To impart the knowledge of different techniques and methods in biotechnology

Course Outcomes:

- Understand the basic measurement methods and its applications in biotechnology
- Describe the instrumentation and applications of different spectroscopic techniques
- Demonstrate the principles, techniques and applications of chromatography.
- Explain the determination of pH and their applications in buffer preparations
- Understand different purification techniques of primary and secondary metabolites
- Examine the applications of equipments involved in experimental biotechnology

List of Experiments

1. Estimation of Polyphenol by Colorimetric Method
2. Verification of Beers Law and Construction of Beers Law plot
3. Preparation of buffer solution with Henderson-Hasselbach equation and its verification with pH meter
4. Titration curves of Acetic acid and Citric Acid using pH meter
5. Precision and Validity of an experiment
6. Determination of analytical wavelength for given sample
7. Estimation of sugars by ascending paper chromatography
8. Identification of amino acids by ascending paper chromatography
9. Determination of turbidity by nephelometry
10. Conductivity measurement in titration
11. Gas Chromatography
12. High Performance Liquid Chromatography

17BT2009 BASIC INDUSTRIAL BIOTECHNOLOGY

Credits: 3:0:0

Course Objectives:

- The study of the subject constitutes the production of bioproducts .
- It imparts the knowledge of basic principles of science and engineering applied to Industrial Biotechnology.
- The study also focuses on a creative perspective in using microorganisms for the production of various types of bioproducts

Course Outcomes:

The students will be able to

- Gain basic knowledge on the biology of microorganisms and fermentation technology.
- Understand the principles related to aerobic and anaerobic fermentation processes.
- Apply the principles on real time fermentation models using microorganisms.
- Analyze conceptually the need for the production of bioproducts related with food, drug industries.
- Evaluate the media optimization procedures for the better scale up standards in the fermentation industry.
- Create fermentation processes in lab scale and to scale up for large volume production

UNIT I - 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 - A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, acetic acid etc.,); amino acids (glutamic acid, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT III - Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,)

UNIT IV - Production of industrial enzymes such as proteases, amylases, Production of biofertilisers, biopreservatives (Nisin), cheese, biopolymers(PHB).

UNIT V - Production of vaccines and monoclonal antibodies. Products of plant and animal cell culture.

Text Books

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005. 4th Edition, 2005
2. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001.

Reference Books

1. Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.

17BT2010 METABOLISM AND BIOENERGETICS

Credits: 3:1:0

Pre-requisite: 14BT2001 Basics of Biochemistry

Course Objectives:

- To learn the metabolic pathways and their regulations
- To learn the importance of bioenergetics
- To understand the inborn errors of metabolism.

Course Outcomes:

The students will be able to

- Acquire knowledge on the metabolic pathways
- Summarize the biosynthesis and degradation pathway of amino acids
- Explain the importance of bioenergetics, energy rich compounds.
- Understand the metabolic reactions of nucleotides
- Learn the various inborn errors of metabolism
- Analyze the anabolic and catabolic reactions of lipids

UNIT I - Glycolysis, TCA cycle Pentose phosphate pathway, Glycogenesis and Glycogenolysis; Glycogen storage diseases.

UNIT II - Transamination and urea cycle. Biodegradation of selected amino acids- Ala, Thr, Leu, Ile, Tyr, Phe, Trp. Biosynthesis of amino acids- tyrosine. phenylalanine and tryptophan and inborn errors of amino acid metabolism

UNIT III - Biosynthesis and oxidation of fatty acids, ketogenesis, energetics of beta oxidation, cholesterol biosynthesis and degradation, inborn errors of lipid metabolism

UNIT IV - Anabolism of purines and pyrimidines, catabolism of purines and pyrimidines, regulatory pathways, inborn errors of purine and pyrimidine metabolism

UNIT V - Definition, redox biochemistry. Energy rich compounds. Respiratory chain and Oxidative phosphorylation.

Text Book:

1. Murray R.K, Granner B.K, Mayes P.A, Rodwell V.W. "Harper's Biochemistry", Prentice Hall International, 4th edition, 2008.

Reference Books

1. Lehninger, David L. Nelson & Michael M. Cox, "Principles of Biochemistry", Freeman Publishers,4th edition, 2005.
2. Lubert Stryer, "Biochemistry", WH Freeman & Co., 4th edition, 2000.
3. Voet and Voet, "Biochemistry", John Wiley & Sons Inc., 2nd Edition, 2013.

17BT2011 BIOPROCESS PRINCIPLES

Credits: 3:0:0

Course Objectives:

- To understand the principles of bioprocessing and appreciate its applications in Bioprocess Technology
- To understand the importance of medium formulations and optimization
- To Understand the sterilization kinetics

Course Outcomes:

The students will be able to

- Review the fermentation processes and sampling
- Summarize media formulation and medium optimization for fermentation process
- Analyze Thermal death kinetics of microbes, sterilization time and filter sterilization of medium and air

- Demonstrate isolation and storage of industrially important microbes
- Assess inoculum development for fermentation process
- Examine stoichiometry of cell growth and product formation

Unit I - Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, aseptic condition and containment, Sampling

Unit II - 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 by Plackett burmann method

Unit III - 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 - Isolation of industrially important microbes, preservation and storage of industrially important microbes, Quality control of preserved stock cultures and development of inoculum for industrial fermentation

Unit V - 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

Text Book

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Butterworth – Heinemann An Imprint of Elsevier India Pvt.Ltd., 2nd edition, 2005.

Reference Book

1. Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts" , Prentice Hall of India Pvt. Ltd., 2nd edition, 2002

17BT2012 BIOPROCESS LAB

Credits: 0:0:2

Corequisite: 17BT2011- Bioprocess Principles

Course Objectives:

- To learn the culturing of microbes and quantifying biomass production
- To study enzyme kinetics
- To learn immobilization techniques

Course Outcomes:

The students will be able to

- Acquire knowledge in the cultivation of microorganisms and estimating its dry weight.
- Demonstrate enzyme assay qualitatively and quantitatively
- Examine factors affecting enzyme activity.
- Devise methods to produce fermented products
- Utilize solid state fermentation for production of fermented products
- Assess the effect of substrate concentration on growth of microbes.

List of 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 by entrapment method
7. Components of Fermentor
8. Citric acid production by Solid State Fermentation
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

17BT2013 FLUID MECHANICS FOR BIOTECHNOLOGISTS

Credits: 3:1:0

Course Objectives:

To acquire a sound knowledge on fluid properties and fluid statics

- Dynamic characteristics for through pipes and porous medium,
- Flow measurement and fluid machineries

Course Outcomes:

The students will be able to

- Understand the fundamental properties of fluids and its characteristics under static conditions.
- Develop empirical correlation using dimensionless analysis.
- Analyze flow of fluid through pipe and over the of solid Understand and select flow meter(s),
- Characteristics of pumps used in Chemical Process Industries
- Evaluate the process parameters.
- Create basic equipments from learnt principles.

UNIT I - Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II - Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III - The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

UNIT IV - Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V - Flow measurement - Constant and variable head meters; Velocity measurement techniques;Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans.

Text Books

1. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006
2. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGrawHill, (1991).

References

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)
3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005

17BT2014 FLUID MECHANICS & HEAT TRANSFER LAB

Credits : 0:0:2

Course Objectives:

- To provide extensive knowledge on various unit operations and flow measuring equipments involved in bioprocess industries

Course Outcomes:

The students will be able to

- Understand the heat transfer concept and its applications.
- Understand the important of fluid mechanics applications.
- Analyze various flow meters for wide range of applications in industrial biotechnology
- Demonstrate the friction factor for wide range of applications in industrial biotechnology
- Demonstrate the thermal conductivity of materials for wide range of applications in

heat exchangers

- Experiment with annular pipe for wide range of applications in industrial.

List of Experiments

1. Calibration of Flow Meter (Venturimeter)
2. Determination of pressure head loss in Annular Pipe
3. Thermal Conductivity for Insulating Medium
4. Determination of friction factor in Helical Coil
5. Determination of Darcy's Friction Factor
6. Determine the overall heat transfer coefficient in Double pipe Heat Exchanger (Parallel and Counter Flow)
7. Determine the coefficient of discharge in Orifice Meter
8. Determine the overall heat transfer coefficient in Shell and Tube Heat Exchanger
9. Determinations of Minor Losses in Pipes (Sudden Expansion And Contraction)
10. Determine the flow rate of Rota meters
11. Pressure Drop in a Fluidized Bed Column
12. Pressure Drop Across Packed Column

17BT2015 MOLECULAR BIOLOGY

Credits: 3:0:0

Course Objectives:

- To understand the basics of molecular biology and gene expression.
- To understand DNA damage and repair systems
- To get an overview on the regulation of gene expression

Course Outcomes:

The students will be able to

- Understand the fundamental concepts of the organization of genome and central dogma
- Summarize the fundamental mechanism on the process of replication, transcription and translation in the gene expression
- Recognize common mutations, their natural repair systems and the natural gene expression regulation systems in prokaryotes and eukaryotes
- Discuss and distinguish the replication of prokaryotic and eukaryotic DNA
- Explain the synthesis of RNA and post-transcriptional modifications
- Comprehend the role of operons and cis/trans elements in gene regulation

UNIT I - Chromosome organization in prokaryotes and eukaryotes, Different forms of DNA, Classical experiments : Grifith, Hershey and chase; Avery McLeod & McCarty. Bacterial Recombination: Transformation, Transduction, Sexduction and Conjugation. Lytic and lysogeny

UNIT II - DNA replication- Semi conservative replication, Meselson stahl experiment, Enzymes in replication, Replication in prokaryotes, D-loop and rolling circle mode of replication, regulation of replication, replication of linear viral DNA. Replication in eukaryotes and telomere replication. Mutation : types, DNA repair - methylation, mismatch, SOS, recombination.

UNIT III - RNA polymerase, features of promoters and enhancers, transcription factors, Prokaryotic and eukaryotic transcription, inhibitors, post-transcriptional modification - RNA splicing and RNA editing. Transcription in virus : RNA replicase, Reverse transcriptase.

UNIT IV - Elucidation of genetic code-salient features, Process of translation in prokaryotes and eukaryotes, Post-translational modifications, Inhibitors..

UNIT V - Regulation of gene expression: In prokaryotes - lac and trp operons. Regulation in eukaryotes – cis and trans elements, chromatin in gene regulation.

Text book

1. David Friefelder, "Molecular Biology", Narosa Publ. House. 6th edition 2003

Reference books

1. David R. Hyde, "Genetic and Molecular Biology", Tata McGraw Publications, New Delhi, 4th edition, 2010.
2. Lehninger, A. L, Nelson D. L and Cox, M. M, "Principles of Biochemistry", Freeman Publishers, New York, fourth edition, 2005

3. Gardner, Simmons and Snustad, “Principles of Genetics”, John Wiley, 8th edition, 2000

17BT2016 GENETIC ENGINEERING AND BIOETHICS

Credits: 3:0:0

Course Objectives:

- Helps the student to understand the tools and steps in Genetic engineering.
- Trains students on the strategy employed in genetic engineering.
- Helps the student understand the power of genetic engineering and the social implications and the ethics to be followed.

Course Outcomes:

The students will be able to

- Students learn the basics of genetic engineering
- Students understand the basic tools employed in genetic engineering.
- Students understand the use of cloning vectors in genetic engineering.
- Students are aware of the polymerase chain reaction and its variations and applications.
- Students learn the strategy of gene cloning.
- Students understand the implications of ethical issues pertaining to genetic engineering.

UNIT I - Restriction enzymes- Classification-nomenclature; Ligases- Modifying enzymes; Probe preparation and the methods of labeling them; Southern hybridization-Northern hybridization; Western blotting, Autoradiography; DNA finger printing-RFLP Analysis-chromosome walking.

UNIT II - Properties of ideal vectors Plasmids as vectors- PBR322- pUC vectors--M13-Lambda phage vectors ,Cosmid vectors, Phagemids-Cloning vectors in Gram positive bacteria- streptomycetes, Shuttle vectors, Expression vectors, YAC, BAC, Mammlian cells-SV40 & CMV vectors.

UNIT III - Mechanism of Polymerase chain reaction, types of PCR, Inverse PCR, Nested PCR, Molecular beacons, RACE PCR, RAPD, RFLP.

UNIT IV - Construction of recombinant DNA: Preparation of competent cell-Transformation (Physical, chemical and biological methods of Transformation), transfection- Recombinant selection and screening of Recombinant DNA, Genomic Library, cDNA library.

UNIT V - Definitions, history & views on ethics and bioethics. Ethical issues pertaining to biology and biotechnology. Special procedures for r-DNA based product production. Biosafety regulations, r-DNA guidelines- National and international, levels of containment.

Text Books

1. Desmond S. T. Nicholl, “An Introduction to Genetic Engineering, 3rd Edition ” Cambridge University Press; South Asian edition , 2010
2. Monika Jain “Recombinant DNA Techniques”, Narosa Publishing House, 2012.
3. Barry R. Schaller "Understanding Bioethics and the Law: The Promises and Perils of the Brave New World of Biotechnology" Praeger Publishers Inc, 2007

Reference Books

1. Sandy B. Primrose, Richard Twyman “Principles of Gene Manipulation and Genomics “Backwell Scientific Publications 2010.
2. Sandhya Mitra, “Genetic Engineering Principles and Practice”, Macmillan Publications, 2008.
3. Dubey R. C, “Text book of Biotechnology”, S. Chand & Co. Publications, 2006.
4. Richard Sherlock, John D. Morrey "Ethical Issues in Biotechnology" Rowman & Littlefield Publishers, 2002

17BT2017 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Credits: 0:0:2

Course Objectives:

- The objective of the course the student will learn various basic techniques in molecular biology and genetic engineering.
- The student will learn how to isolate DNA from various sources.
- The student will learn to manipulate DNA.

Course Outcomes:

The students will be able to

- The student knows how to isolate DNA from Plant source.
- The student knows how to isolate DNA from Animal source.
- The student knows how to isolate DNA from bacterial source.
- The student knows how to carry out qualitative and quantitative measurements on Nucelic acids.
- The student knows how to manipulate DNA using restriction and ligation techniques.
- The student knows how to transfer DNA into bacteria by the transformation technique.

List of Experiments

1. Isolation of genomic DNA from plant tissue
2. Isolation of genomic DNA from animal liver
3. Isolation of genomic DNA from microorganism (E.Coli)
4. Isolation of plasmid DNA from microorganism
5. Quantitative and qualitative analysis of isolated genomic DNA using spectrophotometer
6. Agarose gel electrophoresis of DNA and analysis of their molecular weights by gel documentation
7. Extraction of proteins from plant or animal tissue and confirmation with qualitative tests
8. Separation and identification of proteins by SDS-PAGE using Coomassie Brilliant Blue stain
9. Restriction enzyme digestion of DNA samples confirmation through Agarose gel electrophoresis
10. Ligation of DNA fragments and confirmation through Agarose gel electrophoresis
11. Competent bacterial cell preparation
12. Transformation of DNA into competent cells

17BT2018 BIOORGANIC PRINCIPLES

Credits 3:0:0

Course Objectives:

- This course aims at making the students understand the structure and interactions of organic compounds of biological significance.
- This provides knowledge in understanding the reaction processes of biological molecules.
- This will help the student to understand the chemical bases of enzyme catalyzed reactions

Course Outcomes (CO):

The students will be able to

- Acquire the basic knowledge on isomerism and stereochemistry of organic compounds
- Understand the basic reaction mechanism types in organic chemistry
- Apply chemical bonding concepts in the protein structure and its stability
- Learn the mechanism of catalysis and fundamentals of enzymes catalysis
- Analyze the mechanisms of reactions catalyzed by various enzymes
- Evaluate the mechanism of coenzyme involvement in enzymated reactions

UNIT I - Stereochemistry-cis & trans configuration, R, S notation, E, Z Isomerism, D & L system with reference to simple sugars, Optical Isomerism, Polarimeter- principle and instrumentation, Enantiomers,, Diastereomers

UNIT II - Chemical bonds-ionic bonds, Covalent and coordination covalent bonds, Hydrogen bonds, Hdrophobic bonds, van der Waals forces, Chemical bonds involved in protein structure, Homolytic and heterolytic fission, Types of organic reactions, Mechanism of nucleophilic substitution reaction, Mechanism of elimination reaction

Unit III - Acid-base catalysis; Enzyme catalysis Catalytic mechanism of RNase-A, Catalytic mechanism of Lysozyme, Covalent catalysis, Nucleophilic catalysis: Mechanism of action of chymotrypsin, Electrophilic catalysis: Mechanism of action of carboxypeptidase - A, Proteases, Electrostatic catalysis.

UNIT IV - Specificity of enzyme action, Alterations in enzyme specificities, Causes of specificity, HIV-1 protease, Amide bond hydrolysis, Ester bond hydrolysis, Stereochemical course of enzymatic reactions.

UNIT V - Introduction –coenzymes, Nicotinamide nucleotides-ADH, Nicotinamide nucleotides-LDH, Flavin nucleotides-glucose oxidase, Flavin nucleotides-glutathione reductase, Pyruvate dehydrogenase complex, Coenzyme –A , TPP, Tetrohydro folate

Text Books

1. Trevor Palmer, "Enzymes: Biochemistry, Biotechnology, Clinical chemistry", Affiliated East-West Press Pvt. Ltd, New Delhi, 6th edition 2004.

Reference:

3. Harish K. Chopra, Anupama Parmar and Parmjt S. Panesar, "Bio-Organic chemistry", Narosa Publishing House, New Delhi, 2013
4. Nelson, D. L. and Cox, M. M, "Lehninger's Principles of Biochemistry", Freeman Publishers, New York, 4th edition, 2008.

14BT2019 BIOREACTOR ENGINEERING

Credits: 3:0:0

Course Objectives:

- This course aims at making the students understand the fundamental principles and concepts of Bioreactor engineering.
- This will help the student understand stoichiometric calculations, models of growth and product formation

Course Outcomes:

The students will be able to

- Acquire knowledge on principles of stoichiometry and concepts of bioreactor engineering.
- Assess elemental balance equations and models of growth and product formation.
- Classify growth kinetics and product formation kinetics using models
- Devise methods to calculate volumetric mass transfer coefficient and determination methods.
- Analyze bioreactors for free cell and immobilized cell reactions
- Discuss parameters to be monitored and controlled in Fermentation processes

UNIT I - Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, various yield coefficients of biomass and product formation, oxygen consumption and heat evolution in aerobic cultures,

UNIT II - Simple unstructured kinetic models for microbial growth, Monod model, Substrate uptake kinetics and maintenance coefficient, growth of filamentous organisms, product formation kinetics - Leudeking-Piret models, substrate and product inhibition on cell growth and product formation. Determination of kinetic parameters for monod equation

UNIT III - Oxygen transfer in microbial bioreactors; oxygen uptake rates and determination of oxygen transfer coefficients (k_La) by correlations and experimental methods; Mass transfer in heterogeneous biochemical reaction system, role of aeration and agitation in oxygen transfer and types of aerators and agitators.

UNIT IV - Bioreactors for free cells – batch, continuous, fed batch, chemostat with recycle and multi stage chemostat systems, air lift and loop reactor, Bioreactors for immobilized cells: packed – bed, fluidized bed and hollow – fibre membrane bioreactors. Basics of solid state fermentation, various scale- up criteria for bioreactors.

UNIT V - Basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in Fermentation processes- Temperature, pressure, flow measurement, rate of stirring, shaft power, weight, Dissolved Oxygen, pH, inlet and exit gas analysis. Online data analysis of chemical parameter measurements for biochemical processes.

Text Books

1. Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts" Prentice Hall of India Pvt. Ltd.,2nd edition, 2005.
2. Peter F. Stanbury, Stephen J. Hall & Whitaker. A, "Principles of Fermentation Technology", Butterworth – Heinemann an Imprint of Elsevier India Pvt.Ltd., 2nd edition, 2005.

Reference Books

1. Lee, J.M, "Biochemical Engineering", 1st Edition, Prentice Hall, 2001
2. Blanch, H.W and Clark, D.S, "Biochemical engineering", Marcel Dekker, 1997

17BT2020 ENZYME ENGINEERING

Credits: 3:0:0

Course Objectives:

- To develop skills of the students in the area of Enzyme Engineering

- To study various methods of immobilization

Course Outcomes:

The students will be able to

- Classify enzymes and enzymatic reactions towards various concepts in biotechnology.
- Apply the theoretical and practical aspects of reaction kinetics of enzyme substrate reaction
- Examine various enzyme kinetics and enzyme inhibition models
- Summarize methods of extraction and purification of enzymes
- Formulate the concepts of enzyme immobilization and its applications in food, pharmaceutical and chemical industries
- Design of biosensors and its applications in various industries

UNIT I - Classification of enzymes, quantification of enzyme activity and specific activity. Effect of pH and temperature on enzyme activity, Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation.

UNIT II - kinetics of single substrate reactions without inhibition- Michelis – Menten parameters, Estimation of MM parameters, Enzyme Inhibition – Substrate, Product and Toxic compound inhibition, types and derivation.

UNIT III - Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications.

UNIT IV - Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, Encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages of Different immobilization techniques

Unit V - Enzyme biosensors, Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

Text Books

1. T Palmer, "Enzymes", Horwood Publishing Series, 2001. 6th edition, 2006

Reference Books

1. Martin Chaplin and Christopher Bucke, "Text book on Enzyme Technology", Cambridge University Press, 4th edition, 2004.
2. Shuler, M.L. and Kargi,F, " Bioprocess Engineering - Basic concepts" Prentice Hall of India Pvt. Ltd., 2nd edition, 2002.

17BT2021 IMMUNOLOGY

Credits: 3:0:0

Course Objectives:

- This course aims to impart basic knowledge in Immunology,
- To help the students familiarize with the organs and cells of the immune system, the immune response and molecular interactions involved in immune response.
- To make the students aware of the applications of immunology such as, immunodiagonosis and immunotherapy.

Course Outcomes:

The students will be able to

- Student learns the history and development of the field of immunology.
- Student understands the types of immunity, the basic plan of the immune of the immune system and the organs of the immune system.
- The students learn about the cells of the immune system and their functions.
- Students understand the humoral immune system
- Students understand the physiology and the pathology of the immune system.
- Students aware of the applications of immunology in diagnosis and treatment of diseases.

UNIT I - Introduction and an overview of immunology, History of immunology, Types of Immunity - Innate and acquired immunity, Cell mediated and humoral immunity; Organs of the immune system: Lymphoid organs - primary and secondary.

UNIT II - Granulocytes and Agranulocytes, haematopoisis, extravasation, phagocytosis. T and B Lymphocytes & NK cells. Major histocompatibility complex; antigen processing and presentation, T-Cell activation and the cellular immune response.

UNIT III - Antigens- chemical and their molecular nature; Haptens; Adjuvants. Antibody – structure, Classes, Genes and Antibody diversity. Antigen Antibody reactions; Neutralization, Opsonization. Complement, Cytokines.Vaccines.
UNIT IV - Injury and inflammation; immune responses to infections: immunity to bacteria, and virus; Transplantation: laws,, consequences and genetics of transplantation, Cancer immunology – Tumour Associated Antigens and Tumour Specific Antigens; Autoimmunity; Autoimmune disorders, Allergy and hypersensitivity, Tolerance, Immunosuppression and AIDS.
UNIT V - Diagnostics; immunodiffusion, Haemagglutination, RIA, ELISA, Western Blotting, Immunofluorescence Assay, Immunohistochemistry. Therapeutics and prophylactics; Abzymes, Monoclonal Antibody production, Chimeric & humanized antibodies. Vaccines.

Text Book

1. Roitt I, Male, Brostoff, "Immunology", Mosby Publ., 2002.

Reference Books

1. Tizard, "Immunology", Saunders college publication, 5th Edition. 2004
2. Kuby J, "Immunology", WH Freeman & Co., 2000.
3. Ashim K. Chakravarthy, "Immunology", TataMcGraw-Hill, 2001

17BT2022 CELL BIOLOGY AND IMMUNOLOGY LAB

Credits: 0:0:2

Course Objectives:

- To make the students learn to understand practical concepts in cell biology
- To acquaint the students with basic laboratory techniques involved in cell biology.
- To acquaint the students with basic laboratory techniques involved in immunology.

Course Outcomes:

The students will be able to

- Students learn to stain and differentiate various cells.
- Students learn to handle fish and use it as a model animal for immunology.
- Students learn to prepare antigen and immunize animals.
- Students learn to separate cells of the immune system.
- Students learn to perform techniques in humoral immunity.
- Students learn to perform techniques in cell mediated immunity.

List of Experiments

1 Differentiation of Blood Cells Using Giemsa Staining
2 Osmosis and Tonicity Studies Using Red Blood Corpuscles
3 Staining for Various Stages of Mitosis in *Allium cepa* root tip (Onion)
4 Handling fish (Tilapia) and locating immunological organs in fish.
5 Administration of Antigen and drawing blood from fish.
6 Drawing Blood and Harvesting Anti serum from Fish.
7 Separation of Peripheral Blood Mononuclear Cells.
8 Trypan Blue Assay for to distinguish live versus dead cells .
9 Determination of Antibody titer by passive hemagglutination
10 Demonstration of Delayed Type Hypersensitivity in Fish
11 Graft rejection in Fish
12 Single Radial Immunodiffusion.

17BT2023 CHEMICAL REACTION ENGINEERING

Credit: 3:0:0

Course Objectives

- To estimate kinetic parameter
- To apply design equations.

Course Outcomes:

The students will be able to

- Describe the kinetics of reactions

- Design equations to determine the performance of ideal reactors
- Create various models for describing non- ideal behavior of reactors
- Analyze performance of combined reactors
- Explain adsorption and desorption phenomena in heterogeneous systems.
- Create design of various fermentor / bioreactors

UNIT I - Principles of Homogeneous reactions – and rate equations-estimation of rate constants using constant volume and constant pressure Batch reactor-data for typical reactions – Arrherius equation-Non elementary reaction kinetics-Multiple reactions-yield Concepts.
UNIT II - Performance equations for single batch reactor, ideal CSTR, ideal PFR-Application to design.
UNIT III - Multiple reactor systems – selection of suitable reactor systems for multiple reactions-recycle reactor-Principles in non isothermal reaction and reactors.
UNIT IV - Non Ideal reactors- Non Ideal Flow-Tracer experiments and application-TIS model, Axial Dispersion model-for tubular reactors. Exchange volume and By Pass and dead volume models for CSTRS.
UNIT V - Gas-Liquid Reactions-kinetics-G-L reactor design Principles-Principle of Catalysis-types of catalytic reactors-Concept of effectiveness factor in Catalytic reactions-G-L-S-reactors – slurry reactor.

Text Books

1. Levenspiel, Octave "Chemical Reaction Engineering", 3rd Edition, John – WileySons, 2002.
2. Fogler, H.S. "Elements of Chemical Reaction Engineering", 2nd Edition, Prentice Hall, 2002

References

1. Missen, R.W. etal., "Chemical Reaction Engineering and Kinetics", John – Wiley, 1999.
2. Davis, Mark E and Robert J. Davis "Fundamentals of Chemical Reaction Engineering" McGraw – Hill, 2005.
3. Harri ot, Peter "Chemical Reactor Design" Marcel Dekker, 2003.
4. Sila, Harry "Chemical Process Engineering : Design and Economics" Marcel Dekker, 2003
5. Nauman, E. Bruce "Chemical Reactor Design, Optimization, and Scaleup", McGraw –
6. Hill, 2002.
7. Richardson, J.E. and D.G. Peacock "Coul son & Richardson' s Chemical Engineering",
8. Vol.3 (Chemical & Biochemical Reactors & Process control) 3rd Edition, Butterworth
9. Heinemann/ Elsevier, 2006.

17BT2024 DOWNSTREAM PROCESSING

Credit: 3:0:0

Course Objectives:

- To study the cell disruption methods, solid-liquid separation techniques
- To develop skills of the students in downstream processing with emphasis on purification of products.
- To study the finishing steps in the purification of bio-products

Course Outcomes:

The students will be able to

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Identifying product isolation techniques
- Illustrate various purification methods of chromatography
- Assess finishing operations like crystallization, lyophilization and drying for the bio products
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I - Overview of bio separation, Introduction to downstream processing principles, characteristics of bio molecules and bio processes. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilization of bio products.
UNIT II - Separation of cells and other insoluble from fermented broth – sedimentation, Filtration (Pretreatment, filtration theory, continuous rotary filters), Microfiltration, Centrifugation (batch, continuous and basket).

UNIT III - Adsorption, Leaching, Liquid-liquid extraction, aqueous two-phase extraction, precipitation of proteins by different methods, Membrane based purification: Ultrafiltration, Microfiltration, Nanofiltration, Electrodialysis, Reverse osmosis, Dialysis, Diafiltration, Pervaporation, Perstraction

UNIT IV - Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio affinity and pseudo affinity.

UNIT V - Case Studies of Downstream Processing - Baker's yeast, Ethanol, Citric acid, Penicillin, Insulin, crystallization, Introduction to drying, Equilibrium, Different types of moisture contents, Rate of Drying and drying curve, Batch Drying and calculation of time of drying, types of driers, Lyophilization, Formulation.

Text Books

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

Reference Books

1. Sivasankar.B "Bioseperations: Principles and Techniques", PHI Learning Pvt. Ltd., 2006
2. Belter P.A, Cussler E.L & Wei-Houhu,"Bioseparations – Downstream Processing For Biotechnology", Wiley Inter science Publications, 1988.
3. Bio separation science and engineering. Harrison et al. 2006. Oxford Univ. Press
4. Unit operations in chemical engineering. McCabe, Smith and Harriot. McGraw Hill Co.
5. Scopes R.K., "Protein Purification – Principles and Practice", Narosa Publications, 2004.
6. Trevor G, and Harrison, Roger G, and Rudge, "Bioseparations Science and Engineering", Day Scott R, Publisher, Oxford University Press, USA, 2002

17BT2025 DOWNSTREAM PROCESSING LAB

Credit: 0:0:2

Co-requisite: 17BT2024- Downstream Processing

Course Objectives:

- To develop the skills of students in various downstream process operations
- To understand the extraction of bio-products by various techniques
- To understand the finishing and polishing process of bio-products

Course Outcomes:

The students will be able to

- Predict cell disruption techniques to release intracellular products.
- Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.
- Examine protocols on various techniques like extraction, precipitation and adsorption for concentrating the biological products.
- Perform basic scale-up calculations for downstream unit operations
- To determine appropriate operating ranges and scale-up parameters for downstream processing steps
- Learned various Drying techniques and Lyophilization for formulating the products for different end uses.

List of experiments:

1. Liquid – Liquid Extraction
2. Studies In Cross Current Leaching
3. Drying Of Solids By Light Source
4. Solids Recovery By Centrifugation
5. Casein Precipitation
6. Flocculation
7. Protein Purification By Salting Out Method
8. Batch Sedimentation
9. Adsorption Techniques
10. Packed Bed Distillation
11. Cell Disruption By Chemical Method
12. Lyophilization (Freeze Drying Of Culture)

17BT2026 MECHANICAL OPERATIONS

Credits: 3:0:0

Course Objectives:

- The study of the subject constitutes the different types of mechanical operations in a chemical industry.
- It imparts the knowledge of basic principles of science and engineering applied to process molecules of varying sizes.
- The study also focuses on a creative perspective in using equipments used for mechanical operations and knowing how it is designed and how it works.

Course Outcomes:

The students will be able to

- Examine the need on how a chemical industry processes the products..
- Describe the principles of each and every downstream equipment used in the industry.
- Experiment on the downstream proceese like sedimentation, filteration which plays a pivotal role.
- Evaluate the volumetric flow rates and output rates of the treatment devices.
- Create basic parameters or equipments for using in the mechanical operation line.

UNIT I - Characterization of solid particles, Screen analysis, Mixing of solids,
Mixer for free flowing solids.
UNIT II - Size reduction equipments, crushers, grinders, Ultra fine grinders, Cutting machines, Screening equipment, Screen Effectiveness
UNIT III - Conditions for Fluidization, Types of fluidization, Conveyers and their types.
UNIT IV - Introduction, Cake filters, Filter press, Shell and leaf filters, Centrifugal filters, Filter media . Filter aids, Principles of cake filtration, Clarifying filters, Batch sedimentation, Rate of sedimentation, , Cyclones, Centrifuges.
Unit V Different types of agitators, Various types of Mixers, Power calculation and impeller tip speeds.

Text Books:

1. McCabe Smith, "Unit Operation in Chemical Engineering", McGraw Hill, 7th edition, 2002.

Reference Books:

1. Foust A. S. & associates, "Principles of Unit Operations", John Wiley and Sons, 3rd editon, 1980.

17BT2027 CHEMICAL AND BIO THERMODYNAMICS

Credit: **3:0:0**

Course Objectives:

- This course aims at making the students understand the fundamental principles and concepts of chemical and bio thermodynamics engineering.
- The students will learn about thermo dynamic laws and and measurement
- The students will study the design equations for various bio process.

Course Outcomes:

The students will be able to

- Apply the laws of thermodynamics to chemical and bio processes
- Calculate differences in thermodynamic properties using equations of state, charts and tables
- Solve problems dealing with multiphase physical and reactive systems
- Explain the molecular basis of thermodynamics
- Interpret thermodynamic data for applications in chemical engineering processes and biotechnology.

UNIT I - 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 - 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 - Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid liquid equilibria and solid-solid equilibria.

UNIT IV - 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 V - Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

Text Books

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering
2. Thermodynamics", 6th Edition. Tata McGraw-Hill, 2003.
3. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.

Reference

1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley, 3rd edition, 1989
2. Smith J.M.,Van Ness H.C.,Abott M.M"Chemical Engineering Thermodynamics", McGraw-Hill,6thedition, 2001.

17BT2028 HEAT AND MASS TRANSFER OPERATION

Credit: 3:0:0

Course Objectives:

- This course aims at making the students understand the fundamental principles and concepts of Heat and mass transfer operations..
- The students will learn about mass balances and enthalphy balancing .
- The students will study the design equations for various unit operation equipments.

Course Outcomes:

The students will be able to

- Explain the principles of diffusion and mass transfer coefficient.
- Understand the principles of gas liquid operations
- Describe vapour liquid operations in biotech industries
- Learn the concept of liquid – liquid extraction operations
- Understand the solid fluid operations and its equipments with application
- An Understand the mass Transfer principles and its application

Unit I - Modes of heat transfer; Conduction: Fourier's law, Conductivity and heat flux, Conduction through flat slab, Determination of thermal conductivity , cylinder and sphere, Heat transfer through multilayer cylinders, Conduction through materials in composite series, Problems solving the hallo sphere, cylinder and multi layers.

Unit II - Modes of heat transfer; Conduction: Fourier's law, Conductivity, Conduction through flat slab, cylinder and sphere, Heat transfer through multilayer cylinders, Conduction through materials in series and parallel; Insulating materials: General properties and applications; Convection – Dimensional analysis applied to natural convection and forced convection, Heat transfer coefficients; Condensers – filmwise and dropwise condensation

Unit III - Heat Exchangers: Types of flow, LMTD, Fouling, Construction, working and design of Double pipe and shell & tube heat exchange, Fouling factor- cleaning dirt factor, Evaporation- operation, Steam economy, capacity, Evaporation equipments, feeding methods . Overall heat transfer coefficients in evaporators, Calculation methods for single effect evaporator, Overview of Multiple effect evaporator, Evaporation of biological materials

Unit IV - Introduction to mass transfer operations, Molecular and Eddy Diffusion in fluids: Fick's laws Steady state equimolar molecular diffusion and non-equimolar diffusion in fluids , Diffusivity of gases, solids , Interphase Mass Transfer: Concept of overall mass transfer coefficient for liquids and gases, Theories of Mass Transfer – Film, Penetration and Surface renewal theories

Unit V - Vapor-liquid Equilibria, P-x-y and T-x-y diagrams, Ideal solutions, Deviation from ideality, Minimum and maximum boiling azeotropes, Flash and differential distillation, continuous rectification, Determination of number of stages by McCabe-Thiele method.Adsorption Nature of adsorbents, adsorption isotherms – adsorption of single stage operation , problem solved , Adsorption equipments,-fixed bed and moving bed adsorption.

Text Book:

1. K. A. Gavhane,(1992), Heat Transfer, Nirali Prakashan 3rd edition, 1992.
2. Incropera F.P. "Fundamentals Of Heat And Mass Transfer", John Wiley,1998. 2nd Edition, 1998.

References

1. Christie John Geankoplis., *(*2003*), Transport process and separation process principles*, 4th edition, New Delhi: Prentice-Hall of India Private Limited.
2. Donald, Q.Kern .,(2003). *Process Heat Transfer*,New Delhi:Tata McGraw Hill.
3. Warren L. McCabe, Julian C. Smith, Peter Harriot.,(2005).*Unit Operations of Chemical Engineering*, 7th edition , New Delhi:Tata McGraw Hill.

17BT2029 PLANT PHYSIOLOGY AND STRESS MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To learn the principles of plant physiology.
- To introduce the concepts of plant growth and development.
- To create awareness on basic principles of plant function and cell physiology

Course Outcomes:

The students will be able to

- Understand the organization of plants from the level of cells through tissues, tissue systems, and organs.
- Illustrate the physiological mechanisms involved in the uptake and transport of water and the translocation of food by plants.
- Classify relationship of complementary metabolic pathways such as photosynthesis and respiration in energy acquisition and use during plant development
- Elaborate understanding of plant natural products with respect to their role in plant defense mechanisms
- Analyze the major effects and physiological mechanisms of growth regulators in plants
- Evaluate the stress related response of plants

Unit I - Introduction –Role and significance of water - diffusion, imbibitions, osmosis and its significance, plasmolysis, Definitions - field capacity, water holding capacity of soil and permanent wilting point, Absorption of water - mode of water absorption – active and passive absorption and factors affecting absorption, Translocation of solutes - phloem and xylem transport, Transpiration - types - Steward's theory of mechanism - significance, factors affecting transpiration and guttation - antitranspirants.

Unit II - Mineral nutrition - introduction - criteria of essentiality of elements - macro, secondary and micronutrients - sand and soil less culture- hydroponics, Mechanism of uptake – physiological role of nutrients, Foliar diagnosis - nutritional and physiological disorders - foliar nutrition and fertigation .

Unit III - Photosynthesis - requirements of photosynthesis - light, CO2, pigments and water, Mechanism of photosynthesis - light reaction - cyclic and non cyclic photophosphorilation - Red drop - Emerson Enhancement Effect, Photosynthetic pathways - C3, C4 and CAM, Differences between C3, C4 and CAM pathways - Factors affecting photosynthesis, Photorespiration - photorespiration process and significance of photorespiration, Respiration - Glycolysis, TCA and Pentose Phosphate Pathway, Oxidative phosphorylation – differences between oxidative phosphorylation and photophosphorylation. Respiratory quotient and energy budgeting in respiration.

Unit IV - Growth - growth curve, phases of growth and factors influencing growth, Growth analysis - LAI, LAD, SLW, SLA, LAR, NAR, RGR and CGR in relation to crop productivity,- Source sink relationship - Photoperiodism - Role of phytochrome in flowering and regulation of flowering. Plant growth regulators - growth hormones - definition and classification - physiological role of auxins and GA, Physiological role of Cytokinin, Ethylene and ABA - synthetic growth regulators and their uses in crop productivity,

UNIT V - Environmental stresses - water stress - physiological changes - adaptation to drought and amelioration, Temperature stress - Physiological changes - low and high temperature - chilling injury - tolerance – alleviation, Low light and UV radiation stresses - salt stress - physiological changes and alleviation, Global warming – Carbon Sequestration physiological effects on crop productivity, Seed germination - physiological changes during seed germination,. Abscission – senescence- ripening - types, causes, physiological and biochemical changes and regulation.

Text Book:

1. Salisbury F and C. Ross, "Plant Physiology", Wordsworth Publishing co., Belmont, California, 6th editon, 2005.

References Books

1. H.S. Chawala, "Introduction to Plant Biotechnology", Oxford IBH, 2002
2. Jain, J.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
3. Pandey, S. N. and B. K.Sinha, 2006.Plant Physiology. Vikas Publishing House Private Limited, New Delhi.

4. Purohit, S.S, 2005. Plant physiology, Student edition, Jodhpur.
5. Ray Noggle, G. and Fritz, G. J., 1991.Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Taiz. L. and Zeiger. E., 2006.Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

17BT2030 PLANT GENETIC ENGINEERING

Credits: 3:0:0

Course Objectives:

- To ensure students in having strong foundation in plant tissue culture
- To create awareness among students about cell culture techniques and its applications in industries.
- To ensure students in developing basic knowledge on secondary metabolites production and its applications.

Course Outcomes:

The students will be able to

- Elaborate basic principles of plant tissue culture
- Illustrate the different methods of plant tissue culture
- Classify the different techniques of plant transformation
- Elaborate the details of various plant transformation vectors
- Analyze the importance of GM crops
- Evaluate the methods of in vitro drug production

UNIT I - History-tissue culture lab - establishing aseptic conditions -types of media and their preparation plant hormones - organogenesis–direct and indirect (meristem/shoot apex culture, callus and suspension culture)

UNIT II - Significance and application of another culture, ovule culture, embryo culture-somatic embryogenesis-protoplast fusion-somaclonal variation-artificial seeds-micropropagation

UNIT III - Biology of Agrobacteriumtumefaciens-plant transformation methods-stable and transient-Agrobacterium-mediated,biolistic,PEG/liposome-mediated,electroporation,chloroplast Transformation, protoplast transformation, site directed integration of transgene (zinc finger)

UNIT IV - Binary and co-integrate vectors-gateway vectors-promoters-selectable and screenable markers-marker free transgenics-significance and applications.

UNIT V - Biotic and abiotic stress tolerant transgenic plants (Btcotton, roundup readysoybean),blue rose, Vitamin A fortified rice,metabolic engineering-oil and secondary metabolite production, Production of edible vaccines and other biotech drugs in transgenic plants

Text Book

1. Razdan.M.K, "Introduction to Plant Tissue Culture"2nd edition, SciencePublishers, 2003.

References

1. Adrian Slater, Nigel W. Scott, Mark R. Fowler,"Plant Biotechnology-TheGenetic Manipulation of Plants"third edition, Oxford University Press, 2008.

17BT2031 AGRICULTURE AND BIOMASS ENERGY

Credits: 3:0:0

Course Objectives:

- To create awareness in the present scenario of agriculture entrepreneur
- To create awareness on renewable energy
- To develop basic knowledge on techniques in biomass energy production

Course Outcomes:

The students will be able to

- Relate the concept of agriculture
- Illustrate the agricultural oprerations
- Compare the Biotech industries and products
- Examine the Biomass and energy production
- Justify the recent conversion technologies
- Estimate the Environmental impacts

UNIT I - Agriculture – importance, agricultural implements, irrigation, fertigation, seeds, crop rotation, agricultural operations, marketing, important agricultural crops, Infrastructural facilities,
UNIT II - Biotechnological Products in India, Quality parameters and quarantine procedures of export, Market integration
UNIT III - Production strategies, harvest, storage, and pretreatment for diverse biomass feedstocks. Biotech industries & institutes in India & world, Concepts of Biotech park
UNIT IV - Biomass – importance and source, techniques and application of energy production. Fundamental theories and applied technologies used in production and conversion of biomass.
UNIT V - Conversion technologies covered include ethanol fermentation, biodiesel catalysis, combustion, pyrolysis, gasification, and anaerobic digestion. Environmental impacts.

Text Books

1. Gry Agnete Alsos, Sara Carter, Elisabet Ljunggren, Friederike Welter. The Handbook of Research on Entrepreneurship in Agriculture and Rural Development, Edward Elgar Pub, 2011

References Books

1. Robert C. Brown, Biorenewable Resources: Engineering New Products from Agriculture, Iowa State Press, Blackwell Publishing. 2003
2. Acharya and Agrawal , Agriculture Marketing in India , Oxford IBH, N. Delhi, 2004.
3. Kotlar and Armstrong , Principles of Marketing by Prentice-Hall, N. Delhi. 2013.
4. Raychaudhuri, S.P. 1964. Agriculture in ancient India. Indian council of Agricultural Research, New Delhi. 4. Razia Akbar (Tr) 2000. Muskha Dar Fauni – Falahat (The art of agriculture). Agri – History Bulletin No. 3. Asian Agri. History foundation, Secundrabad.

17BT2032 HORTICULTURAL CROP PRODUCTION, MANAGEMENT AND GREEN HOUSE TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To provide foundation in horticulture crop production
- To create awareness on Green house technology

Course Outcomes:

The students will be able to

- Asses knowledge on the basic horticulture crop production
- Categorize the various propagation methods involved in horticulture
- Illustrate various practices for cultivation of major Fruit crops
- Discuss the green house technology
- Propose the planning and construction of green house
- Inspect the media requirements in agriculture

UNIT I - Horticulture- Definition, scope, importance, and branches of horticulture. Classification of horticultural crops, Propagation methods, growth habit, training and pruning objectives, methods and season,
UNIT II - Special horticultural practices for horticultural crop production, plant growth regulators and their uses in horticulture.
UNIT III - Package of practices for cultivation of major horticultural crops Fruits, Major pest and diseases of horticultural crops and their control,
UNIT IV - Types of green house, importance, functions and features of green house, Scope and development of green house technology.
UNIT V - Location, Planning of various components of green house, Design criteria, Construction material, covering material and its characteristics, growing media, green house irrigation systems. nutrient management.

Text Book

1. Kumar, P, Management of Hort. Crops Horscience series Vol. 11, New India Publishing Agency, NIPA. 2008.

References Books

1. Manohar, Greenhouse Technology and Management , International Book Distribution Co., Lucknow, 2006.
2. Bose, T.K., S.K.Mitra, A.A. Farooqi and M.K. Sadhu (Eds) 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta.

3. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
4. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications,
5. Greenhouse technology and management, Castilla, N, 2013, CABI

17BT2033 DEVELOPMENTAL BIOLOGY

Credits: 3:0:0

Course Objectives:

- To provide with fundamentals and concepts of developmental biology.
- To make students understand about the events involved in the formation of embryo.
- This course serves as a foundation for stem cell research.

Course Outcomes:

The students will be able to

- Describe the molecular changes happening in cell development
- Predict the role of genes and its expression during the process of the development of organs in the embryo and its development
- Understanding the role of proteins in the development of embryo stage by stage
- Gaining knowledge in the formation of organs in the embryo
- To understand about the sex determination during embryonic development
- This paper will provide the compete growth and development of Human embryo

Unit I - Developmental Genetics: An introduction to genetic molecular mechanisms in relation to development of embryo Gene expression for the development of Embryo

Unit II - Internal fertilization in mammals – Getting gametes into oviduct: Translocation and capacitation Hyperactivation, thermotaxix and chemotaxis Recognition at Zona pellucida- Gamete Fusion and Prevention of Polyspermy Fusion of genetic material

Unit III - Early Drosophila development- Fertilization-cleavage-gastrulation, Genes that pattern the Drosophilla Body plan,

Unit IV - Early Mammalian Development- Cleavage – Mammalian Gastrulation- Organogenesis

Unit V - Sex Determination- Chromosomal Sex Determination – Environmental sex determination

Text Books

1. Scott F. Gilbert, "Developmental Biology, 9th edn. Sinauer Associates, Incorporated, 2010..

Reference Book

2. Willium. J. Larsen, Human Embryology 3rd ed. Churchill Livingstone, 1998.

17BT2034 HUMAN GENETICS AND GENOMICS

Credits: 3:0:0

Course Objectives:

- To provide foundation in human genetics.
- To provide basic knowledge in genomics.

Course Outcomes:

The students will be able to

- Acquire knowledge on the basics of human genetics and genomics
- Analyze and identify the meternal effects in inheritance
- Identify and analyze the chromosomal mutations and its impact in humans
- Assess the application of genomics in the field of disease diagnosis,
- Understand the knowledge in mapping of genomes and genetic disease treatments.
- Acquire the importance of gene therapy and its appllications

Unit I - Chromosome structure and function, Location , Interaction of genes, Gene Environment interactions

Unit II - Meternal effects and inheritance, linkage and crossing over, Genetics of sex determination

Unit III - Mutations: Genomic mutation- Variation in chromosomal number , chromosomal mutations- variation in chromosomal structure and gene mutation

Unit IV - rDNA in Genetics: Human genetic diseases, Positional cloning, Chromosomal abnormalities for locating disease genes. RFLP for lineage analysis, DNA finger printing used in courts and identification
Unit V - Gene therapy in Human beings- Cystic fibrosis treatment in Vitro, Human geneome mapping- Human chromosome separation using cell sorting and analyzing
Large scale sequencing of Human HPRT gene

Text Book.

1. Bruce R. Korf , Human genetics and genomics 3rd ed. Blackwell publishing, 2013

Reference Books

2. Recombinant DNA 2nd Ed., James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller,Scientific American Books, New York 2nd ed. 1992.
3. Genetics by C. B. Powar, 2nd ed., 2000. Mc Grraw hill publishers, New Delhi.

17BT2035 VACCINE BIOTECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To learn the types of vaccine, immunological effects and regulatory guidelines
- To provide the knowledge on conventional to recent technology of vaccine production
- To learn about various vaccine delivery methods

Course Outcomes:

The students will be able to

- Develop the skills to critically assess the different types of vaccines available and their suitability for different diseases
- Develop an understanding of immunization methods and schedules of immunization
- Learn the techniques required for vaccine commercialization
- Demonstrate an understanding of the importance of strict quality control and regulation in the vaccine production process
- Develop ability to critically analyse various delivery methods of vaccine
- Demonstrate an understanding of the importance of vaccines as a public health strategy

UNIT I - Introduction to Vaccines - definition, History of vaccine development, Principles of vaccination, Conventional and Modern vaccines, role and properties of adjuvants, passive and active immunization, immunization programs and role of WHO in immunization programs.
UNIT II - Types of vaccines: Live, Killed, attenuated, Subunit, synthetic, DNA, recombinant and edible vaccines, Chimeric vaccines, polyvalent vaccines, Use of nanoparticles in vaccine application
UNIT III - Techniques in Vaccine Production: Purification, preservation and formulation techniques. Commercial production of DPT, TT, polio, rabies and hepatitis vaccines.
UNIT IV - Delivery methods: Immunomodulators-Innovative methods of delivery of immunogens through liposomes, microsperes, ISCOMS.
Unit V - Regulatory and Biosafety measures: Quality assurance in vaccine production. Regulatory issues - Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines.

Textbook:

1. Lowrie DB & Whalen R. "New Generation Vaccines", 3rd Edn. Informa Healthcare Humana Press, 2000
2. Barry R Bloom, Paul-Henri Lambert, "The Vaccine Book", Academic Press.2002
3. Robinson A & Cranage MP. "Vaccine Protocols", 2nd Ed. Humana Press, 2003

Reference books:

1. Kindt, T.R. A. Goldsby, B. A. Osborne and J. Kuby, Kuby Immunology, W.H. Freeman & company, 2007.
2. Plotkin, S.A W. A. Orenstein and P. A. Offit, Vaccines, W B Saunders Company, 2012.
3. Cheryl Barton, Advances in Vaccine Technology and Delivery, Espicom Business Intelligence, 2009.
4. Ronald W. Ellis, New Vaccine Technologies, Landes Bioscience, 2001.

17BT2036 ANIMAL BIOTECHNOLOGY AND CELL CULTURE TECHNIQUES

Credits: 3:0:0

Course Objectives:

- To develop skills of the students in the area of animal biotechnology
- To learn about cell culture techniques

Course Outcomes:

The students will be able to

- Acquire knowledge in primary cell culture techniques, maintenance of cell line
- Understanding the use of scaling up of cell culture and the production of products from cell cultures
- Gaining knowledge in the latest field of Tissue engineering and to culture cells in 3D methods and its applications
- *In vitro* fertilization and the manipulation of embryo done for genetic screening will provide wider understating among the students and create awareness
- Studying the development of transgenic animals will make the students to know more about breed development and choosing of the breeds for milk production
- Assess about the scope and applications in this subject

UNIT I - Basics of cell culture, Layout of cell culture laboratory chemically defined and serum free media. Animal cell cultures and their maintenance and preservation.

UNIT II - Scaling up of cell cultures, Suspension cultures, continuous flow cultures, immobilized cultures. cell culture as a source of various products – Vaccine Production

UNIT III - Tissue engineering: 3D culturing, Different stages of tissue engineering, Protocols for culturing,Different types of cells in matrices for tissue engineering.

UNIT IV - Animal Breeding, Invitro fertilization , Embryo transfer- Micromanipulation technology, germ cell manipulation, sperm and embryo sexing

Unit V - Transgenic Animals, Transgenic Animals and their significance. Ethical issues in Animal Biotechnology Ethical issues in Animal Biotechnology

Text Books

1. Introduction. R. Ian Freshney. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition. Publisher, John Wiley & Sons, 2011.

Reference Books

1. Ranga M.M. "Animal Biotechnology", Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. "Text Book of Animal Biotechnology", Akshara Printers, 2000.
3. Animal cell culture 3rd ed., by John R.W. Masters A Practical Approach Oxford University press New York 2005

17BT2037 CANCER BIOLOGY

Credits: 3:0:0

Course Objectives:

- To study the factors affecting cancer development, the genetic and cellular basis for cancer development.
- To study the involvement of carcinogens in cancer development.
- To study the characteristic features of cancer invasion, metastasis, their diagnosis and the treatment modalities available.

Course Outcomes:

The students will be able to

- Acquire understanding of the complexity and pathology of cancer, highlighting the need for attention
- Describe the factors, cell cycle de-regulation and mutations leading to cancer
- Attain the knowledge in the fundamentals of carcinogenesis and the complex cause of different cancers
- Understand the molecular and cellular mechanisms that lead to cancer development and progression- oncogene, apoptosis, angiogenesis
- Illustrate the mechanism of cancer invasion - metastasis and analyze different cancer cases –its management methods

- Comprehend the basis of cancer diagnosis, therapy and prevention and summarize advanced methodologies used in cancer research

Unit I - Benign verses cancer tumors, characteristics of cancer cell, tumor grading and staging, histopathology and cytopathology, classification and nomenclature; action of cancer- metabolism, cancer death; factors of carcinogenesis, lifestyle and diet in cancer; regulation of cell cycle, modulation of cell cycle in cancer, mutations that cause changes in signal molecules

Unit II - Carcinogen, theory of carcinogenesis, Types - chemical carcinogenesis, metabolism of carcinogenesis- CYP450 reductase mechanism, physical carcinogenesis - ionizing and non- ionizing radiations, radon; Viral carcinogenesis – Retro viruses - RSV, Papilloma virus; Endogenous carcinogenesis.

Unit III - Cancer associated genes and signal targets, telomerase role in cancer, proto-oncogenes and oncogenes - classification, role in cancer - activation of kinases- Ras pathway, transcription factors-myc, AP-1, bcl-2/bax Growth factors and receptors related to transformation-EGF, FGF, VEGF, PDGF, TGF; identification and detection of oncogenes. Tumor suppressor genes - p53 and Rb; apoptosis-intrinsic and extrinsic pathways; angiogenesis and cancer.

Unit IV - Invasion - three step theory of invasion; Soil and seed hypothesis; Metastatic cascade - basement membrane disruption, role of proteinases and adhesion molecules in metastasis, inflammation and cancer.

Case study – Different solid and blood cancers– etiology, diagnosis and treatment

Unit V - Tumor markers, advances in cancer detection – bioassays and biopsy examinations, molecular tools for early diagnosis of cancer; Different forms of therapy - chemotherapy, radiation therapy, molecular and immunotherapy- use of signal targets towards therapy of cancer; Gene therapy; Role of antioxidants in preventing cancer.

Text Book

1. Robert G, Mckinnell, Ralph E. Parchment, Alan.O. Perantoni, G. Barry Pierce, "The Biological Basis of Cancer", Cambridge University Press, New York. 4th edition, 2003.

Reference Books

1. Macdonald F and Ford CHJ. "Molecular Biology of Cancer", Bios Scientific Publishers, 2002.
2. Ranga M.M. "Animal Biotechnology", Agrobios India Limited, 2002
3. Ramadass P, Meera Rani S. "Text Book of Animal Biotechnology", Akshara Printers, 2000.
4. Dubey, R.C, "Text Book of Biotechnology", S. Chand & Co, 2004.

17BT2038 BIOPHARMACEUTICAL TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To demonstrate the basics of biopharmaceutical technology to the undergraduate students.
- To motivate the undergraduate students in analyzing the drug metabolism and mode of action.
- To elaborate basic of formulations of drugs and to apply them in clinical trials.

Course Outcomes:

The students will be able to

- Explain about drug development, principles, mechanism of actions of drug.
- Outline on preparation of biotechnology oriented pharmaceutical products.
- Demonstrate various testing and quality assurance of different form of drug preparation.
- Compare the pharmaceutical products available in the market.
- Evaluate the recent advances in drug manufacturing.
- Relate the regulations in clinical trial and management.

UNIT I - Introduction - Development of Drugs and Pharmaceutical Industry. Drug Metabolism and Pharmacokinetics - Drug Metabolism – Physico-Chemical Principles –Pharmacodynamics – Action of drugs in humans.

UNIT II - Manufacturing Principles - Compressed tablets – wet granulation, – Dry granulation – Direct compression – Tablet presses formulation – Coating – Pills – Capsules sustained, action dosage forms. Quality control tests for tablets and capsules. Packaging of solid dosage forms.

UNIT III - Manufacturing Principles – Parental, solutions – Oral liquids – injections – Ointments. Quality control tests for semisolid and liquid dosage forms. Packaging of semisolid and liquid dosage forms

UNIT IV - Pharmaceutical Products - Vitamins – Cold remedies – Laxatives –Analgesics –External Antiseptics – Antacids. Antibiotics – Biologicals – Hormones. Recent advances in the manufacture of drugs using r-DNA technology.

UNIT V - Clinical Trials & Regulations - Clinical Trials – Design, double blind studies, placebo effects. FDA regulations (General) and Indian Drug regulations- highlight. Good Laboratory Practice, Good manufacturing practice.

Text Books

1. 1.DM Brahmankar, Sunil B Jaiswal, "Biopharmaceutics and Pharmacokinetics-A Treatise", Vallabh prakashan, 2005.
2. Ansel, H., Allen, L., Popovich, N, "Pharmaceutical Dosage Forms and Drug Delivery Systems", Williams & Wilkins, 1999.

Reference Books

1. Lippin cott, "Remington's Science and Practice of Pharmacy", Williams & Wilkins publishers, 2005.
2. Goodman & Gilman's, "The pharmacological basis of therapeutics" by Joel Griffith Hardman, Lee E. Limbird, Alfred G. Gilman.2005
3. Tripathi KD, "Essential of Medical pharmacology", Jaypee Brothers Medical Publishers 2003.

17BT2039 BIOCHEMICAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To provide the idea to determine the rates of enzyme catalyzed reactions and to provide knowledge on the immobilization of enzymes.
- To provide knowledge regarding cell growth patterns and design of various bioreactors.
- To study the enzyme kinetics and inhibition models

Course Outcomes:

The students will be able to

- Classify chemical and biochemical processes
- Acquire knowledge on growth kinetics and growth inhibitor models
- Examine various enzyme kinetics and enzyme inhibition models
- Assess the role of aeration and agitation in fermenter design
- Design batch and continuous sterilization Process
- Develop various novel bioreactors

UNIT I - comparison of chemical and biochemical processes, industrially important microbial strains, preservation and storage of industrially important microbes, Quality control of preserved stock cultures

UNIT II - Kinetics of single substrate reactions without inhibition- Michelis – Menten parameters, Estimation of MM parameters, Enzyme Inhibition – Substrate, Product and Toxic compound inhibition, types and derivation.

UNIT III - Simple unstructured kinetic models for microbial growth, Monod model, Substrate uptake kinetics and maintenance coefficient, growth of filamentous organisms, product formation kinetics - Leudeking-Piret models, substrate and product inhibition on cell growth and product formation. Determination of kinetic parameters for monod equation

UNIT IV - Bioreactors for free cells – batch, continuous, fed batch, chemostat with recycle and multi stage chemostat systems, air lift and loop reactor, Bioreactors for immobilized cells: packed – bed, fluidized bed and hollow – fibre membrane bioreactors. Basics of solid state fermentation, various scale- up criteria for bioreactors.

UNIT V - Bioreactors for free cells – batch, continuous, fed batch, chemostat with recycle and multi stage chemostat systems, air lift and loop reactor, Bioreactors for immobilized cells: packed – bed, fluidized bed and hollow – fibre membrane bioreactors.

Text books:

1. Shuler M.L and Kargi F, "Bioprocess Engineering Basic Concepts" Prentice Hall of India 4th edition, 2002.

Reference books:

1. Lee, J.M, "Biochemical Engineering", Prentice Hall, 2nd Edition, 2001
2. Blanch, H.W and Clark, D.S, "Biochemical engineering", Marcel Dekker, 1997

17BT2040 METABOLIC ENGINEERING

Credits: 3:0:0

Course Objectives:

- To develop skills of the students in the area of metabolic engineering to alter the existing metabolic pathway

- To introduce novel metabolic pathways in microorganisms using r-DNA technology
- To learn molecular techniques in order to enhance the product yield

Course Outcomes:

The students will be able to

- Ability to integrate modern biology with engineering principles
- Acquire knowledge on the principles and regulation of metabolic pathways
- Analyze different methods to obtain improved production strains
- Categorize the synthesis of primary and secondary metabolites and bioconversions
- Practical applications of metabolic engineering in chemical, medical, and environmental fields
- Develop a good appreciation of the multidisciplinary aspects of biotechnology

UNIT I - Analysis of metabolic control in glycolysis, metabolic flux analysis and its applications in aminoacid production by glutamic acid bacterium

UNIT II - Feedback control systems, alteration of feedback regulation for enhanced production of primary metabolites: glutamic acid, Mutants which do not produce feedback inhibitors or repressors- auxotrophs-lysine, isoleucine, arginine, purine nucleotides.

UNIT III - Producers of secondary metabolites, Precursor effects, trophophase- idiophase relationship, applications of secondary metabolites,

UNIT IV - Antibiotics, vitamins, Mycotoxins- maintenance of genetic stability; Bioconversions

Unit V - Product over production examples: amino acids, polyhydroxyalkanoic acids, By-product minimization of acetate in recombinant E. coli, Extension of substrate utilization range for organisms such as S. cerevisae and Z. mobilis for ethanol production, Improvement of cellular properties

Textbook

1. Gregory N. Stephanopoulos , Aristos A. Aristidou & Jens Nielsen, "Metabolic Engineering: Principles and Methodologies", Academic Press, An Imprint of Elsevier India Pvt.Ltd.,1st edition, 1998.
2. S. Cortassa, M.A.Aon,A.A.Iglesias and D.Llyod, " An Introduction to Metabolic and Cellular Engineering", World Scientific Publishing Co. Pte. Ltd, 2002.
3. Christiana D. Smolke, " The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

Reference Book

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2nd edition, 2005
2. W.Crueger and A. Crueger, "A Text Book of Industrial Microbiology", Panima Publishing Corporation, 2005
3. Lehninger, A. L, Nelson D. L and Cox, M. M, "Principles of Biochemistry", Freeman Publishers, New York, fourth edition, 2005.

17BT2041 PROCESS EQUIPMENT DESIGN

Credit: 3:0:0

Course Objectives:

- To design safe and dependable processing facilities.
- This course focus on plant layout and design of piping systems
- This will provide the basic knowledge to carryout design process cost effectively.

Course Outcomes:

The students will be able to

- Utilize principles of process equipment design, the mechanical aspects of the design
- Design various unit operation equipments, including safety considerations
- Develop flow measurement devices
- Design safe and dependable processing facilities
- Describe the Scale up criteria of bioreactors
- Analyze the plant layout.

UNIT I - Shell and tube heat exchanger , double pipe heat exchanger , Single effect evaporator and vertical tube evaporation,

UNIT II - Design of the following equipments as per ASME, ISI codes, drawing according to scale; monoblock and multiplayer vessels, combustion details and supporting structure.
UNIT III - Construction details and assembly drawing of distillation column; Plate and Packed absorption Towers; Design of fractional Distillation Towers.
UNIT IV - Design of venturimeter and orifice meter,Design of flow control device - Gate, Globe valves, their material of construction.
UNIT V - Design of airlift fermentor ; parts of fermenter, Ideal batch reactor design, Plant layout For Ethylalcohol and Citric acid .

Text Books.

1. Joshi, M.V, "Process Equipment Design", MacMillan, 3rd edition, 2004.

Reference Books:

1. Brownbell I.E., Young E.H.. "Chemical Plant Design" 1985.
2. Kern D.Q. "Heat Transfer". McGraw Hill, 1985.
3. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th edition, McGraw-Hill, 2001.
4. Wnell, L.E, & Young, E.H.: Process Equipment Design, Wiley Eastern, New Delhi, (2000).
5. Ludwig, E.E.: Applied Process Design for Chemical & Petrochemical Plants, Vols. I, II & III, (2nd Ed.), Gulf Publishing Company, Texas, (1977, 1979, 1983).
6. Perry, R.H. & Green, D.W.: Perry's Chemical Engineers' Handbook, (7th Ed.),McGraw Hill (ISE), (2000).

17BT2042 PILOT PLANT AND SCALE UP PRACTICE

Credits: 3:0:0

Course Objectives:

- To provide basic knowledge of scale-up practice
- To teach the details of pilot plant design.
- To study about Pilot plants for reactors and mechanical operations equipments

Course Outcomes:

The students will be able to

- Acquire knowledge in pilot plants for reactors and mechanical operations equipments
- Examine Pilot plant design for several unit operation equipments.
- Assess sampling data and safety factors and dimensional analysis
- Design the bioreactor incorporating scale up concept
- Design bioreactor based on the process requirement

Unit I - Pilot plants, size estimation, sampling data, cost and safety factors, Pilot plants for reactors and mechanical operations equipments
Unit II - Oxygen Pathways in cell cultivations, volumetric oxygen transfer coefficient (K_La), oxygen transfer coefficicnt, oxygen transfer mechanism, resistances to gas liquid interface, Maxing/ Agitation in Biofluids, Measurements of Dissolved Oxygen (DO) and K_La, Assessment of K_La
Unit III - Scale up concerns of microbial, mammalian and plant cell processes, Scale up criteria, Selection of scale up criteria, Dimensional analysis, scale up equations.
Unit IV - Pilot plant design for heat exchangers, mixer equipments, batch and continuous distillation columns. Pilot plants for reactors and mechanical operations equipments
Unit V - Case studies, Economic analysis

Text Book:

1. S.N. Mukhopadhyay, "Process Biotechnology Fundamentals", Viva Books, Second Edition, 2004.

Reference Books:

1. Johnson and Thring, "Pilot plants models and scale up methods in chemical engineering", McGraw Hill Book co. 2nd edition, 1987.
2. Henley and Staffin, "Stage-wise process design", John Wiley, 2nd edition, 1988.
3. Bisio and Kabel, "Scale up of Chemical Process", John Wiley, 2nd edition 1985.

17BT2043 INDUSTRIAL SAFETY AND HAZARD ANALYSIS

Credits: 3:0:0

Course Objectives:

- Students learn about implementation of safety procedures,
- risk analysis and assessment
- hazard identification

Course Outcomes:

The students will be able to

- Demonstrate the awareness of plant safety in selection and layout of chemical plants and the usage of safety codes.
- Exhibit the skill in classifying chemical, fire, explosion hazards
- To understand the occupational diseases
- Analyze the bio medical and engineering response to health hazards
- To implement the effective process control and instrumentation.

UNIT I - Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II - Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III - Over all risk analysis-emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV - Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-Vizag Bopal analysis

Unit V - Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

Text Books

1. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.

References

1. Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., " Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

17BT2044 INDUSTRIAL EFFLUENT TREATMENT

Credits: 3:0:0

Course Objectives:

- The study of the subject constitutes the sources, characteristics of waste water Provides various methods for treatment of wastewater.
- It imparts the knowledge of basic principles of science and engineering applied to the problem of water pollution.
- The study also focuses on a creative perspective in using equipments used for effluent treatment and knowing how it is designed and how it works.

Course Outcomes:

The students will be able to

- Gain basic knowledge on waste water treatment.
- Understand the principles to design equipments for waste eater treatment.
- Apply principles on real time environment.
- Analyze conceptually the need for the effluent treatment.
- Evaluate the volumetric flow rates and output rates of the treatment devices.

- Create basic parameters or equipments for using in the effluent treatment processes.

UNIT I - Introduction to industrial effluents and their treatments, Waste water constituents (Physical, Biological and Chemical). Metallic and Non metallic constituents.
UNIT II - Mixing, types of mixers. Screening, types of industrial screening devices. Grit removal, Sedimentation and their processes.
UNIT III - Aeration Systems, Filteration Systems and devices. Coagulation- definition and types of coagulation processes and types of coagulants used (Chemical, Biological)
UNIT IV - Adsorption – Types of natural adsorbants, Chemical Adsorption for phosphorous removal, removal of heavy metals (Cadmium,Lead,Mercury) by adsorption techniques.
UNIT V - Biological treatment and processes involved for effluents- Activated Sludge process, Oxidation ponds, Attached growth and biological trickling filters.

Text Books:
1. Metcalf & Eddy, "Wastewater Engineering (Treatment and Reuse)", 4th Edn, Tata – McGraw Hill, New Delhi, 2003.

Reference Books
1. Mark J. Hammer.: "Water and waste water technology" – 5thEdn", Prentice Hall of India Pvt. Limited, New Delhi, 2007.

17BT2045 POLLUTION CONTROL AND ENGINEERING

Credits: 3:0:0

Course Objectives:
- To give an exposure to various control acts
- To study the advantages and disadvantages of impact assessment methods
- To study the methods of reducing the waste and reusing it.

Course Outcomes:
The students will be able to
- Gain basic knowledge on pollution, its types
- Outline Pollution control acts and regulations.
- Employ collected raw data on pollution caused by industries.
- Evaluate audit reports on pollution is finally controlled.
- Create various approaches for material reuse
- Integrate various recycling methods

UNIT I - The water (prevention and control of pollution) act 1974 and rules 1975- CPCB-formXIII,XIV,XV,The air (prevention and control of pollution) act 1981 and rules 1982,CPCB-form I,VI. National ambient air quality standards.
UNIT II - The environment (protection) act 1986, rules 1986-definitions, constitution, function and fund of central & state boards. Penalties and procedure, miscellaneous, standards of emission or discharge of environmental pollutants. Form V
UNIT III - Environmental impact assessment notification, 2006-environmental clearance, list of projects, form I, general structure of EIA documents, content of summary EIA
UNIT IV - The manufacture, use, import, export and storage of hazardous microorganisms genetically engineered organisms or cells rules, 1989-definitions,competent authorities, animal and human pathogens
UNIT V - Biomedical waste (management and handling) 1998,-categories of biomedical waste, colour coding and type of container for disposal of biomedical wastes,label for transport of biomedical waste containers/bags (schedule IV), standards for treatment and disposal of biomedical wastes (schedule V),waste management facilities like incinerator/autoclave/microwave system, form-I,II,III.

Text book:
1. C. S. Rao Environmental Pollution Control Engineering, New Age International, 2007

Reference Books
1. Peter Wathern, "Environmental Impact Assessment theory and practice", Unwin Hyman Ltd. Routledge, 1990,
2. L. Lee Harrison , "Environmental Health and Safety Auditing Handbook", 2nd edition, McGraw Hill, Inc., New York, 1995

3. Kirkwood, R. C. and Longley, A. J., “Clean Technology and Environment”, Chapman & Hall, 1995.

17BT2046 MECHANICAL OPERATIONS LAB

Credits: 0:0:2

Course Objectives:

- The experimentation constitutes different processes involved in downstream operations in a biotech and a chemical industry
- It imparts the knowledge of basic principles of science and engineering applied to the mechanical operations on macro and micro molecules.
- The study also focuses on a creative perspective in using equipments used for mechanical operations and knowing how it is designed and how it works.

Course Outcomes:

The students will be able to

- Gain basic knowledge on various mechanical functioning of process equipments.(Mixers, dryers, screens)
- Understand the principles to design equipments for treating macromolecules used in the drug and biotech industries.
- Apply the principles on real time environment.
- Analyze conceptually the need for downstream operation.
- Evaluate analytically problems related with mechanical operating equipments.
- Create basic parameters or equipments for using in the different biotech downstream processing industries.

List of Experiments:

1. Screen Effectiveness
2. Ball Mill
3. Sigma Mixer
4. Ribbon Mixer
5. Dewatering centrifuge
6. Angle of Repose
7. Plate & Frame Filter Press
8. Sparkler Filter Press
9. Cross flow dryer
10. Through flow dryer
11. Extruder
12. Crushing and grinding

17BT2047 PLANT AND ANIMAL TISSUE CULTURE LAB

Credits: 0:0:2

Course Objectives:

- To learn the basic techniques of animal cell culture
- To impart the technical skills of plant tissue culture
- To develop the knowledge of preservation and conservation techniques in cell culture

Course Outcomes:

The students will be able to

- Gain knowledge in Animal cell culture technique
- Understand the sterilization techniques and its importance
- Analyze and determine the growth of cell culture techniques
- Evaluate the efficacy of drugs in animal cell culture
- Apply the propagation methods for commercially important plants
- Understand various in vitro techniques in animal and plant cell culture system

List of Experiments

1. Basics of tissue culture laboratory design and maintenance.
2. Packing and Sterilization of glass and plastic wares for cell culture.
3. Preparation of reagents and media for Animal cell culture.
4. Quantification and cell viability test using Tryphan blue.

5. Culturing of Spleenocytes from Spleen.
6. Isolation and culturing of Thymus cells.
7. Introduction to Plant Cell & tissue Culture.
8. Types of sterilization.
9. Preparation and sterilization of different culture media.
10. Sterilization and inoculation of explants for micropropagation.
11. Sterilization and inoculation of explants for callus culture.
12. Preparation of synthetic seeds.

17BT2048 BIOPROCESS CONTROL AND INSTRUMENTATION

Credits: 3:0:0

Course Objectives

- To control and measure the processing facilities in a cost effective manner.
- To focus on plant layout control and piping systems
- To provide in-depth knowledge on control systems

Course Outcomes:

The students will be able to

- Analyze open-loop systems
- Analyze and apply the knowledge of linear closed loop systems
- Develop working knowledge of control system by frequency response
- Analyze Frequency response and apply it to advanced control systems
- Develop working and design knowledge of Digital controllers
- Compare different control modes for dstillation and heat exchanger.

Unit I - OPEN LOOP SYSTEMS Laplace Transforms - Standard functions, Open loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics

Unit II - CLOSED LOOP SYSTEMS Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems, Routh- Hurwitz and Root-locus stability of a control system

Unit III - FREQUENCY RESPONSE Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, Principle of Nyquist diagram, stability criterion, tuning of controller settings

Unit IV - ADVANCED CONTROL SYSTEMS Introduction to advanced control systems, cascade control, feed forward control, model predictive control, control of distillation Column and heat exchanger. Adaptive controller, Supervisory controller and Ratio controller

Unit V - DIGITAL CONTROLLERS Introduction to Computer control loops, Digital computer, computer process Interface, digital to analog and analog to digital converters, sampling continuous signal, Hardware components of a DDC loop, New control Design problems

Text Books

1. Coughnowr, D. R., Process Systems Analysis and Control, Mc Graw Hill, New York, 2nd Edition,1991
2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., New Delhi,1990

References

1. Doeblin Ernest , Measurement Systems, Mc Graw Hill, New York , 2005
2. C. A. Smith and A. B. Corripio, Principles and Practice of Automatic P r o c e s s Control, John 36
3. A.Suryanarayanan, “Chemical instrumentation and process control”, Khanna Publishers 2nd edition, New Delhi, 1995
4. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., New Delhi,1990

17BT2049 APPLIED MEDICAL BIOCHEMISTRY

Credits: 3:0:0

Course Objectives:

- To learn the biochemistry of living cells.
- To provide knowledge on the biochemistry of proteins, lipids and carbohydrates.
- To introduce the different methods of investigation of metabolism and diagnostic tools.

Course Outcomes:

The students will be able to

- State and explain the biochemistry of proteins, lipids and carbohydrates in living cells.
- Employ biochemical reaction and suggest suitable investigation methods.
- Assess the metabolism of biomolecules.
- Summarize the functions of various organs
- Focus on significance of clinical analysis
- Explain the role of vitamins in human health

UNIT I - Biochemistry of living cells, sub cellular fractionation using the differential centrifugation method. Functions of each organelle, redox potential, oxidative phosphorylation, Transport of substances across biological membranes.

UNIT II - Definition, Classification, Structure of monosaccharides, disaccharides, their biomedical importance, diabetes, Blood sugar analysis and glucose tolerance tests.

UNIT III - Lipids, Definition, Classification, Fatty acids, classification and functions, essential fatty acids structure and functions, and cholesterol, Structure and properties, their biomedical importance.

UNIT IV - Proteins, Composition, general properties, classification, biomedical importance, identification of proteins by chromatography and electrophoresis.

Unit V - Vitamins, Classification, functions and deficiency symptoms, hypervitaminosis. Uses of isotopes in biochemistry. Methods of investigation of metabolism, Liver function tests, Renal function tests, Urine analysis and gastric function tests.

Text Book:

1. Murray R.K, Granner B.K, Mayes P.A, Rodwell V.W. "Harper's Biochemistry", Prentice Hall International, 2008.

References:

1. Donald Voet, Judith,G.Voet and Charlotte, W.Pratt."Fundamentals of Biochemistry, Life at the Molecular Level."JohnWiley&sons,Inc.(Asia). 2006.
2. Keith Wilson and JohnWalker. "Principles and Techniques of Biochemistry and Molecular Biology". Sixth Edition. Cambridge University Press.2007.
3. Rodney Boyer, "Modern Experimental Biochemistry," Third edition. Addison Wesley Longman Inc.2000.

17BT2050 MEDICAL BIOCHEMISTRY LABORATORY

Credits: 0:0:1

Co-requisite: 17BT2049 Applied Medical Biochemistry

Course Objectives:

- To learn the biochemistry of living cells.
- To provide knowledge on the biochemistry of proteins, lipids and carbohydrates.
- To introduce the different methods of investigation of metabolism and diagnostic tools.

Course Outcomes:

The students will be able to

- Explain and discuss the biochemistry of proteins, lipids and carbohydrates in living cells.
- Demonstrate biochemical reaction and suggest suitable investigation methods.
- Construct the metabolism of biomolecules.
- Discuss the biochemistry of vitamins
- Demonstrate the estimation methods of macroelements
- Analyze and investigate the metabolic disorders in urine sample

List of Experiments

1 Study of biochemical solutions, units and measurements
2 Estimation of total carbohydrate by Anthrone method
3 Qualitative analysis of carbohydrates
4 Estimation of protein by Lowry's method
5. Estimation of amino acid by Ninhydrin method
6. Estimation of cholesterol by Zak's method
7. Qualitative Analysis of amino acids
8. Qualitative Analysis of Lipids
9. Estimation of ascorbic acid
10. Dry of food materials and estimation of phosphorus

17BT2051 HUMAN PHYIOLOGY AND ANATOMY

Credits: 3:0:0

Course Objectives:

- To explain the basics on the structure animal cell and organs
- To illustrate the different systems of the body and their functioning
- To demonstrate the fundamentals in human anatomy and physiology

Course Outcomes:

The students will be able to

- To give outline on animal cells, their functions and membrane transportation of cells.
- To explain the composition of blood and its function on maintaining homeostasis.
- To demonstrate the components of respiratory and cardiovascular systems.
- To describe briefly about the anatomical locations, structures and their physiological functions of respiratory and cardiovascular systems.
- To illustrate the structure and functions of nervous system and parts of brain.
- To explain about the structure of eye, ear and kidney and their functions.

UNIT I - Cell: structure and organelles, function of each component. Cell membrane, transport across membrane, origin of cell membrane potential (Nernst and Goldman and Katz equations), action potential.

UNIT II - Blood composition, Functions of blood, functions of RBC. WBC types and their functions, blood groups, importance of blood groups, identification of blood groups, blood flows factors regulating blood flow such as viscosity, radius, density etc.

UNIT III - Components of Respiratory system. Oxygen and carbon di oxide transport and acid base regulation, structure of Heart, properties of cardiac muscle, cardiac muscle and pace maker potential, cardiac cycle, ECG, Heart sound, volume and pressure changes and regulation of heart rate.

UNIT IV - Structure of a neuron, Synaptic conduction. Conduction of action potential in neuron. Parts of brain cortical localization of functions, EEG. Simple reflexes, with drawls reflexes. Autonomous nervous system and its functions

Unit V: Structure of Eye, Ear and auditory and visual pathways. Structure of kidney and nephron, Mechanism of Urine formation and base regulation. Dialysis.

Text Books:

1. Anne Waugh, Allison Grant, "Ross and Wilson: Anatomy and Physiology in health and Illness", Churchil Livingston Elsvier 2010.

References:

1. Elaine . N. Marieb, "Essentials of Human Anatomy and Phsiology" 8th edition, Pearson education, New Delhi 2007
2. William F Ganang "Review of Medical physiology" 2nd edition McGraw Hill , New Delhi, 2000

17BT2052 BIOMATERIALS AND ARTIFICIAL ORGANS

Credits: 3:0:0

Course Objectives:

- To learn and understand the Concepts, Classification and Properties, and Structural variations in biomaterials.

- To understand the testing of implants and cell-interfacing materials.
- To know the applications of biomaterials in Artificial Organs and their development.

Course Outcomes:

The students will be able to

- Identify and know the structural variations in biomaterials.
- Determine and classify the various properties of biomaterials.
- Explain the methods for testing implants with different aspects of biomaterials
- Recall the cell-biomaterial interactions for constructing artificial organs.
- Remember the Interfacing materials and ethical implications.
- Apply the biomaterials in the healthcare sectors.

UNIT I - Definition, classification and properties of bio-materials, Surface, bulk, mechanical and biological. Types of biomaterials; Biological response to biomaterials; Crystal structure of metals; Crystal structure of ceramics; Carbon based materials; General structure of polymers; Synthesis of polymers. Bending properties; Time dependent properties – creep properties of polymers; Influence of porosity and the degradation of mechanical properties; Introduction to fatigue.

UNIT II - Wound-healing and blood compatibility. Surface modification of biomaterials – plasma treatment, radiation grafting, self-assembled monolayers (SAMs), Langmuir – Blogett films and covalent biological coatings; Protein properties that affect biomaterial surface interaction; biomaterial surface interaction that affect interactions with proteins; Protein adsorption kinetics; DLVO model for cell adhesion; Assays to determine the effects of cell-material interactions – agar diffusion assay, adhesion assays and migration assays.

UNIT III - Biocompatibility – Toxicology, Biocompatibility, Mechanical and Performance Requirements, Regulation. Biomaterials associated infection. Cytocompatibility evaluation laboratory, Tissue compatibility evaluation laboratory, Hemocompatibility evaluation laboratory, Sterility evaluation laboratory, Histopathology evaluation laboratory, Physiochemcial evaluation laboratory.

UNIT IV - In vitro assays for inflammatory response due to biomaterial implantation; Fibrous encapsulation of healing process; Ideal features of soft tissue implants; Metallic Implant materials, Polymeric Implant materials, Tissue replacement materials-soft, hard and blood interfacing materials.

UNIT V - Heart, heart valves, oxygenators - bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators - Anatomy & Physiology of EAR-air conduction, bone conduction, masking, functional diagram of an audiometer. Dialysers - Haemodialysis: flat plate type, coil typeand hollow fiber. Haemodialysis Machine, Portable kidney machine - Brief of lungs gaseous exchange / transport, artificial heart - Lung devices, Dental implants.

Text Book:

1. Joon B.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications" CRC Press, 4th edition, 2003.

Reference Books:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons. An Introduction to Materials in Medicine. Academic Press. USA, 2006.
2. Sujata V. Bhatt, "Biomaterials" Second Edition, Narosa Publishing House,2005.
3. Rajendran V. and Marikani A., Materials Science, Tata McGraw Hill Pub. Company Ltd., New Delhi, 2004.

17BT2053 OCCUPATIONAL SAFETY MANAGEMENT

Credit: 3:0:0

Course Objectives:

- To know about the health issues and safety principles
- To apply safety practice through training methods
- To know the occupational safety and health Act and its applications

Course Outcomes:

The students will be able to

- Identify hazards in the home or workplace that pose a danger to their safety or health.
- Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- Present a coherent analysis of a potential safety or health hazard.

- Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.

- Indicate a comprehension of the changes created by OSHA in everyday life.
- Identify the decisions required to maintain protection the environment, home and workplace as well as personal health and safety.

UNIT I - - Personal Health and Safety - personal health and safety at home and in the workplace, blood borne virus, hepatitis B, HIV, dermatitis, skin care, Personal Safety - emergency first aid treatment - reaction to accidents, reporting of accidents, pro-active procedures when accidents occur, cleaning the accident site, personal safety wear and protective equipment.
UNIT II - - Accidents & Their Effect on Industry - costs of accidents, work accident costs and rates, time lost - work injuries, parts of the body injured on the job - chemical burn injuries, Carpal Tunnel, Syndrome Injuries, Drugs and Alcohol in the Workplace. Theories of Accidents - Domino Theory of Accident Causation, Human Factors Theory of Accident Causation, Accident/Incident Theory of Accident Causation, Epidemiological Theory of Accident Causation, Systems Theory of Causation, Combination Theory of Accident Causation.
UNIT III - Regulatory matter-Occupational Safety and Health Act (OSHA) of 1971, compliance with established regulations-safe equipment and management supervision, Hazardous Material Information, System - routes of entry into the body of toxic materials, general safety precautions, cleaning chemical spills, MSDS sheets, Falling, Impact, Acceleration and Lifting Hazards - correct lifting techniques, selecting correct lifting procedures in the workplace, safety equipment, safe storage of materials at home and in the workplace, dealing with manual handling, Workers Compensation - injuries and workers compensation, workers' compensation legislation, resolution of workers' compensation disputes. Roles of Health and Safety Personnel - the modern health and safety team, health and safety manager, engineers and safety
UNIT IV - Stress and Safety - workplace stress defined, sources of workplace stress, human reaction to workplace stress, measurement of workplace stress, shift work, stress and safety, improving safety by reducing stress, stress in safety managers, stress and workers compensation. Mechanical Hazards and Safeguarding - common mechanical injuries, safeguarding defined, lockout/tag out systems, taking corrective action, Heat and Temperature Hazards - the body's response to heat, heat stress and its prevention, overview of cold hazards, preventing cold stress, Fire Hazards - sources of fire hazards, fire dangers to humans, detection of fire hazards, reducing fire hazards, development of Fire Safety Standards, fire safety myths, fire hazards defined, Noise and Vibration Hazards, hazards levels and risks, identifying and assessing hazardous noise conditions, noise control strategies, vibration hazards.
UNIT V - First aid in emergencies - reporting accident, Promoting Safety, safety committees. Health and Safety Training - rationale for health and safety training, Industrial Hygiene - hazards in the workplace, entry points for toxic agents, airborne contaminants, asbestos hazards, hazard recognition, evaluation and control. Importance of Computers, Automation and Robots, Safety and the Environment, Product Safety and Liability and Ergonomics and Safety.

Text Book:

1. Mark A. Friend, James P. Kohn**, "**Fundamentals of Occupational Safety and Health, Bernan Press, 23-Jun-2014.

Reference Books:

1. Geoff Taylor, Kellie Easter, Roy Hegney, "Enhancing Occupational Safety and Health", Elsevier Butterworth-Heinemann, 2004.
2. Occupational safety Manual, BHEL, Trichy, 1988

17BT2054 MEDICAL WASTE TREATMENT

Credits: 3:0:0

Course Objectives:

- To identify the modes of medical waste treatment
- To understand the pollution and health hazards
- To analyze the methods of water treatment

Course Outcomes:

The students will be able to

- Outline about Medical wates and its disposal
- Practice the ways of preventing pollution and personal safety
- Design of instrumentation and control techniques for potable water treatment
- Gains knowledge in computer monitoring system
- Summarize the instruments in waste disposal and its uses
- Develop knowledge for medical waste disposals in hospitals.

UNIT I - Classification of Medical wastes: Sources and classification of medical waste-color code-handling, sterilization, treatment.
UNIT II - Environmental Hazards:-Hazards –personal safety-environmental pollution-health hazards.
UNIT III - Waste Treatment and monitoring system: medical waste treatment system-temperature and level control, toxic gas detector-design of alarm system-central monitoring- pollution monitoring system
UNIT IV - Instuments for monitoring : water pollution-central monitoring system,Proper disposal of wastes , incinerator. Temperature level and flow control for computer applications in central monitoring system
Unit V: Case studies: Hospital Managements , collection , transportation and safe disposal-regulations, ethical issues in waste disposal.

Text Book:

1. P.K. Behera, "Sustainable biomedical waste management", Dominant Publishers And Distributors, 3rd edition, 1993.

References:

1. Dr. Shalini Sharma, SVS Chauhan, "An analysis of medical waste management", Lambert publisher, 2000**.**
2. Etcalf& Eddy, "Wastewater Engineering (Treatment and Reuse)", 4th Edn, Tata – McGraw Hill, New Delhi, 2003.
3. Mark J. Hammer.: "Water and waste water technology" – 5thEdn", Prentice Hall of India Pvt. Limited, New Delhi, 2007.
4. James M. Montgomery.: "Water treatment principles and design" – A Wiley IntersciencePublication, Newyork, 1985.

17BT2055 CELLBIOLOGY AND IMMUNOLOGY

Credits: 3:0:0

Course Objectives:

- This course aims to impart basic knowledge in cell biology & Immunology,
- To help the students familiarize with the organs and cells of the immune system, the immune response and molecular interactions involved in immune response.
- To make the students aware of the applications of immunology such as, immunodiagonosis and immunotherapy

Course Outcomes:

The students will be able to

- Summarize the history and development of the field of cell biology
- Learn various organelles of the cell and their functions.
- Understand the types of immunity, the basic plan of the immune of the immune system and the organs the cells of the immune system and their functions.
- Gains knowledge the humoral immune system
- Outline and understand the physiology
- Aware of the pathology of the immune system.

UNIT I - History of cell biology, inventions, discoveries and the cell theory. Cellular organization, prokaryotes and eukaryotes, Organelles and specialization, Membranes and membrane transport; Plasma membrane & Transport, Cell Wall, ECM, Cell-Cell Interactions.
UNIT II - Modes & Types of Cellular Signals, Receptors: GPCRs, RTKs, Cytokine Receptors & NRTKs, Enzyme linked receptors. Intracellular Signal Transduction Pathways,
Cytoskeleton and cell motility; Structure and Organization of Actin filaments, Microtubules and Intermediate Filaments, Cell Movement, Motor Proteins. Cell Cycle; stages, mitosis, Meiosis.
UNIT III - Introduction and an overview of immunology, History of immunology, Types of Immunity - Innate and acquired immunity, Cell mediated and humoral immunity; Organs of the immune system: Lymphoid organs - primary and secondary.
UNIT IV - Granulocytes and Agranulocytes, haematopoisis, extravasation, phagocytosis. T and B Lymphocytes & NK cells. Major histocompatibility complex; antigen processing and presentation, T-Cell activation and the cellular immune response. Antigens- chemical and their molecular nature; Haptens; Adjuvants. Antibody – structure, Classes Antigen Antibody reactions; Neutralization, Opsonization. Complement, Cytokines

UNIT V - Injury and inflammation; immune responses to infections: immunity to bacteria, and virus; Transplantation: laws,, consequences and genetics of transplantation, Cancer immunology – Tumour Associated Antigens and Tumour Specific Antigens; Autoimmunity; Autoimmune disorders, Allergy and hypersensitivity, Tolerance, Immunosuppression and AIDS.

Text Book

1. Alberts, Molecular Biology of the Cell, Garland Sciences, 4th edition, 2002.
2. Roitt I, Male, Brostoff, "Immunology", Mosby Publshers, 3rd edition2002.

Reference Books

1. Geoffrey M. Cooper, Robert E. Hausman, The Cell, A Molecular Approach – 6th Edition Sinauer Associates, Inc..
2. Tizard, "Immunology", Saunders college publication, 5th Edition, 2004.
3. Kuby J, "Immunology", WH Freeman & Co., 2000.
4. Ashim K. Chakravarthy, "Immunology", TataMcGraw-Hill, 2001

17BT2056 TISSUE ENGINEERING

Credits: 3:0:0

Course Objectives

1. To introduce the basic concepts of tissue organisation in the human body and the theories related to normal physiology and repair
2. To inculcate knowledge on cell culture, cell signalling and molecular growth factors.
3. To develop tissue implants and transplants and its regulation in tissue engineering

Course Outcomes

The students will be able to

- Outline the fundamental concepts about types of cells and culturing procedures
- Analyze the cellular interaction and molecular aspects of cell differentiation, communication and growth.
- Design scaffolds, tissue implants and its use in tissue engineering
- Gain knowledge in 3D culture mechanism and cell interactions
- Acquire Knowledge in the tissue engineering applications
- Understand about the regulatory issues and therapeutic uses and its recent developments.

UNIT I - Introduction, Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, cell culture techniques

UNIT II - Scaffold and transplant, egineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength

UNIT III - Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells in tissue engineering

UNIT IV - 3D cell culturing and protocols involved for the 3D cell culture of different types of cells cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering.

Unit V - Case study of multiple approaches: Ethical, FDA and regulatory issues of tissue engineering, Current scope of development and use in therapeutic and in-vitro testing

Text Book

1. Introduction. R. Ian Freshney. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition. Publisher, John Wiley & Sons, 2011.
2. Animal cell culture 3rd ed., by John R.W. Masters A Practical Approach Oxford University press New York 2005

Reference Books

1. Robert. P.Lanza, Robert Langer & William L. Chick, Principles of tissue engineering, , Academic press.
2. Joseph D. Bronzino, The Biomedical Engineering –Handbook, CRC press.
3. B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino,Tissue Engineering, CRC- Taylor & Francis

17BT2057 TECHNIQUES IN PATHOLOGY AND MICROBIOLOGY

Credits: 3:0:0

Course Objectives

- Gain knowledge on the structural and functional aspects of living organisms

- To understand the properties of antigens and antibodies and the concept of antigen-antibody interactions
- To understand the morphological characteristics and cultivation of bacteria

Course Outcomes

The students will be able to

- Acquire the knowledge of concepts of cell injury, neoplasia and changes produced thereby in different tissues and organs
- Understand in brief, about the hematological diseases and investigations necessary to diagnose them
- Demonstrate various antigen-antibody interactions and techniques
- Evaluate the working principle of microscope in diagnosis of infectious and non infectious diseases
- Recognize the fundamental concepts in the structure and functioning of a cell
- Acquire knowledge of common immunological techniques for disease diagnosis

UNIT I - Necrosis, apoptosis**,** cellular adaptations of growth and differentiation, Inflammation and Repair, Neoplasia, tumours, carcinogenesis, autopsy and biopsy, Hemostasis, Edema, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders.

UNIT II - Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies, antigen and antibody reactions

UNIT III - Light microscope, fluorescence, TEM & SEM. Preparation of samples for electron microscope. Staining methods.

UNIT IV - Morphological features and structural organization of bacteria, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture

Unit V: Instrumentation for immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

Textbook:

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition, WB Saunders Co. 2005.

References:

1. Prescott, Harley and Klein, "Microbiology", 5th edition, McGraw Hill, 2002 (Units III,IV& V).
2. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
3. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2005.
4. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007

17BT2058 MICROBIOLOGY AND IMMUNOLOGY

Credit 3:0:0

Course Objectives:

- To impart knowledge on classification and structure and function of microbes
- To learn the nutrition and control of microorganisms
- To understand the fundamental principles and concepts of immune system.

Course Outcomes:

The students will be able to

- Understand the historical perspective and scope of microbiology and its advances.
- Simplify and know the structure, functions and nutritional requirements of microbes.
- Understand the concepts of control and growth of microbes and Antimicrobials.
- Outline the general concepts of immune system, cells, organs of the immune system and Antigens and Antibodies.
- Interpret the concept of cell mediated immunity and complement system
- Demonstrate the concept of hypersensitivity and transplantation immunology

UNIT I - An overview of microbiology including a historical perspective of microbiology, Origin of Leeuwenhoek's Animalcules, Germ theory of fermentation and disease, Development of laboratory techniques to study microorganisms, Developments in disease. Classification and Nomenclature of microorganisms; Basics of Microscopy - light and electron microscopy; Principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining and fungal staining.

UNIT II - Morphology, Structure and Functional anatomy of Prokaryotic and Eukaryotic Cells. Multiplication of bacteria, viruses, algae, protozoa and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage. Nutritional requirements of bacteria and different media used for bacterial culture; Screening and isolation of organisms- Pure culture techniques (spread plate, pour plate, streak plate) Preservation methods.

UNIT III - Microbial growth and factors affecting growth. Growth curve and different methods to quantify bacterial growth, Aerobic and Anaerobic; Introduction to chemosynthesis. Physical and chemical control of microorganisms – sterilization: Moist heat, dry heat, radiation and filtration. Disinfection: phenol, alcohol and detergents. Host-microbe interactions, Chemotherapy and antibiotics- anti-bacterial, anti-fungal agents, anti-viral agents, mode of action and resistance to antibiotics.

UNIT IV - Historical background, general concepts of the immune system. Innate and adaptive immunity. Structure, properties and functions of the immune cells & organs: Hematopoeisis, T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils Mast cells and dendritic cells. Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and CALT. Antigens and haptens; Properties; Adjuvants. B and T cell epitopes. T-dependent and Tindependent antigens. Antibodies: Classification, Structure, function and properties of the antibodies; Antibody as B cell receptor, antigenic determinants on antibodies (isotype, allotype and idiotype).

UNIT V - Major histocompatibility gene complex: Organization of MHC- Types and Functions, Structure and cellular distribution of HLA antigens. Cell mediated immunity: Cell types (CTLs, NK cells, macrophages and TDTH cells), effector mechanisms and effector molecules of cell mediated reactions. Cytokines – interleukins and interferons (outline only).Complement system: Components of the complement activation - classical, alternative and lectin pathways. Biological consequence of complement activation and complement deficiencies. Hypersensitivity: Types and mechanism of hypersensitive reactions Autoimmunity: Mechanisms of induction of organ specific and systemic, autoimmune diseases. Therapeutic approach. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, properties and types of rejection, tissue typing, immunosuppressive therapy. Immunity and tumors: Types of tumors, tumor antigens (TSTA and TATA), immune response to tumors.

Text Books:

1. Kuby, J. H. Immunology, 6th Edn., New York, USA,W. H. Freeman Publication. 2007.
2. Prescott LM, Harley JP, Klein DA, "Microbiology", Wm. C. Brown Publishers,3rd edition, 2001.

Reference Books:

1. Pelczar MJ, Chan ECS & Krein NR, "Microbiology", Tata McGraw Hill Edition, NewDelhi, India, 2007
2. Roitt, I., Brostoff, J. and David, M. Immunology, 11th Edn., New York, USA Mosby publishers Ltd. 2008.
3. Tizard, "Immunology", Saunders college publication, 5th Edition. 2004.

17BT2059 ANALYTICAL INSTRUMENTATION

Credits: 3:0:0

Course Objectives:

- To provide the students an ability to understand the principles of instrumentation
- To impart the knowledge of different techniques and methods in biotechnology
- To improve the understanding of applications of techniques in the field of biotechnology

Course Outcomes:

The students will be able to

- Understand the basic techniques of drug extraction
- Illustrate the different methods of spectroscopy
- Classify the various techniques of Chromatography
- Elaborate the importance of electrophoresis and thermal analysis techniques
- Analyze the methods of structural elucidation of different drugs
- Evaluate the importance of detection of radioactive isotopes

UNIT I - Buffers, pH – pH meter and applications, Solvent extraction –introduction and principle; Extraction techniques– batch, stripping or back, continuous and counter-current; Principle of solid extraction (Soxhlet); Types -Temperature assisted, pressurized hot water and supercritical fluids based extraction.

UNIT II - Basic principle of Spectroscopy -Beer-Lambert's law, Principle, Instrumentation and applications of Colorimeter, Flame photometry, spectrofluorimetry and Spectrophotometer: types– UV – visible – Raman spectroscopy.

UNIT III - Principle, types and applications of Chromatography- Thin layer, Adsorption, Ion-exchange, Affinity, Gelfiltration, GC and HPLC.
UNIT IV - Principle, Types and applications of Electrophoresis– agarose gel, polyacrylamidegel (PAGE), SDS-PAGE–principle, instrumentation and applications; isoelectric focusing–principle and applications; Thermo gravimetricanalysis (TGA)-Principle, instrumentation and applications
UNIT V - Mass spectrometry–principle, instrumentation (electron spray ionization [ESI] & chemical ionization [CI]) and applications; nuclear magnetic resonance (NMR) –principle, instrumentation and applications; Radioactive isotopes, radioactive decay and their types, radioactive techniques - RIA, GM counter, Scintillation counter, Applications in Medicine & Diagnosis.

Text Books

1. Willard and Merrit, "Instrumental Methods and Analysis" 6th edition, CBS Publishers & Distributors, 2002.

Reference Books

1. Gurdeep R. Chatwal and Sham K. Anand. Instrumental Methods of Chemical Analysis. 5th Edition. Himalaya Publishing House, India. (2012).
2. B.K.Sharma. Instrumental Methods of Chemical Analysis. 24th revised and enlarged edition. GOEL Publishing House, India. (2014).
3. Keith Wilson and John WalkerPrinciples and Techniques of Practical Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press, U.K. (2010).
4. Douglas A. Skoog, F.James Holler and Stanley R. Crough. Instrumental Analysis. 6th Edition. Brooks Cole Publishing Company. USA, (2007).

17BT2060 BIOLOGY IN EVERYDAY LIFE

Credits: 3:0:0
Course Objectives:

- To understand the fundamental principles and concepts of immune system.
- To impart knowledge on recent developments in biology
- To learn the applications of biology in health and human welfare

Course Outcomes:
The students will be able to

- Classify organismal form, function, and diversity.
- Understand Human health and welfare and manage stress.
- Know about the Molecules that define Life and immunotherapeutics.
- Develop a knowledge base for entrepreneurship.
- Appraise the recent trends in biology.
- Demonstrate the ability to undertake careers in biology and be a professional.

UNIT I - Introduction on each application area, Classification of Life forms – Prokaryotes and Eukaryotes, Body plan and Design of Life Forms, Tree of Life and its Fruits. Evolution – Charles Darwin and Carl Linnaeus - Taxonomy, Hierarchy in Classification. Human Nutrition – Macronutrients, Human Nutrition – Micronutrients, Case Study – I (Typhoid Mary).
UNIT II - The Human Body during Health and Disease – Digestive system - Gastroesophageal Reflux Disease (GERD), Jaundice, Dysphagia, Crohn's Disease, Ulcerative Colitis, Celiac disease, Gall Stones, Irritable Bowel Syndrome, Hemorrhoids, and Anal Fissure; Renal System – UTI's, Painful Bladder Syndrome (PBS), Bladder Control Problems, Kidney Stones, Prostatitis, Proteinuria, and Kidney Failure; Circulatory system - High Blood Pressure, Atherosclerosis, Aneurysms, Thrombotic Disorders, Congenital Defects. Stress. Alcohol and Drug Abuse. Depression. Case Study – II (Substance abuse and Social Concern).
UNIT III - Microbes - The Good, the Bad and the Ugly. Bacteria, Fungi, Protozoa, Virus, and Helminthes. Uses in daily life. The Fermentation Industry - Bread making, Beer making and Batter – Idly making– Wine making. Antibiotics – Classification and Mechanism of action in Antibiotics. Immunotherapeutics. Drug Resistance. Microbes as Fertilizer. Organisms as Pesticides. Biofuels and Bioenergy.
UNIT IV - Biomolecules – Types and Properties - Carbohydrates, Fats, Lipids and Nucleic Acids. DNA - Blueprint of Life, Flow of Genetic information, Genes to Function, Forensics - Crime Scene Investigation. Murder mystery and DNA. DNA Fingerprinting. DNA Diagnostics. Population Genetics.
UNIT V - Genetically Modified Plants and Animals, Human Cloning, Stem Cells Depot, Drug Resistant Pathogens, Biosafety and Ethics, Nobel Prizes in Medicine and Physiology, Careers in Biosciences – A Survey.

Text Books:

1. Arthur C Guyton, "A Textbook of Human Physiology", Elsivier Saunders, International Edition, 11th Edition, 2006.
2. Peter Raven et al "Biology", McGraw-Hill Education; 10 edition, January 9, 2013.

Reference Books:

1. Prescott LM, Harley JP, Klein DA, "Microbiology", Wm. C. Brown Publishers,3rd edition,2001.
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, "Principles of Fermentation Technology", Butterworth – Heinemann An Imprint of Elsevier India Pvt.Ltd., 2nd edition, 2005.
3. Bruce Alberts, Molecular Biology of the Cell. "Essential of Molecular Biology" by David Frielder, 2010.

17BT2061BIOTECHNOLOGY AND ENVIRONMENT

Credits: 3:0:0

Course Objectives:

- To learn the importance of biotechnology
- To learn the importance of environment
- To understand the significance of conservation

Course Outcomes:

The students will be able to

- Acquire knowledge on the scope of biotechnology
- Dramatize the health hazards of various pollutants
- Explain the importance of waste water treatment
- Understand the significance of waste management
- Outline the various bioremediation techniques
- Dramatize the conservation of biodiversity

UNIT I - Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal. Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.

UNIT II - Industrial Waste Water Management, Purification of waste water; Aerobic and anaerobic treatments; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.

UNIT III - Biomass, Energy and Solid waste Management, Biomass waste as renewable source of energy; Methods of energy production; Conversion of Solid Waste to Methane; Biogas production; Biofuels, Management of Sludge and Solid waste treatment- Land filling, lagooning, Composting and Vermi Composting.

UNIT IV - Biodiversity and Conservation, Definition, Types, Genetic, Species, Ecosystem; Biodiversity at Global Levels; Values of Biodiversity; Hotspots in Biodiversity; Loss of Biodiversity and its causes threats to Biodiversity; Biodiversity and itsConservation- In situ and Ex situ, IPR and Patenting.

Unit V - Bioremediation and Biodegradation, types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation.

Text Book:

1. Dubey, R.C. "Text Book of Biotechnology", S. Chand & Co, 2nd edition, 2004.

Reference Books

1. 1.Foster C.F; Johnware D.A, "Environmental Biotechnlogy", Ellis Harwood Ltd.3rd edition, 1987
2. Gupta P.K. "Elements of Biotechnology", Rastogi Publications, 2004

17BT2062 ENTREPRENEURSHIP IN BIOENGINEERING

Credits: 3:0:0

Course Objectives:

- To impart various aspects of product design and development
- To inculculate concept generation and selection
- To understand technology behind the product of the service

Course Outcomes:

The students will be able to

- Understand the principles of product design, basic management techniques, entrepreneurial skills and funding agencies.
- Apply knowledge to the fundamentals of business plan, practical management concepts like leadership and motivation.
- Induce entrepreneurial intent as well as innovation, scalability and marketing of the product.
- Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career.
- Assess the commercial viability of a new technology based idea to prototype.
- Transform research based ideas into feasibility and business plans.

UNIT I - Concept and evolution of entrepreneurship, development of Entrepreneurship, stages in entrepreneurial process, entrepreneurship in India, Role of SSI in economic development, Government support for SSI. Role of society and family in the growth of an entrepreneur. Challenges faced by women in entrepreneurship.
UNIT II - Identification of business opportunities, project selection, contents, formulation, guidelines by planning commission for project report. Product design, importance, objectives, factors influencing product design, Product Development Process, sources of ideas for designing new products, stages in product design.
UNIT III - Creativity and innovation, generation of ideas, technical and market feasibility study, opportunity assessment, business plan preparation, execution of business plan, conversion of ideas to prototype, risk taking-concept; types of business risks.
UNIT IV - IPR and copy right, financial opportunity identification; banking sources; non banking institutions and agencies; venture capital and angel investors, meaning and role in entrepreneurship, government schemes for promoting entrepreneurship.
UNIT V - Procedure for getting license and registration, challenges and difficulties in starting an enterprise, host institution support, The role of technology/social media in creating new forms of firms, organizations, networks and cooperative clusters. Market- traditional and E-commerce, expanding markets: local to global.

Text Books:

1. "Entrepreneurial Development", Jayshree Suresh, 5th Edition, Margham Publications, 2008.
2. "Entrepreneurship", Robert D. Hisrich, 6th Edition, Tata McGraw Hill Publications.2009.

Reference:

1. 1."Entrepreneurship: Theory", Process and Practice, Donald F. Kuratko, 9th Edition, Cengage Learning, 2011.

17BT2063 POLLUTION CONTROL

Credits: 3:0:0

Course Objectives:

- To give an exposure to various control acts
- To study the advantages and disadvantages of impact assessment methods
- To study the methods of reducing the waste and reusing it.

Course Outcomes:

The students will be able to

- Gain basic knowledge on pollution, its types
- Summarize Pollution control acts and regulations.
- Employ preparation EIA report
- Evaluate audit reports on pollution is finally controlled.
- Understand the methods of material reuse
- Understand recycling methods

UNIT I - The water (prevention and control of pollution) act 1974 and rules 1975- definitions, constitution, function and fund of central & state boards. Penalties and procedure, miscellaneous. Prevention and control of water pollution.
UNIT II - The air (prevention and control of pollution) act 1981 and rules 1982,definitions, constitution, function and fund of central & state boards. Penalties and procedure, miscellaneous National ambient air quality standards.
UNIT III - The environment (protection) act 1986,rules 1986-definitions, constitution, function and fund of central & state boards. Penalties and procedure, miscellaneous, standards of emission or discharge of environmental pollutants.

UNIT IV - Environmental impact assessment notification,2006-environmental clearance, list of projects, form I, general structure of EIA documents, content of summary EIA,

UNIT V - The plastics manufacture, sale and usage rules,1999-definations,restriction on manufacture, sale, distribution and use of virgin and recycled plastics carry bag and recycled plastic containers

Text book:

1. C. S. Rao Environmental Pollution Control Engineering,New Age International, 2007

Reference Books

1. Peter Wathern, “Environmental Impact Assessment theory and practice”, Unwin Hyman Ltd. Routledge, 1990,
2. L. Lee Harrison , “Environmental Health and Safety Auditing Handbook”, 2nd edition, McGraw Hill, Inc., New York, 1995
3. Kirkwood, R. C. and Longley, A. J., “Clean Technology and Environment”, Chapman & Hall, 1995.