

Proposed scheme of absorption for students of old syllabus of B.Tech Biotechnology into a new syllabus

As per RTM Nagpur University semester pattern
New syllabus

IIIrd Semester

Sr. No	Code(Board) Theo./Pract	Subject	Th/Pr
1	BT BIT 301T (BBT)	Microbiology	Theory
2	BT BIT 302T (BBT)	Bioprocess calculation	Theory
3	BT BIT 303T (BBT)	Bioorganic chemistry	Theory
4	BT BIT 304T (BGE)	Applied Mathematics III	Theory
5	BT BIT 305T (BGE)	Applied Physical Chemistry II	Theory
7	BT BIT 306P (BBT)	Microbiology Laboratory	Practical
6	BT BIT 307P (BBT)	Bioorganic chemistry Laboratory	Practical
8	BT BIT 308P (BGE)	Applied Physical Chemistry II Laboratory	Practical

IVth Semester

Sr. No	Code(Board) Theo./Pract	Subject	Th/Pr
1	BT BIT 401T (BBT)	Biochemistry Metabolism	Theory
2	BT BIT 402T (BBT)	Plant Utility	Theory
3	BT BIT 403T (BBT)	Analytical Biotechnology	Theory
4	BT BIT 404T (BBT)	Cell Biology	Theory
5	BT BIT 405T (BGE)	Electronics & Instrumentation	Theory
7	BT BIT 405P (BBT)	Analytical Biotechnology Laboratory	Practical
6	BT BIT 405P (BBT)	Biochemistry Metabolism Laboratory	Practical
8	BT BIT 405P (BGE)	Electronics & Instrumentation Laboratory	Practical

As per RTM Nagpur University semester pattern
old syllabus

IIIrd Semester

Sr. No	Code(Board) Theo./Pract	Subject	Th/Pr
1	3S.BT.01(BBT)	Microbiology	Theory
2	3S.BT.02(BBT)	Bioprocess calculation	Theory
3	3S.BT.03(BBT)	Bioorganic chemistry	Theory
4	3S.BT.04(BGE)	Applied Mathematics II	Theory
5	3S.BT.05(BGE)	Electronics & Instrumentation	Theory
7	3S.BT.06(BBT)	Microbiology Laboratory	Practical
6	3S.BT.07(BBT)	Bioorganic chemistry Laboratory	Practical
8	3S.BT.08(BGE)	Electronics & Instrumentation Laboratory	Practical

IVth Semester

Sr. No	Code(Board) Theo./Pract	Subject	Th/Pr
1	4SBT01(BBT)	Biochemistry Metabolism	Theory
2	4SBT02(BGE)	Plant Utility	Theory
3	4SBT03(BGE)	Electrical Engineering	Theory
4	4SBT04(BBT)	Cell Biology	Theory
5	4SBT05(BGE)	Applied Physical Chemistry II	Theory
7	4SBT06(BGE)	Electrical Engineering Laboratory	Practical
6	4SBT07(BBT)	Biochemistry Metabolism Laboratory	Practical
8	4SBT08(BGE)	Applied Physical Chemistry II Laboratory	Practical

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Proposed scheme of absorption of new course to old course of Fifth and Sixth, Semesters of **B.Tech.**

(BIOTECHNOLOGY) Vth semester:

As per RTM Nagpur University semester pattern old syllabus

As per RTM Nagpur University semester pattern new syllabus.

sr.No	semester	subject code	subject	Th/Pr	sr.No	semester	subject code	subject	Th/Pr
1	V	5S BT.01 (BBT)	Fluid Mechanics & Solid Handling	Theory	1	V	BT BIT 501T (BBT)	Fluid Mechanics & Solid Handling	Theory
2	V	5S BT.06 (BBT)	Fluid Mechanics & Solid Handling Laboratory	Practical	2	V	BT BIT 506P (BBT)	Fluid Mechanics & Solid Handling Laboratory	Practical
3	V	5S BT.02 (BBT)	Analytical Biotechnology	Theory	3	IV	BT BIT 403T (BBT)	Analytical Biotechnology	Theory
4	V	5S BT.07 (BBT)	Analytical Biotechnology Laboratory	Practical	4	IV	BT BIT 405P (BBT)	Analytical Biotechnology Laboratory	Practical
5	V	5S BT.03 (BBT)	Heat Transfer in Biotechnology	Theory	5	V	BT BIT 503T (BBT)	Heat Transfer in Biotechnology	Theory
					6	V	BT BIT 507P (BBT)	Heat Transfer in Biotechnology Laboratory	Practical
6	V	5S BT.04 (BBT)	Molecular Biology	Theory	7	V	BT BIT 504T (BBT)	Molecular Biology	Theory
7	V	5S BT.08 (BBT)	Molecular Biology Laboratory	Practical	8	V	BT BIT 508P (BBT)	Molecular Biology Laboratory	Practical
8	V	5S BT.05 (BBT)	Immunology	Theory	9	V	BT BIT 505T (BBT)	Immunology	Theory
					10	V	BT BIT 502T (BBT)	Biochemical Reaction Engineering I	Theory

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Proposed scheme of absorption of new course to old course of Fifth and Sixth, Semesters of **B.Tech.**
(BIOTECHNOLOGY)

VI semester:

As per RTM Nagpur University semester pattern new syllabus (C.B.S.)					As per RTM Nagpur University semester pattern old syllabus.				
Sr .No	NEW semester	subject code	subject	Th/Pr	Sr .No	OLD semester	subject code	subject	Th/Pr
1	VI	6S BT.01 (BBT)	Genetic Engineering	Theory	1	VI	BT BIT 601T (BBT)	Genetic Engineering	Theory
2	VI	6S BT.02 (BBT)	Mass Transfer in Biotechnology	Theory	2	VI	BT BIT 602T (BBT)	Mass Transfer in Biotechnology	Theory
3	VI	6S BT.06 (BBT)	Mass Transfer in Biotechnology Laboratory	Practical	3	VI	BT BIT 607P (BBT)	Mass Transfer in Biotechnology Laboratory	Practical
4	VI	6S BT.03 (BBT)	Biochemical Reaction Engineering	Theory					
					4	VI	BT BIT 603T (BBT)	Biochemical Reaction Engineering II	Theory
5	VI	6S BT.04 (BBT)	Process Control in Biotechnology	Theory	5	VI	BT BIT 604T (BBT)	Process Control in Biotechnology	Theory
6	VI	6S BT.07 (BBT)	Process Control in Biotechnology Laboratory	Practical	6	VI	BT BIT 608P (BBT)	Process Control in Biotechnology Laboratory	Practical
7	VI	6S BT.05 (BBT)	Industrial Biotechnology	Theory	7	VI	BT BIT 605T (BBT)	Industrial Biotechnology	Theory
8	VI	6S BT.08 (BBT)	Industrial Biotechnology Laboratory	Practical	8	VI	BT BIT 609P (BBT)	Industrial Biotechnology Laboratory	Practical
					9	VI	BT BIT 606T (BBT)	Communicative English	Theory

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Proposed scheme of absorption of new course to old course of seventh, Semesters of B.Tech. (BIOTECHNOLOGY)

As per RTM Nagpur University semester pattern old syllabus					As per RTM Nagpur University semester pattern new syllabus.(CBS)				
Sr .No	Old semester	subject code	Subject	Th/Pr	Sr .No	New semester	subject code	Subject	Th/Pr
1	VII	7SBT.01 (BBT)	Environment and Biotechnology	Theory	1	VII	BT BIT 701T (BBT)	Environment and Biotechnology	Theory
2	VII	7SBT.02 (BBT)	Downstream Processing in Biotechnology	Theory					
3	VII	7SBT.03 (BBT)	Tissue Culture Technology	Theory	2	VII	BT BIT 702T (BBT)	Tissue Culture Technology	Theory
4	VII	7SBT.04 (BBT)	Bioprocess and Equipment Desigh	Theory	3	VII	BT BIT 703T (BBT)	Bioprocess and Equipment Desigh	Theory
5	VII	7SBT.05 (BBT)	Computational Techniques and Process Modelling	Theory					
					4	VII	BT BIT 704T (BBT)	Bioindustry Economics and Entrepreneurship Development	Theory
					5	VII	BT BIT 705T (BBT)	Elective I: i) Cryogenic Application in Biotechnology ii) Renewable energy Technology iii) Biomaterial Sciences	Theory
6	VII	7SBT.06 (BBT)	Tissue Culture Technology Laboratory	Practical	6	VII	BT BIT 706P (BBT)	Tissue Culture Technology Laboratory	Practical
7	VII	7SBT.07 (BBT)	Bioprocess and Equipment Design	Practical	7	VII	BT BIT 707P (BBT)	Bioprocess and Equipment Design	Practical
8	VII	7SBT.08 (BBT)	Seminar Industrial Training and Tour Report	Practical	8	VII	BT BIT 708P (BBT)	Seminar Industrial Training and Tour Report	Practical

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Proposed scheme of absorption of new course to old course of **Eighth, Semesters of B.Tech. (BIOTECHNOLOGY)**

As per RTM Nagpur University semester pattern old syllabus					As per RTM Nagpur University semester pattern New syllabus (CBS)				
Sr. No	Old semester	subject code	subject	Th/Pr	Sr. No	New semester	subject code	subject	Th/Pr
1	VIII	8SBT01 (BBT)	Cryogenic application in Biotechnology	Theory					
2	VIII	8S BT 02 BBT	Project Management and Economics of Bioprocess Industry						
	VII	7S BT.02(BBT)	Downstream Processing in Biotechnology	Theory	1	VIII	BT BIT 801T (BBT)	Downstream Processing in Biotechnology	Theory
	VII	7S BT.05(BBT)	Computational Techniques and Process Modeling	Theory	2		BT BIT 802T (BBT)	Computational Techniques and Process Modeling	Theory
3	VIII	8S BT.03(BBT)	Bioinformatics	Theory	3	VIII	8S BT.03(BBT)	Bioinformatics	Theory
4	VIII	8S BT 04 (BBT)	ELECTIVE: 1)Biostatistics 2)Food biotechnology 3)Pharmaceutical Biotechnology 4)Nanotechnology	Theory					
					4	VIII	BT BIT 804T (BBT)	Elective II 1)Food Biotechnology 2)Pharmaceutical Biotechnology 3)Biostatistics	Theory
5	VIII	8S BT 06 (BBT)	Bioinformatics Laboratory	Practical	5	VIII	BT BIT 805P (BBT)	Bioinformatics Laboratory	Practical
6	VIII	8S BT 07 (BBT)	Project work/Dissertation	Practical	6	VIII	BT BIT 806P (BBT)	Project work/Dissertation	Practical

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
SECOND YEAR B.TECH (BIOTECHNOLOGY)
THIRD SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
											Sessional	University	Sessional	University	
1	BT BIT 301T (BBT)	Microbiology	3	-	1	4	3	-	1	4	20	80	-	-	100
2	BT BIT 302T (BBT)	Bioprocess calculation	3	-	1	4	3	-	1	4	20	80	-	-	100
3	BT BIT 303T (BBT)	Bioorganic chemistry	3	-	1	4	3	-	1	4	20	80	-	-	100
4	BT BIT 304T (BGE)	Applied Mathematics III	3	-	1	4	3	-	1	4	20	80	-	-	100
5	BT BIT 305T (BGE)	Applied Physical Chemistry II	3	-	1	4	3	-	1	4	20	80	-	-	100
1	BT BIT 306P (BBT)	Microbiology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
3	BT BIT 307P (BBT)	Bioorganic chemistry Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
5	BT BIT 308P (BGE)	Applied Physical Chemistry II Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			15	12	5	32	20	6	-	26	100	400	75	75	650

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
SECOND YEAR B.TECH (BIOTECHNOLOGY)
FOURTH SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1	BT BIT 401T (BBT)	Biochemistry Metabolism	3	-	1	4	3	-	1	4	20	80	-	-	100
2	BT BIT 402T (BGE)	Plant Utility	3	--	1	4	3	-	1	4	20	80	-	-	100
3	BT BIT 403T (BBT)	Analytical Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
4	BT BIT 404T (BBT)	Cell Biology	3	-	1	4	3	-	1	4	20	80	-	-	100
5	BT BIT 405T (BGE)	Electronics & Instrumentation	3	-	1	4	3	-	1	4	20	80	-	-	100
7	BT BIT 405P (BBT)	Analytical Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
6	BT BIT 405P (BBT)	Biochemistry Metabolism Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
8	BT BIT 405P (BGE)	Electronics & Instrumentation Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			15	12	5	32	20	6	-	26	100	400	75	75	650

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
THIRD YEAR B.TECH (BIOTECHNOLOGY)
FIFTH SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BT BIT 501T (BBT)	Fluid Mechanics & Solid Handling	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 502T (BBT)	Biochemical Reaction Engineering I	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 503T (BBT)	Heat Transfer in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BT BIT 504T (BBT)	Molecular Biology	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 505T (BBT)	Immunology	3	-	1	4	3	-	1	4	20	80	-	-	100
6.	BT BIT 506P (BBT)	Fluid Mechanics & Solid Handling Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
7.	BT BIT 507P (BBT)	Heat Transfer in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
8.	BT BIT 508P (BBT)	Molecular Biology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			15	12	5	32	20	6	-	26	100	400	75	75	650

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
THIRD YEAR B.TECH (BIOTECHNOLOGY)
SIXTH SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
											Sessional	University	Sessional	University	
2.	BT BIT 601T (BBT)	Genetic Engineering	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 602T (BBT)	Mass Transfer in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 603T (BBT)	Biochemical Reaction Engineering II	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BT BIT 604T (BBT)	Process Control in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 605T (BBT)	Industrial Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
6.	BT BIT 606T (BGE)	Communication English	3	-	-	3	3	-	-	3	10	40	-	-	50
7.	BT BIT 607P (BBT)	Mass Transfer in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
8.	BT BIT 608P (BBT)	Process Control in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
9.	BT BIT 609P (BBT)	Industrial Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			18	12	5	31	23	6	-	29	110	440	75	75	700

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOURTH YEAR B.TECH (BIOTECHNOLOGY)
SEVENTH SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BT BIT 701T (BBT)	Environment and Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 702T (BBT)	Tissue Culture Technology	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 703T (BBT)	Bioprocess and Equipment Design	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BT BIT 704T (BBT)	Bio Industry Economics and entrepreneurship development	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 705T (BBT)	Elective I*	3	-	1	4	3	-	1	4	20	80	-	-	100
6.	BT BIT 706P (BBT)	Tissue Culture Technology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
7.	BT BIT 707P (BBT)	Bioprocess and Equipment Design	-	4	-	4	-	2	-	2	-	-	25	25	50
8.	BT BIT 708P (BBT)	Seminar Industrial Training and Tour Report	-	-	-	4	-	-	-	4	-	-	100	-	100
Total			15	8	5	32	15	2	-	28	100	400	150	50	700

• **BT BIT 705T(BBT) Elective I:**

I	Cryogenic application in Biotechnology
ii	Renewable energy Technology
iii	Biomaterial Science

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOURTH YEAR B.TECH (BIOTECHNOLOGY)
EIGHTH SEMESTER

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
			L	P	T	Total	L	P	T	Total	Theory		Practical		
											Sessional	University	Sessional	University	
1.	BT BIT 801T (BBT)	Downstream Processing in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 802T (BBT)	Computational Techniques and Process Modeling	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 803T (BBT)	Bioinformatics	3	-	1	4	3	-	1	4	20	80	--	-	100
4.	BT BIT 804T (BBT)	Elective-II*	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 805P (BBT)	Bioinformatics Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
6.	BT BIT 806P (BBT)	Project work/Dissertation	-	6	-	6	-	6	-	6	-	-	100	100	200
Total			12	10	4	26	16	8	-	24	80	320	125	125	650

• **BT BIT 804T(BBT) Elective II:**

I	Food Biotechnology
ii	Pharmaceutical Biotechnology
iii	Biostatics

Credit distribution as per AICTE guidelines

Total Credits = 200 (Actual Credits are 212)

Credits per Semester = 26

Credit Distribution:

No.	Subject Head Credits as per	AICTE		Actual	
		% Of Credit	Credits	Credits	% Of Credit
1	Humanities	5 to 10	10 to 20	09	04.25
2	Basic Sciences	20 to 25	40 to 50	39	18.40
3	General Engineering	20 to 25	40 to 50	28	13.20
4	Core Subjects	55 to 65	110 to 130	136	64.15
				212	100.00

Semester	Core	Humanities	Basic Science	General Engineering	Total
I	0	4	19	5	28
II	0	2	14	9	25
III	16	0	06	04	26
IV	16	0	0	10	26
V	26	0	0	0	26
VI	26	03	0	0	29
VII	28	0	0	0	28
VIII	24	0	0	0	24
Total	136	09	39	28	212

List of Electives:

Elective-I	Cryogenic application in Biotechnology	Renewable energy Technology	Biomaterial Science
Elective-II	Food Biotechnology	Pharmaceutical Biotechnology	Biostatics

Teaching Scheme B.Tech (Biotechnology)

THIRD SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 301T (BBT)

Microbiology

Unit I: Historical background of microbiology. Microbial taxonomy, Construction and working principles of different types of microscopes – compound, dark field, phase contract, fluorescence and electron microscope. Study of bacteria, yeasts, molds & actinomyces on the basis of morphology, physiological requirements and reproduction.

Unit II: Nutritional requirements of microorganisms. Autotrophic & heterotrophic mode of Nutrition. Composition and classification of different types of Nutrient media. Methods of isolation & characterisation of pure culture and methods of storage of pure cultures.

Unit III: Growth of microorganisms. Phases of growth curve. Specific growth rate and Generation Time. Growth inhibitors and methods of evaluation of antimicrobial agents. Synchronised & balanced growth . Different methods of enumeration of microorganisms.

Unit IV: Defnaton of terms , factors influencing antimicrobial activity, mechanism of cell injury, physical control of growth(moist heat, dry heat, osmotic pressure,radiation, filtration etc) Chemical control (heavy metals, detergents, gaeciour sterilization etc). Effect of heat, water activity, and irradiation on growth of microorganisms, D₁₀ value, F value, Z value and TDT curve. standardization of disinfectants.

Unit V: Viruses – Introduction, structure and classification. DNA and RNA viruses, plant and animal viruses. Structure of Bacteriophage, Viral reproduction.- lytic and lysogenic cycle.virus cultivation and assay.

Unit VI: Microbial genetics – Transformation, conjugation and transduction. Economically important bacteria, fungi and viruses and their industrial application.

Books Recommended:

1. Microbiology , Pelezer M.J.Chan ECS & Krieg NR,Tata McGraw Hill
2. Foundation in Microbiology, Talaro K, Talaro A, Cassida Pelzar and Reid W.C.Brown Pub.
3. General Microbiology , R.Y. Stanier
4. General Microbiology , Prescott.
5. General Microbiology , Brook.
6. A textbook of Microbiology by Dr.R.C.Dubey and Maheshwari
7. Textbook of microbiology- R.Ananthanarayana CKJ Paniker
8. General Microbiology vol I and vol II by Powar and Daginawala

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 302T(BBT)

Bio-Process Calculations

Unit 1: Basic principles, the concept of gram atom and gram mole. Conversion of units from one system to another, concept of excess reactant, conversion and yield, selectivity and degree of completion of reaction.

Unit 2: Ideal gases, partial pressure, vapour pressures, application of ideal gas laws, volume changes with changes of composition, dissociating gases, humidity and saturation, solubility and crystallisation.

Unit 3: Material balance without chemical reaction, recycle, purge and bypass calculations, material balance with chemical reaction.

Unit 4: Energy balance without chemical reaction, combined material and energy balances.

Unit 5: Energy balance with chemical reaction, combined material and energy balances.

Unit 6: Materials and energy balance for biotech systems with specific examples.

Books Recommended:

1. Chemical Process Principles : Hougen and Watson, Vols I & II
2. Stoichiometry : B I Vora and Bhatt
3. Stoichiometry : Williams and Johnson
4. Basic principles and calculation in chemical engineering –David mautner ,himmelblau, james B.Riggs.
5. Biochemical engineering and biotechnology- Ghasem.D. Najafpour
6. Stoichiometry and process calculation- B.Lakshmiktty

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 303T(BBT)

Bio-Organic Chemistry

Unit 1: Chemistry of Carbohydrates: Classification and structure of carbohydrates. Chemical reactions of carbohydrates, physical and chemical properties of sugars, starch, pectin, gums and other polysaccharides.

Unit 2: Chemistry of Lipids: Definition and classification of lipids. Chemistry of fatty acids, and compound lipids. Characterization of fats: Saponification and iodine value. Chemistry of processing of fats and oils, hydrogenation of fats, shortening agents, confectionery fat etc. Rancidity of fats and oils, its prevention and antioxidants. Importance of lipid in cell structure.

Unit 3: Chemistry of Proteins: Classification and structure of amino acids, Classification and structure of protein (primary, secondary, tertiary & quaternary). Isolation and purification of proteins. Denaturation and renaturation of protein. Salting in and salting out of protein. Ramachandran plot.

Unit 4: Chemistry of Nucleic acids: Structure of DNA and RNA, Structure of nucleotides and nucleosides, classification, isolation, separation and assay. Types of RNA: mRNA, rRNA and tRNA and their structures. Sequencing of nucleic acids.

Unit 5: Chemistry of Enzymes: Introduction, classification and nomenclature of enzymes. Enzyme regulation. Assay techniques, isolation and purification of enzymes and their importance.

Unit 6: Chemistry of Steroids, Vitamins, chemistry of plant and animal pigments, alkaloids, tannins and other phytochemicals.

Books Recommended

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Biochemistry-J.L.Jain S.Chand and Company
5. Biochemistry- Prasaranga, Bangalore University
6. Fundamental of Biochemistry – Dr.A.C.Deb
7. Textbook of Organic Chemistry (A Modern Approach)
8. The Biochemistry of Nucleic acid – Tenth Edition-Roger L.P.Adams, John T. Knowler and
9. David P.Leader, Chapman and Hall Publications

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 304T (BGE)

Applied Mathematics III

UNIT-I- Integral Transforms-Laplace transform, inverse Laplace transforms, Applications of Laplace transforms in solving ordinary and partial differential equations.

UNIT-II- Analytical function, Cauchy-Riemann conditions, conjugate functions, singularities, Cauchy's integral theorem and integral formula, Residue theorem, Evaluation of integral by residue theorem, contour integration,

UNIT-III- Partial Linear Differential Equations of first & higher orders, Laplace Equations, Poission equation, Wave equation, Solution of these equations by substitution, Separation of variables.

UNIT-IV- Numerical methods using finite difference technique for the solution of parabolic, hyperbolic and elliptic partial differential equations.

UNIT-V- Operations Research- Optimization by linear programming, Fundamental theorems of linear programming, simplex methods, Basic variables ,basic solutions ,artificial variables, minimax theorems, Convex set, Vertex of convex set, the external solution to linear programming problems, Charnbig-M-method,

UNIT-VI- Statistical Analysis- Test of significance in Large samples, small samples, sampling of attributes, χ^2 , t, F, Z distributions. Theory of testing hypothesis in application to acceptance sampling regression and correlation coefficients, Rank correlation coefficients and Test of significance for them.

Books Recommended:

1. Numerical Methods for Scientists and Engineering by Barron and Salvodori.
2. Fundamentals of Mathematical Statistics by Gupta and Kapoor.
3. Elements of Statistics by Elhance.
4. Introduction to Statistics by Goon Gupta and Das gupta.
5. Linear Programming:Methods and Applications by P.K. Gupta and Mannmohan.

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 305T (BGE)

Applied Physical Chemistry II

Unit 1: Thermodynamics I: The chemical potential, Gibb's Duhem equation, Fugacity, Activity, Determination of fugacity, Chemical equilibria only for Homogeneous system- Reaction Isotherm, Relation between K_p, K_c, K_x , The Van't Hoff equation

Unit 2: Thermodynamics II: The Clausius Clapeyron Equation, The Phase Rule and its derivation, its application to water system and CO_2 system, Simple Eutectic system- Lead Silver system, Nernst distribution law, its applications- Solvent extraction theory and principle

Unit3: Thermodynamics of solutions I : Raoult's Law, Vapour Pressures of ideal solutions, Activity of ideal solution, chemical potential of ideal solution, Gibb- Duhem- Margules Equation, Free energy, entropy, and enthalpy of mixing

Unit 4 : Thermodynamics of solutions II : Vapour Pressures of real solutions, Vapour Pressure-composition and Boiling Point composition Curves of completely Miscible Binary Solutions, Distillation method of immiscible liquids : Fractional distillation and steam distillation, Colligative properties-vapour pressure lowering, Osmotic pressure, Elevation of boiling point, depression of freezing point

Unit 5 : Electrochemistry I : Specific, Equivalent and Molecular conductance, effect of temperature on conductivity, Transport Number, their determination- Hittorf's method and Moving Boundary Method, Kohlrausch's Law, its applications, Debye Huckel Theory of strong electrolytes

Unit 6 : Electrochemistry II : Reversible electrodes, Reference electrodes, standard electrode potential, Thermodynamics of reversible electrodes, The Nernst Equation, Concentration cells with and without transference, liquid junction potential, Applications of Emf measurements, Hydrolysis of salts

Books Recommended:

1. Thermodynamics for Chemists : S.Glasston, D Van Nostrand Co, New York, USA
2. An Introduction to Thermodynamics : R P Rastogi and R R Mishra
3. Introduction to Electrochemistry : S.Glasston, D Van Nostrand Co, New York, USA
4. Physical Chemistry : G Barrow, Benjamin Publisher, New York, US
5. Physical Chemistry : Vemupalli, Wiley East West
6. Principles of Physical Chemistry : Puri Sharma and Pathania

PRACTICALS

BT BIT 306P (BBT)

Microbiology

1. Introduction to parts and working of microscope.
2. Preparation of culture media/ agar slants /plates
3. Demonstration of techniques of pure culture of microorganism.
4. Staining of bacteria (simple and Gram's stain) and fungi.
5. The quantitative bacteriological examination of water/milk by SPC method.
6. Determination of growth curve of bacteria
7. Presumptive test for coliform group of bacteria.
8. IMVic test of enteric bacteria
9. Determination of phenol coefficient.
10. Determination of antibiotic sensitivity test of the UTI causing organism.
- 11.

BT BIT 307P (BBT)

Bio-organic Chemistry

1. Preparation of buffers- Citrate and phosphate buffers.
2. Determination of reducing sugar by dinitro-salicylic (DNS) method.
3. Protein estimation by Lowry's method.
4. Protein estimation by Biuret method.
5. Estimation of DNA by diphenylamine reagent method.
6. Estimation of RNA by orcinol reagent method.
7. Determination of isoelectric point of casein.
8. Estimation of inorganic phosphate by Subbarao's method.
9. Quantitative estimation of Ascorbic acid.

BT BIT 308P (BGE)

Applied Physical Chemistry II

1. To study the $KI_3 \rightarrow KI + I_2$ equilibrium in aqueous solution.
2. To study the ternary system of Toluene-Acetic acid-water
3. To study the adsorption of acetic acid on charcoal and verify the Freundlich adsorption isotherm
4. To determine the heat of crystallization of $CuSO_4 \cdot 5H_2O$.
5. To determine the integral and differential heats of solution of a salt.
6. To determine the thermometric titration curve in the neutralization of strong and weak acids against a strong base.
7. To find the constant of a conductivity cell and hence determine the dissociation constant of a weak acid.
8. To determine the solubility of sparingly soluble salts conductometrically

9. To find the pH of buffers and the dissociation constant of an acid using Quinhydrone electrode.
10. To determine the transport number by the e.m.f. method.
11. To study the kinetics of saponification of methyl acetate by sodium hydroxide by conductometry.
12. To verify the Kohlrausch's law.

Teaching Scheme B.Tech (Biotechnology)

FOURTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 401T (BBT)

Biochemistry-Metabolism

Unit 1: Carbohydrate Metabolism: Gluconeogenesis, glycolysis, and TCA cycle, Glycogen metabolism, Hormonal regulation of carbohydrate metabolism. Electron transport chain.

Unit 2: Lipid Metabolism- Beta oxidation, oxidation of saturated and unsaturated fatty acids, fatty acid biosynthesis, ketone bodies. Synthesis of phospholipid.

Unit 3: Protein and amino acid metabolism (aromatic and sulfur). Nucleic acid metabolism

Unit4: Plant metabolism – Photosynthetic apparatus (bacterial system), cyclic and non-cyclic Photophosphorylation , Dark reaction. Plant hormones and its regulation in plants. Glyoxylate cycle.

Unit 5: Microbial Metabolism

A) Respiration: EMP, HMP and ED Pathways, Oxidative phosphorylation.

B) Metabolism of Xenobiotics (detoxification), free radicals and antioxidants.

Unit 6: Biochemical Energetics: Energy Yielding and Energy Requiring Reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP Yield, Monooxygenase system and ATP pump, Active Transport, Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy.

Books Recommended:

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Biochemistry- J.L.Jain S.Chand and Company
5. Biochemistry by U. Satyanarayana and U. Chakrapani
6. Fundamental of Biochemistry – Dr. A. C. Deb
7. Harper's Biochemistry by Robert K. Murray, Harold A. Harper
8. The Biochemistry of Nucleic acid – Tenth Edition-Roger L. P. Adams, John T. Knowler and David P. Leader, Chapman and Hall Publications.
9. Atext book of Biochemistry by Dr.AVSS Ramarao and Suryalakshmi.

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 402T(BBT)

Plant Utilities

THERMODYNAMICS:

Laws of perfect gases, thermodynamics processes, First and Second Law of thermodynamics, Entropy, The clausius inequality, Steady Flow Processes, carnot Cycle.

PROPERTIES OF STEAM:

Use of steam tables, measurement of dryness fraction, entropy of steam, temperature entropy and mollier charts, clausius clapeyron equation, Rankine Cycle.

UNIT II: STEAM GENERATORS:

General Description, Boiler Mounting and Accessories, Natural and Artificial Draught, Equivalent Evaporation and Thermal efficiency. Fuels use in boilers – liquids, gaseous and hydrocarbon

UNIT III: TURBINE:

Theory and working of impulse, reaction and gas turbine. Bleeding and reheating.

UNIT IV: INTERNAL COMBUSION ENGINES:

Cycle of operation, two and four stroke cycle, general description of S.I and C. I. engines, ignition, injection and governing.

UNIT V: WATER

Sources, conditioning and management of water for cooling of hot gases, cooling towers, cooling ponds. Design of chimney. Constructional details and design aspects.

UNIT VI: ENVIRONMENTAL ASPECTS OF PLANT LOCATION

Environmental issues for site selection, natural disasters.

BOOKS RECOMMENDED

1. Fundamental of Engineering Thermodynamics – John and Howel
2. Introduction to Engineering Thermodynamics – M Gengel and Boles
3. Applied Thermodynamics – Aestop
4. Applied Thermodynamics – R N Joel
5. Energy and Environmental Management in Industries- Gupta

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 403T(BBT)

Analytical Biotechnology

Unit 1: Centrifugation: Principle of centrifugation. Sedimentation, sedimentation constant. Types of centrifugation, swing, fixed angle centrifugation. Introduction to ultracentrifugation and its application.

Unit 2: Radiosotopy: Tracer techniques: Radioactive and nonradioactive. Radiotracers. Geiger Muller Counter (GM Counter), Proportional and Scintillation counters, autoradiography. Detection of nonradioisotopes.

Unit 3: Spectroscopy: Introduction and Principle of spectroscopy, Beer-Lamberts law, Single beam and double beam spectrophotometer. Types of sphectroscopy techniques and their applications, Infrared and Raman spectroscopy (IR), FTIR Spectroscopy for structural determination of hydrocarbons, aminoacids, carbohydrates. Atomic Absorption Spectrometry – measurement of trace elements,

Unit 4: Chromatography: Classification of techniques, distribution coefficients, retention chromatography, sorption mechanisms, retention parameters, factors affecting retention, qualitative and quantitative aspects of chromatography, peak shape sorption isotherms, column efficiency, band broadening processes, selectivity and resolution. Types of chromatography TLC, paper chromatography, chiral, Gas Chromatography, Liquid Chromatography, HPLC.

Unit 5: Electrophoresis: Electrophoresis of proteins and nucleic acids; ID & 2D Gels; pulsed field electrophoresis; capillary electrophoresis; western southern and northern blotting; dot and slot, gel documentation.

Unit 6: Determination of homogeneity of molecular weight of proteins. Mass Spectrometry and its Application - LCMS, MALDI-TOFF and SELDI. Spectrophotometry (UV & Visible) and Spectroflourimetry, , Optical Resonance Dichroism (ORD) and circular dichroism (CDR), Nuclear magnetic Resonance (NMR) and Electron Spin Resonance Spectroscopy (ESRS), Magnetic Resonance Imaging (MRI).

Books recommended:

- 1) Analytical Biotechnology 01 Edition: Thomas
- 2) Analytical Biotechnology: Capillary Electrophoresis And Chromatography: Horvath
- 3) Biophysical Chemistry :Upadhyay and Upadhyay Nath

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 404T (BBT)

Cell Biology

Unit 1: Biophysics of Membrane: salient features of membrane, chemical composition of membrane, molecular structure, modification of cell membrane and biophysical importance, types of membrane (nuclear, RBC, mitochondria, cell wall), conformational properties of membrane, permeability of membrane, membrane receptors, Scatchard plots.

Unit 2: Membrane transport – simple and facilitated diffusion; active transport, passive transport, uniport, symport and antiport, group translocation and macromolecules as carriers (glucose transport system), Donnan membrane equilibria, membrane hydrolysis, Ultra filtration and Dialysis.

Unit 3: Signal Transduction: Types of receptors, legend molecules, mechanisms of signal transduction. Tyrosine kinase, ras, raf, G-protein etc.

Unit 4: Introduction to Cell components of prokaryotes and eukaryotes. Cytoskeleton: Membrane structure and function, extracellular membrane and its role in cell behavior and regulation, microfilament, microtubule, and intermediate filament, Morphogenesis and model organism.

Unit 5: Cell cycle and its regulation: Chromosomal organization and introduction to Meiosis and Mitosis, Regulation phase of cell cycle, cell cycle check points, factors involved in cell cycle regulation, Apoptosis and Cancer.

Unit 6: Techniques of cell biology: Brief introduction to Stem Cell Biology: History, definitions, basic technology, applications. Flow cytometry, chemical composition of karyotype, Fluorescence insitu hybridization (FISH)

Books Recommended

1. Molecular Biology of cell – Bruce Alberts et al, Garland publications
2. Animal Cytology & Evolution – MJD, White Cambridge University Publicatins
3. Molecular Cell Biology – Daniel , Sceintific American Books.
4. Cell Biology – Jack D.Bruke, The William Twilkins Company.
5. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.
6. Fundamentals of Biochemistry- Donald Voet, Judith Voet and Charlotte Pratt.
7. Cell Biology Genetics, Molecular Biology Evolution and Ecology by P.S.Verma and V.K. Agrawal.

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 405T (BBT)

Electronics and Instrumentation

UNIT – I-Diode rectifiers, power supply, transistor series with zener, short circuit protection, power supply using SCR, triac, diac, three pin IC regulators.

UNIT – II-Characteristics of BJT Amplifiers: Input-Output impedance, gain, bandwidth, basic design of amplifiers.

UNIT – III-Class A and Class B power amplifiers, push pull, complementary, symmetry connections.

UNIT – IV-Wien bridge oscillator, multivibrators, astable and bistable, analog signal conditioning, filtering and impedance matching, bridge and potentiometric circuits.

UNIT – V-Operational amplifiers, op-amp parameters, inverting amplifiers, non inverting amplifiers, differential amplifier, voltage to current converter, current to voltage converter, integrator, differentiator, linearization.

UNIT – VI-Digital signal conditioning – Digital information, Binary numbers, Gates, Comparators, Digital to analog converters, Analog to digital converters, Thermistors , Thermocouples, Transducers, strain gauge , LVDT.

Books recommended

1. A course in Electrical & Electronic Measurements & InstrumentationBy A.K.Sawhney
2. Principles of Electronics by V.K.Mehta
3. Electronics Devices & Circuits by Sanjeev Gupta
4. Process Control & Instrumentation Technology by C.D.Johnson
5. Instrumentation by R.P.Jain
6. Handbook of Electronics by Gupta & Kumar
7. Electronics Measurements & Instrumentation by V. A. Bakshi & A. V. Bakshi
8. Electronics Principles by Malvino
9. Digital & Analog Technique by Kale & Gokhale
10. Power Electronics by Khanchandani

PRACTICALS

BT BIT 406P(BBT) Analytical Biotechnology

1. Chromatographic separation of bio-molecules.
2. Determination of adsorption spectrum and extinction coefficient.
3. Demonstration of Gel-permeation chromatography/Ion-exchange/Affinity chromatography.
4. Electrophoresis of Biomolecules i.e. proteins and nucleic acid.
5. Purification of proteins and enzymes by salt precipitation, solvent etc.
6. Turbidometric assay of microbial growth.

BT BIT 407P (BBT) Biochemistry

1. Determination of Michaelis constant of enzymes.
2. Assay of amylase enzyme activity from sweet potato.
3. Assay of phosphatase enzyme activity from potato.
4. Assay of lactate dehydrogenase enzyme activity.
5. Assay of succinate dehydrogenase activity.
6. Assay of alanine aminotransferase activity.
7. Assay of aspartate aminotransferase activity.
8. Isolation and crystallization of enzyme urease from jack beans.
9. Effect of Inhibitor on Enzyme activity

BT BIT 408P(BBT) Electronics and Instrumentation

1. To study the zener diode as a voltage regulator.
2. Study of logic gates.
3. A to D converter
4. D to A converter
5. Study of Bridge rectifier
6. Diac characteristics
7. Study of Thermistor
8. Full wave rectifier
9. Triac characteristics
10. CB, CE amplifier
11. Current to voltage converter
12. Voltage to current converter

Teaching Scheme B.Tech (Biotechnology)

FIFTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 501T (BBT)

Fluid Mechanics and Solid Handling

Unit 1: Hydraulics- Nature of Fluid and Fluid Flow. Manometers. Mechanism of noncompressible fluid flow, Reynold's number, Distribution of velocities, Reynold's theorem, frictional losses in pipe line, losses in various fittings, transportation of fluids.

Unit 2: Measurement of Fluid flow, orificemeter and venturimeters, pitot tube, rotameter, notches and weirs, and other miscellaneous meters.

Unit 3: Design and operating characteristics of reciprocating and centrifugal pumps, diaphragm pump, rotary and positive displacement pump.

Unit 4: Size reduction and Separation- Properties of solids, size reduction, types of equipments, power requirements, laws of crushing and grinding, open and closed circuit grinding, critical speed of the ball mill.

Unit 5: Sedimentation - Free and hindered settling, design of thickeners etc. Filtration: - Theories of filtration and washing, constant rate and constant pressure filtration, optimum cycle, handling of compressible cake and use of filter aids.

Unit 6: Mixing and conveying – Fundamentals of mixing and characteristics of mixing equipments, power consumption and efficiencies, design of conveyor belts. Flow through packed column and fluidization, methods of the dust collection, cyclones, electrostatic precipitators, bag filters.

Books Recommended

- 1 Introduction to Chemical Engineering by Badger and Banchero, McGraw Hills International Students Edition.
- 2 Unit Operations in Chemical Engineering by McCabe and Smith, McGraw Hill
- 3 Unit Operations by Brown, John Wiley and Sons Inc. New York.
- 4 Chemical Engineering by Coulson and Richardson, Vol I and II, Pergamon Press, New York

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 502T (BBT)

Biochemical Reaction Engineering – I

Unit 1- Kinetics of Homogeneous Reactions, Interpretation of Batch Reactor Data

Unit 2- Review of reactors, mass and energy balance equations in reactor system, Design of Single Ideal Reactors

Units 3- Design of single reactions- Comparison of volumes of plug flow reactor and Chemostat. Multiple reactors-Methods to show how total volume and conversion is affected in multiple reactors, Recycle reactor, Autocatalytic reactors.

Unit 4- Animal and plant cell cultivation, Phases of cell growth, kinetic model for cell growth, Evaluation of Monod kinetic parameters, Growth of filamentous organism, Substrate and product inhibition on cell growth, multiple fermenters in series, cell recycling in various fermenters.

Unit 5- Design of multiple reactions- parallel Reactions, Irreversible First-Order Reactions in Series, First-Order Followed by Zero-Order Reaction, Zero-Order Followed by First-Order Reaction, Quantitative treatment of reactors, Kinetics of irreversible series-parallel reactions.

Unit 6 – Heat of reaction from thermodynamics, adiabatic and non adiabatic operations, performance of adiabatic flow reactors

Books Recommended

- 1) Chemical Reaction Engineering, 3rd Edition – O.Levenspiel, Willey Eastern 1999
- 2) Chemical Kinetics and Reactor Calculations- Scott Fogler, Prentice Hall
- 3) Biochemical Engineering -James M. Lee, Prentice-Hall Inc. in 1992
- 4) Elements of Chemical Reaction Engineering-S.D.Dawande, Central Techno Publications, Nagpur.
- 5) Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 503T (BBT)

Heat Transfer in Biotechnology

Unit 1 Modes of heat transfer, steady state heat conduction equation, heat conduction in slabs, cylinders, spheres, heat generation inside solids, unsteady state heat conduction, Biot Number, Fourier Number and Heisler Charts.

Unit 2- Thermal insulation and their selection, optimum and economic thickness of insulation. Principles of heat flow in fluids, individual and overall heat transfer coefficients.

Unit 3- Free and Forced convection, dimensionless number in heat transfer, expressions for calculating heat transfer coefficients. Laminar and turbulent transfer inside and outside tubes, annuli, finned tubes. Natural convection and its applications. Film wise condensation and drop wise condensation, heat transfer to boiling liquids, pool boiling, forced convection boiling.

Unit 4- Unsteady state heat transfer in batch vessels. Heat exchangers, classification, applications, mode of operations, effectiveness, flow arrangement, design procedures.

Unit 5- Heat transfer in agitated vessels, coils. Heat recovery methods, recuperative, regenerative heat transfer in packed and fluidized beds. Heat transfer in evaporators, vaporizers, reboilers, reaction kettles, classification, operations and design.

Unit 6- Heat transfer by radiation, green house effect, heat flux by radiation. Heating fluids and reagents. Application of heat in sterilization of media, batch and continuous sterilization, in situ sterilization, chilling, freezing and refrigeration.

Book Recommended:

1. Principles of Heat Transfer and Mass Transfer by SD Dawande, Central Techno Publications, Nagpur.
2. Process Heat transfer by Dr. Kern Tata McGraw-Hill Education, 1950.
3. Fluid Mechanics and Heat Transfer by Kay JM, Cambridge University Press.
4. Heat Transmission by McAdams WH, McGraw Hill book Co, New York.
5. Heat Transfer by P.S.Ghoshdastidar, Oxford University Press
6. Heat Transfer by Y.Cengel, McGraw-Hill, 2003
7. Fundamentals of Heat and Mass Transfer, Frank P. Incropera, David P. DeWitt John Wiley & Sons, 2011

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 504T (BBT)

Molecular Biology

Unit 1- Basics of Molecular Biology- Introduction to Replication (Prokaryotic and Eukaryotic), Transcription (Initiation, elongation and termination, post transcriptional modification, splicing), Translation (mechanism of translation and protein folding).

Unit 2- Mutation and DNA repair- Genetic Code. Mutations: types of mutations, mutagens, mutagenesis. DNA damage and repair mechanism: Types of DNA damage, mechanisms of DNA repair. Selection of mutants by replica plate method.

Unit 3- Prokaryotic gene regulation- Prokaryotic genome organization and structure. Prokaryotic gene expression, operons (lac, tryptophan, arabinose and galactose), positive and negative gene regulations, factors involved in gene regulation.

Unit 4- Eukaryotic Gene Regulation- Eukaryotic genome organization and structure, regulatory sequences (Intron, exon, spacers, amplifiers, and inhibitors) DNA binding protein, ALU sequences, telomerase, transposons. Gene silencing by modification of histones and DNA. RNA in gene regulation.

Unit 5- DNA fingerprinting techniques- Restriction Enzymes. Polymerase Chain Reaction (PCR). Hybridization based fingerprinting and PCR based fingerprinting. DNA probes, chromosome walking.

Unit 6- Molecular biological techniques- microarray, SNP, SSR, Real Time PCR, Southern, Western and Northern blotting. Concept of genomics, proteomics and gene silencing (RNAi technique), Micro RNA

Books Recommended:

1. Gene VII, Lewin . B. 2002, Oxford University, Press, New York.
2. Russel , V.E.A 1992, Molecular Genetic Approach, Springer Verlag.Berlin
3. Freifelder D, " Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.
4. Molecular Biology by Watson. Benjamin-Cummings Publishing Company; 4 edition
5. Basics molecular biology by Avinash Upadhyya and Kakoli Upadhyya, Himalaya Publication.

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 505T (BBT)

Immunology

Unit 1- Introduction, innate and acquired immunity, active and passive immunity. Introduction to cells (T & B lymphocytes, NK cells, mast cells, dendritic cells) and organs of immune system –Primary and secondary (bone marrow, thymus, lymph nodes, CALT and MALT).

Unit 2- Structure of antigens and antibody- Antigens – classification, isotypes, functions and diversity. Antibody – structure, functions, types, monoclonal and polyclonal antibody, Immunoglobulin gene. Generation of antibody diversity and specificity. Concept of Mitogen, hapten, immunogen, adjuvants. MHC and its significance.

Unit 3- B and T cell receptors- cytokines and their biological role . A brief idea about antigen processing and presentation. Humoral and cell mediated immune response. Complement system:-concept of activation, classical and alternative pathway.

Unit 4- Immunology Techniques- Antigen-antibody interaction, precipitin reaction, agglutination, immuno-diffusion. Immunoassay techniques-- Immuno-electrophoresis, ELISA, RIA, Immunochemistry , immunofluorescence. Blood group determination.

Unit 5- Vaccines- Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccinetechnology- recombinant vector vaccines, synthetic peptide vaccines and subunit vaccines, DNA vaccines. antibody engineering- Production of monoclonal antibodies. Chimeric antibody, humanized antibody. Methods of preparation, their clinical applications and applications in Research and development.

Unit 6- Hypersensitivity- Types, mechanisms and disorders; Autoimmunity:- Mechanism and therapeutic approaches, immunodeficiency syndrome and their diagnosis, Immunotherapy Transplantation Immunology:- Types of graft, mechanism of graft rejection, prevention of graft rejection, Tumor immunology:- Tumor Associated antigens and Tumor Specific Antigens;

Books Recommended

1. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4th Edition B.A. Osborne.
2. Essential of immunology Ivan Riot-Blakswel 1997, 4th Edition B.A. Osborne
3. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
4. William, R. Clark The Experimental Foundations of Modern Immunology (1991) (4th Edition) John Wiley and Sons, New York.
5. Principles of Immunology by Dr.N.V.Shastri, Himalaya Publication.
6. Immunology Introduction text book by Nandini Shetty, New age international limited publishers.

PRACTICALS

BT BIT 506P (BBT) Fluid Mechanics and Solid Handling Laboratory

1. To calibrate Venturi meter and obtain its coefficient of discharge.
2. To calibrate an Orifice meter and obtain its coefficient of discharge.
3. To calibrate Rotameter and obtain its coefficient of discharge.
4. To calibrate Notched Weir and to determine its coefficient of discharge (Rectangular and Triangular Notch)
5. To Study Losses in pipes apparatus.
6. To investigate the flow of air alone through a packed column.
7. To verify Bernoulli's theorem.
8. To study Mouth Pieces Apparatus.
9. To study Losses across fittings
10. To study Centrifugal pump test ring
11. To determine Coefficient of discharge of Pitot tube apparatus.

BT BIT 507P (BBT) Heat Transfer in Biotechnology Laboratory

1. Study of heat transfer in natural convection.
2. Study of heat transfer in forced convection.
3. To determine emissivity of test plate.
4. Study of heat transfer in a double pipe heat exchange both in co-current flow and counter-flow conditions.
5. Study of heat transfer in shell and tube heat exchanger.
6. Study of heat transfer in open pan evaporator.
7. Study of heat transfer in lagged pipe.
8. Study of unsteady state heat transfer.
9. To determine the thermal conductivity of insulating material by guarded hot plate method.
10. To study heat pipe apparatus.

Part A: Immunology:

1. Experiments based on Ouchterlony Double Diffusion (ODD) for antigen-antibody pattern.
2. Radial Immunodiffusion (RID).
3. Immunoelectrophoresis.
4. Rocket Immunoelectrophoresis (RIEP).
5. Latex Agglutination.
6. Western blotting technique of proteins

Part B: Molecular Biology:

1. Extraction techniques of DNA
2. Identification and Isolation of PCR products.
3. Isolation and visualization of plasmid by electrophoresis.
4. DNA fingerprinting/Restriction mapping.
5. Southern hybridization.

Teaching Scheme B.Tech (Biotechnology)

SIXTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 601T (BBT)

Genetic Engineering

Unit 1- Introduction, milestones in genetic engineering. Modification enzymes (all enzymes necessary for genetic engineering). DNA markers, Marker Assisted Selection (Development of NIL, identification of different markers-RAPD,AFLP,SSR,SNP etc, calculation of cM distance of marker from gene, linkage of marker with gene.)

Unit 2- r-DNA technology:- Concept of recombinant DNA Technology, vectors – plasmids, bacteriophages, phagemids, cosmids,. Vectors for plants and animal host. Yeast artificial chromosomes. Mammalian Artificial Chromosomes.

Unit 3- Gene Cloning:- concept of gene cloning and cDNA synthesis. cDNA and Genomic Library construction and screening. DNA primers, linkers, adaptors. Alternative strategies of gene cloning. T-DNA and transposone tagging

Unit 4- Protein Engineering:- Concept of Site-directed Mutagenesis and Protein Engineering. Ames's mutagenicity test.

Unit 5- Recombinant protein and IPR:- Classification of recombinant proteins. Processing of recombinant proteins (purification and refolding), Characterization of recombinant proteins. Bioethics: The legal and socioeconomic impacts of Biotechnology. Intellectual property rights.

Unit 6- Application of genetically modified organisms in various fields:- Agriculture, health, fermentation industry, chemical industry (dyes, textiles and leather), bioremediation, effluent treatment plant. Environmental release of GMOs- risk analysis and assessment.

Books Recommended:

1. Gene Cloning :-T.A. Brown 4th Ed Print 2001.
2. Gene VII:- Benjamin Lewin Oxford University Press.1st Ed.Print 2003
3. From genes to Clones:-Winacker 1st Ed.. Panima Publishing Corp. Print 2003
4. From genes to Genomes:- Dale and Schantz JhonWiley and Sons. Print 2002
5. Gene manipulation:-Old and Primrose. Blackwell Science prints 2001.
6. Molecular Biotechnology: Glick and Pasternak ASM Press 2nd edition
7. Saleesha A.Stanely, "Bioethics", Wisdom educational service, 2008.
8. Genetic Engineering by S.Rastogi and N.Pathak. Oxford University Press 2009.

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 602T (BBT)

Mass Transfer in Biotechnology

Unit 1: Molecular diffusion in fluids, Diffusion in solids. Interphase Mass Transfer, coefficient and their correlations/HTU and NTU, concept of Jd factor. Mass transfer in packed and fluidized beds. Concept of effective diffusivity. Diffusion through membranes and applications. Measurement of $k_L a$. Oxygen transfer methodology in fermenters.

Unit 2: Distillation: Vapour liquid equilibrium, T-x,y and P-x,y diagrams, estimation of VLE using vapour pressure data and relative volatility. Vapour liquid equilibrium for multicomponent mixtures. Differential distillation, Equilibrium distillation, Rectification.

Unit 3: Gas Absorption: Equilibrium relationship, mass transfer theories, concept of driving force, individual and overall mass transfer coefficient. Plate column for absorption, analytical and graphical calculation of number of plates. Humidity and air conditioning, wet and dry bulb hygrometry, Humidity charts. Method of humidification and dehumidification, air conditioning.

Unit 4: Liquid Liquid Extraction–Equilibrium for immiscible and partially miscible systems. Supercritical fluid extraction. Concept of number of stages for cocurrent and countercurrent contacting, solid liquid extraction.

Unit 5: Drying characteristics of the biological materials. Theory and mechanism of drying. Free and bound moisture and water activity. Evaluation of drying rates. Material and enthalpy balance equations in continuous drying operations. Equipments for dehydration of biological materials.

Crystallization, Miers theory, nuclei formation, crystal growth. Theory of crystallization, batch and continuous crystallization. Fractional crystallization.

Unit 6: Adsorption - Gas solid isotherms for one and more sorbates, chemisorption, liquid solid isotherms. Adsorption unit – fixed bed equation, isothermal operations, non isothermal operation.

Books Recommended:

1. Chemical Engineering by Coulson and Richardson, Vol I & II. Pergamon Press, New York.
2. Mass Transfer operations by R.E. Treyball, MGH International.
3. Unit Operation by G.G. Brown, CBS publications.
4. Transport Processes and Separation Process Principles by Christie John Geankoplis, Phi Learning.
5. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith, Peter Harriott, McGraw-Hill Publications.
6. Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 603T (BBT)

Biochemical Reaction Engineering – II

Unit I -Non-Ideal Behavior in Reaction Systems- Reasons for non-ideality, concept of macro using –RTD analysis (E-C-F functions), diagnosing the ills of non-ideal bioreactors.

Unit II-Solid Catalyzed Reactions-Surface Kinetics, Pore Diffusion Resistance Combined with Surface Kinetics, Heat Effects during Reaction, Performance Equations for Reactors Containing Porous Catalyst Particles.

Unit III- Non-Catalytic Systems-Fluid-Fluid Reaction Kinetics, Fluid-Fluid Reactors: Design, Fluid-Particle Reaction Kinetics.

Unit IV-Enzyme catalyzed Reaction- Briggs Haldane approach, Michaelis-Menten Kinetics, Factors affecting enzyme reactions, Substrate-Limiting Microbial Fermentation, Product-Limiting Microbial Fermentation.

Unit V-Protein Ligand Interaction- Hill equation and Hill plot, Model for Hemoglobin Oxygen Interaction, Various Immobilization techniques of enzyme, Inhibition of enzyme reactions-competitive, non competitive and uncompetitive inhibition.

Unit VI-Mechanism of catalyst deactivation-fouling poisoning and sintering, rate and performance equation, methods of catalyst regeneration

Books Recommended:

- 1) Chemical Reaction Engineering, 3rd Edition – O.Levenspiel, Willey Eastern 1999
- 2) Chemical Kinetics and Reactor Calculations- Scott Fogler, Prentice Hall
- 3) Biochemical Engineering -James M. Lee, Prentice-Hall Inc. in 1992
- 4) Elements of Chemical Reaction Engineering-S.D.Dawande, Central Techno Publications, Nagpur.
- 5) Principals of Biochemistry by A.Lehninger
- 6) Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 604T (BBT)

Process Control in Biotechnology

Unit 1: Transient response of the first and second order systems. Time constant, damping coefficient. Transfer function for liquid level and mixing processes. Linearization. Response of the first order systems in series. Transfer function and transient response of interacting and non-interacting systems. Transportation lag.

Unit 2: Linear closed loop systems. Bio-chemical reactor control system. Block diagram, pneumatic and electronic controllers and final control elements. Choice of controllers, stabilization time, characteristics of proportional integral and derivative control modes. Transient response of simple control systems. Combination of controllers.

Unit 3: Concept of stability for linear systems. Routh criteria, root locus diagram for positive and negative feedback systems.

Unit 4: Control systems design by frequency response method. Bode stability criterion. Gain and phase margins. Ziegler-Nichols controller settings.

Unit 5: Instrumentation : Measurement of temperature: Expansion Thermometer- solid and liquid expansion thermometer, Electrical sensors for temperature measurement- resistance temperature detectors (RTD), Thermistor, Thermocouple, Pyrometer- radiation pyrometer, optical pyrometer. Measurement of pressure and vacuum: Elastic pressure transducer- Bourdon pressure gauge, Diaphragm pressure gauge, capsule and bellow pressure gauge.

Unit 6: Measurement of head and level: Direct level measurement- point contact method, buoyancy method Indirect level measurement- hydrostatic method radiation method, ultrasonic level detector. Composition Analysis: absorption spectroscopic method- X-ray, UV and IR absorption spectroscopy, Emission spectroscopic method- electric arc method, flame method, fluorescence method, Oxygen analyzer. Composition analysis by density, viscosity, pH measurement, biosensors.

Book Recommended:

1. Process Systems analysis and control Coughanowr and Koppel.
2. Process Control: Peter Harriot, Tata Mc-Graw Hill Publication.
3. Process Dynamics and Control, D.Edgar, 2nd Edition Wiley Publication.
4. Chemical Process Control-George Stephanopoulos, PTR Prentice hall
5. Process Control and Instrumentation- R.P.Vyas, Dennet & Co.2010

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assesment- 20Marks

Duration of Paper: 3Hrs

BT BIT 605T (BBT)

Industrial Bio-Technology

Unit 1: Introduction fermentation technology- Isolation, preservation and improvement of industrially important microorganism. Sterilization process (heat, radiation and filtration method), media for industrial fermentation, development of inoculum for industrial fermentations.

Unit 2: Types of fermentor- (solid state, submerged fermentation and continuous fermentation), Designing of a fermentor, operation and application, instrumentation and control, fermentation kinetics, optimization of fermentation process, aeration and agitation.

Unit 3: Production of Microbial products- Process technology for production of organic solvents such as industrial alcohol, glycerol, acetone butanol, Production of Vit B12. Brief account of steroid transformation.

Unit 4: Enzyme Biotechnology- Production of industrial enzymes. Bioreactors for enzyme production. Industrial applications of enzymes in detergents, leather, beverage, food and pharmaceutical industries. Recent development in a recovery methods and purification for industrial enzyme.

Unit 5: Food Biotechnology- Fermented Foods – Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh, bread, pickles, soya sauce. Microbial Foods – Single cell proteins (SCP). Technique of mass culture of Algae – spirulina. Alcoholic beverages – Wine and beer. Plant cell suspension culture for the production of food additives – Saffron and Capsaicin.

Unit6: Microbial polysaccharides and polyesters- production of xanthan gum and polyhydroxyalkonoides (PHA). Production of biofertilizers, biopesticides, and biosurfactants.

Books Recommended:-

1. Principles of fermentation technology:- Stanbury, Whittaker and Hall, 2nd Ed. 1997. Aditya Books.
2. Fermentation Microbiology and Biotechnology :-El-Mansi and Bryce, 2002
3. Process Biotechnology Fundamental :-Mukhopadhaya
4. Biochemical Engineering and Biotechnology :- Atkinson B and Mavituna F.
5. Industrial Microbiology by Prescott and Dunn, Mc-graw Hill publication.

PRACTICALS

BT BIT 607P (BBT) Mass Transfer in Biotechnology

1. Determination of diffusion coefficient of an organic vapor (acetone) in air.
2. Study of the drying characteristics of a given material under constant drying conditions and to report equilibrium and critical moisture content.
3. Determination of the mass transfer coefficient for the absorption of water vapor on silica gel.
4. Study the operation of a batch rectification column under constant reflux condition.
5. Study the variation of mass transfer coefficient as a function of flow rate of air for the vaporization of naphthalene in a packed bed.
6. Estimation of the rate constant for the physical dissolution of benzoic acid in a liquid.
7. Determination of the effective interfacial area as a function of liquid velocity in a packed adsorption column.
8. Determination of the diffusion coefficient for the given liquid-liquid system as a function of concentration.
9. Estimation of $K_L a$ for air/oxygen absorption in nature.

BT BIT 608P (BBT) Process Control in Biotechnology

1. To determine the valve characteristics of the linear and equal percent valves.
2. To determine the transient response of the first order and second order system.
3. To study the characteristics of flapper nozzle system and to calculate its gain.
4. To study the step response of the first order systems arranged in non interacting and interacting mode and to study its impulse response.
5. To study the advanced control techniques like cascade control, feed forward control, and ratio control using multiprocess trainer.
6. To study the working principle of current to pressure and pressure to current converter using I/P and P/I converter.
7. To study the characteristics of thermistors, thermocouples, and RTD using temperature measurement system.
8. Study of controlling the level using level controller.
9. Study of controlling the temperature using temperature controller.

Part A: Industrial biotechnology

1. Production of citric acid from *Aspergillus* culture.
2. Enzyme immobilization by enzyme entrapment in polyacrylamide gel.
3. Production and estimation of lactic acid and lactose.
4. Cell immobilization with calcium alginate.
5. Preparation of wine.
6. Production and Estimation of alcohol by specific gravity method.
7. Production of enzymes by submerged and solid state fermentation.

Part B: Genetic Engineering

1. To study the Restriction mapping
2. Preparation of competent cell for transformation
3. CaCl_2 method of transformation
4. DNA cloning and blue white screening of recombinant cells.

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 701T (BBT)

Environment and Biotechnology

Unit 1: Sources of Waste and Pollution, Classification and characterization of solid, liquid and gaseous wastes, concepts of biodegrading, measurement of level of pollution such as COD, BOD, TOC, ThOD, soluble, suspended and volatile solids, ammoniacal nitrogen and biological indicator. BOD dilution test and mathematical models for BOD curve.

Unit 2: Sources, characterization and treatment of solid wastes from agro-bioindustries, pharmaceutical industries such as sugar industry, fruit and vegetable wastes, animal and community waste. Landfill, composting, and bioremediation. Process of anaerobic bio-mechanization. KVIC model, sludge recovery and utilization.

Unit 3: Waste water treatment process, primary, secondary and tertiary. Conventional aerobic process, aerated lagoon, trickling filter, activated sludge process, contact inhibition, high rate activated sludge process. Sources, characterization and treatment of liquid wastes from dairy, slaughter house, pharmaceutical industry, brewery, sugar mills, paper and textile mills, tannery.

Unit 4: Basics of air pollution, application of biotechnology for air pollution control, and monitoring. Detection and removal of trace level pollutants such as VOC and odor.

Unit 5: Hazardous Wastes – Classification of hazardous wastes. Physical, chemical and biological hazards. Bio-absorption, bio-degradation and bio-magnification. Risk assessment and quantification, LC, LD 50, LD100, TLV.

Unit 6: Environmental risk assessment, global and environmental issues, waste minimization. National and international agencies for environmental regulation, EPA, WHO, OSHA, NIOSH, ACGIH etc.

Books Recommended

1. Environmental Engineering by G.N. Pandey and G.C. Camey. Tata McGraw-hill Pub. Co. Ltd. New Delhi (1992).
2. Physico chemical process for water quality control, Walker J Weber, Wiley Interscience, New York 91972)
3. Waste Water Engineering, Treatment, Disposal and Reuse. Metcalf and Eddy Tata McGraw Hill Publication Co. (1979).
4. Biotechnology, Vol VIII, Heinz Breuer.
5. Activated Sludge – Theory and Practice, N. F. Gray, Oxford University Press (1990).
6. Environmental data on organic pollutants, Karel Verschueren, Von Nostrand Rheinhold.

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 702T (BBT)

Tissue Culture Technology

Unit 1: Introduction, history and types of plant tissue culture techniques. Concept of totipotency, types of culture media for plants tissue culture. Requirements for auxin, cytokinin and other growth regulators. Solid and liquid media.

Unit 2: Somaclonal variation, callus culture, Callus subculture maintenance, Metabolic patterns in callus culture, Harvesting and measurements, Morphogenesis in callus culture - Bioreactors. **micropropagation**, Cytokinesis, role of cytokinin and auxin, **Endosperm** culture -media requirements, morphogenetic potential – application, **Embryo culture** - culture requirements - applications embryo rescue technique

Unit 3: Tissue culture in Industrial and Medical Biotechnology: Suspension Culture systems, isolation of single and aggregate of cells. Immobilization of cells and use of bioreactors.

Protoplast Culture: Isolation of protoplast and transformation. Bioprocessing for active principles. In vitro production of secondary metabolites, pharmaceuticals and aromatic chemicals. Edible vaccine. .

Unit-4: Tissue culture and Biotechnology: Use of techniques of genetic engineering for obtaining transgenic plants resistant to diseases, insect pests, abiotic stress and herbicides. methods of transformation Mericloning for virus-free plants, selection of plantlets tolerant to biotic and abiotic stresses.. Modifying the expression of resistant gene by antisense RNA technique. In vitro mutagenesis. Genetic engineering with protoplast and haploid cells. **Tissue Culture in Germplasm Conservation:** Introduction to in vitro conservation. Storage techniques, equipment, cryopreservation and tissue culture components used for storage. Achievements and current trends.

Unit 5: Introduction, basic animal tissue culture techniques:Contact inhibition, anchorage dependence and cell-cell interaction. Types of culture medium - natural, synthetic, sera, introduction to balanced salt solution and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon-dioxide, serum and supplements.

Unit 6: Commercial application of animal cell culture:Characterization of animal cell lines, applications of animal cell culture, stem cell technology, bioreactors for animal tissue culture, scale-up of animal culture.Culture screening system, cytotoxicity and diagnostic tests, mass production of biologically important compounds (eg. Vaccines, steroids, vitamin and insulin), harvesting of products, purification and assays. Three dimensional cultures and tissue engineering.

Books Recommended:

1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.
2. Plant tissue Culture : Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996)
3. Elsevier, Amsterdam.

4. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002
5. Freshney R T, "*Animal cell culture - A Practical approach*", Oxford University Press (1987)
6. Spier R R and Griffiths J B, "*Animal Cell Biotechnology*", Academic Press, London (1990)
7. Butler, M "*Mammalian Cell Biotechnology- A Practical Approach*," IRL Oxford University Press (1991)
8. Trigiano, R. N. and D. J. Gray. 2000. Plant tissue culture concepts and laboratory exercises. 2nd ed.(2000)
CRC press, USA.

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 703T (BBT)

Bioprocess & Equipment Design

Unit 1: Analysis of Bioreactors: Modeling of non-ideal behavior in bioreactors, tanks-in-series and dispersion models-application to design of continuous sterilizers, air-lift loop reactors, fluidized-bed bioreactors, stability analysis of bioreactors.

Unit 2: Design variables in distillation, design methods for binary systems, plate efficiency, approximate column sizing, plate contactors and plate hydraulic design. Model simulation using MATLAB-SIMULINK and ISIM software packages.

Unit 3: Design principles of bioreactors, Geometric configuration, flanges, nozzles, gaskets, supports, piping, jackets and coils etc.

Unit 4: Accessories for bioreactors: agitators, aerators, air filters, stabilizers, power requirement.

Unit 5: Chromatography systems: Introduction, engineering aspects of scale up, equipment, automated chromatography systems, Installation, commissioning and validation.

Heat Exchangers: codes and standards for heat exchangers, materials of construction, baffles and tie rods, tube joining methods, Design of shell and tube heat exchangers (U tube and fixed tube) as per IS: 4503 and TEMA standards. Design of heat exchange equipments such as evaporator, plate type heat exchanger, bayonet heat exchanger.

Unit 6: Scale up of bioreactors, safety measures in bioreactors. Material for construction of bioreactors and selection criteria. Cost estimation methods and economic evaluation of projects.

Books Recommended:

1. Process Equipment Design, Vol-1 & 2 by Dawande S. D., Dennet and Company.
2. Process Equipment Design by Joshi, M. V., McMillan, India.
3. Process Equipment Design by Brownell Young, E., Wiley India Pvt. Ltd.-New Delhi.
4. Chemical Engineering Vol.6 by Coulson, J. M., Richardson, J. F. and Sinott, R. K., Pergamon Press
5. Plant Design & Economics for Chemical Engineers, 4th Edition by Max Peters & Klaus D Timmerhauss, Mc Graw Hill Book Co.
6. Bioreactors in Biotechnology:a practical approach by Scragg.A.H., E. Horwood, 1991.
7. Biochemical Engineering Fundamentals by Bailey and Ollis, McGraw Hill
8. Introduction to Chemical Equipment Design by Bhattacharya, B. C., C.B.S. Publications.
9. Bioprocess Engineering-Systems, Equipment and Facilities by Bjorn K. Lydersen, Nancy D'elia and Kim L. Nelson. A Wiley Interscience Publication.

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 704T (BBT)

Bio Industry Economics & Entrepreneurship Development

Unit 1: Nature and purpose of process economics-requirement of project proposals and methods of economic analysis conceptual background for economic analysis such as time value of money, depreciation accounting, cash flow profitability. Financial analysis, ratio analysis, Investment Process, Break even Analysis.

Unit 2: Developing economic data for economic analysis. Estimating capital requirements or total investment for industrial projects. Estimating product costs. Costs, revenues, profits and earning for process plants, problem situation for estimation.

Unit 3: Evaluation and selection of industrial projects. Various modern methods of project evaluation, economic selection of alternatives on the basis of annual costs, present worth, rate of return and payout profile etc

Unit 4: Creativity & Entrepreneur personality & Entrepreneurships in Biotechnology. Entrepreneurship decision about plant/company operation, plant layout, basic principle and function of management, management thought and scientific management movement, organization principle and patterns.

Unit 5: Materials management and control, production, planning and control, manpower planning, employment and utilization. Main function of personal administration. Financial planning and control. Budgetary control. Inventory management.

Unit 6: Modern concept of Selling, marketing. Market planning and implementation. Sales organization and sales management. Public relations. Industrial enterprises and Environmental safety. Advertisement & promotion, concept of Export & Import management.

Books Recommended

1. Handbook of Chemical Engineering. J. H. Perry, Section 25 on Process Economics- 1974.
2. Fundamentals of Cost Engineering – M. C. Bourman
3. Chemical Economics – Happel and Jourdon.
4. Applied Project Management – Ludwig.
5. Plant Design and Economics for Chemical Engineers Peters and Timmermans.
6. Process Economics –Schwayer.
7. Khanna, O. P., “Industrial Engineering and Management”, Khanna Publishers

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 705.i T (BBT) ELECTIVE I

Cryogenic Applications in Biotechnology

Unit 1: Introduction: Historical development, Present areas in cryogenic engineering. Basic thermodynamics applied to liquefaction and refrigeration process. Isothermal, adiabatic and Joule Thomson expansion process. Adiabatic demagnetization. Basic of liquefaction systems.

Unit 2: Low temperature properties of engineering materials: Mechanical properties, thermal properties, electrical and magnetic properties. Properties of cryogenic fluids. Materials of constructions for cryogenic applications.

Unit 3: Gas liquefaction systems: production of low temperatures, general liquefaction systems, liquefaction systems for Air, neon, hydrogen, nitrogen and helium. Efficiency of liquefaction and coefficient of performances irreversibility and losses.

Unit 4: Cryogenic Refrigeration systems: Ideal refrigeration systems, refrigerators using liquids and gases as refrigerants, refrigerators using solids as working media.

Unit 5: General characteristics of mixtures-composition diagrams. Gas separation-principles of rectification-flash calculations. Thermal insulations and their performance at cryogenic temperatures.

Unit 6: Cryogenic storage and transfer systems: Cryogenic fluid storage vessels, cryogenic fluid transfer systems. Effect of ultra-low temperature on plants and animal tissue, microorganism, biomolecules, lyophilization of cells and products. Application of cryogenics - Cryo pumping, cryobiology, superconductivity and super fluidity, cryogenics in space technology, food processing, super conductivity, cryogenics in biology and medicine and recent applications.

Books Recommended:

1. Barron, Randel F., Cryogenic Systems, Oxford University Press, 1985.
2. Dinnerhaos, Q. D., Cryogenic Engineering, McGraw Hill Book Co., 1987.
3. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, 1989.
4. Hasdden, G. G. Cryogenic Fundamental, Academic Press, 1971.
5. Martia Donabedian. Survey of Cryogenic Cooling Techniques.
6. Arora C P, "Refrigeration and Air Conditioning", 19th Edition, Tata McGraw Hill, Delhi (1985).
7. Pradad M, "Refrigeration and Air Conditioning", 2nd Edition, New Age International Private Limited, Delhi (2002).
8. Jordan and Prister, "Refrigeration and Air Conditioning", Prentice Hall of India (1998).

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 705.ii T (BBT) ELECTIVE I

Renewable Energy Technology

Unit- I

Global Energy Requirement and Scenario- Biomass as renewable energy source. First, Second , Third and Fourth generation biofuels.

Unit- II

Ethanol as Biofuel- Process technology for production of ethanol from sugar, starch and Lignocellulosic biomass. Cultivation and Harvesting of dedicated energy crops.

Unit- III

Biodiesel- Chemistry of Biodiesel. Edible and nonedible source of Biodiesel. Cultivation and harvesting of oil seeds. Process technology and biodiesel production.

Unit- IV

Microalgae as source of Biofuel- cultivation and harvesting of microalgae. Process technology for Lipid isolation and conversion to Biodiesel.

Hydrogen production by photosynthetic bacteria, biocatalysis of water and fermentation. Microbial fuel cell development.

Unit- V

Solar energy, solar collectors, solar ponds, photovoltaic cells, chemical storage.

Geothermal energy- Use of geothermal energy , operating principle of different types of wind energy.

Unit- VI

Challenges-Utilization of Renewable energy, Problems in harvesting, transportation and storage of biomass and energy. Environmental impact of biofuels. Nano, micro and mesoscale phenomenon and devices.

Books Recommended:

1. J.E.Smith – Biotechnology, 3rd ed. Cambridge Univ Press
2. S.Sarkar – Fuels and combustion, 2nd ed., University Press
3. Leon Freris, David Infield, “Renewable Energy in Power Systems”, Wiley, 2008.
4. Biofuel Technology Handbook - Dominik Rutz, Rainer Janssen WIP Renewable Energies
5. J. Twidell and T. Weir, “Renewable Energy Resources”, E & F N Spon Ltd, 1986.

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 705.iii T (BBT) ELECTIVE I

Biomaterial Sciences

UNIT 1: General properties of Materials. Classes of materials used in medicine: Metals, Polymers, Hydrogels Bioresorbable and Biodegradable Materials, Ceramics, Natural materials composites thin films, grafts, Coatings medical fibers and Biological functional materials, Smart materials, Pyrolytic Carbon for long-term medical Implants textured and Porous materials non-fouling surfaces

UNIT 2 : Biopolymers: Classification (nucleic acid, protein, polysaccharide). Manufacturing, chemistry and applications of polysaccharide such as dextran, xanthan, gellan, pullulane, chitin, chitosan, etc. structural characterization using protein sequencing by Edman degradation, mass spectrometer, optical tweezer (or atomic force microscopy).

UNIT 3: Fermentative production of polyesters with special emphasis on polyhydroxyalkanoates, and biodegradable polymers such as polylactic acid, polyglycolide and polycaprolactone, lactoyllactic acid. Structure, physical and chemical properties including production of the above polymers.

UNIT 4: Application of biocatalyst such as enzymes and microorganisms in biotransformation process, development of polymer precursors using Biotransformation processes. Precursors: aromatic hydrocarbons, biological formation of specialty hydroxylated monomers, L-homophenylalanine production using membrane bioreactor.

UNIT 5: Types of bioadhesive, nano biomaterial, composite biomaterial. Evaluation of biocompatibility according to United States Pharmacopoeia. Biodegradable plastic. design, synthesis, characterization and application of nanomaterials to biological and biomedical problems. Characterize, predict, and control the biological properties of nanobiomaterials.

UNIT 6: Applications of materials in medicine, Dentistry and Biology: Cardiovascular medical devices. Nonthrombogenic treatments and Strategies. Dental implantation adhesive and Sealants. Ophthalmologic applications-intraocular lens implants. Orthopedic biomaterials, Artificial organs and tissues.

BOOKS:

1. Hench L L Ethridge E.C. Biomaterials, an interfacial approach, Academic press 1982
2. Bronzino J D, The biomedical engineering handbook CRC Press
3. Biomaterials by Bhat Sujata V., Narosa Publishing House.
4. Biomaterials science: an introduction to materials in medicine by Buddy D. Ratner. Elsevier Academic Press.
5. J B Park, Biomaterials - Science and Engineering, Plenum Press, 1984.
6. Biomaterials by Temenoff Johnna S., Dorling Kindersley India Pvt Ltd.
7. Bronzino J D, the biomedical engineering handbook CRC Press

PRACTICALS

Teaching Scheme B.Tech (Biotechnology)

SEVENTH SEMESTER

No. of Credits: 04

Duration of Paper: 3Hrs

BT BIT 706P (BBT)

Papers: 25 Marks

Tissue Culture

1. Organizing Plant tissue culture laboratory: Fumigation and sterilization of culture room
2. Preparation of different plant tissue culture media.
3. Technique of Surface sterilization and Explant preparation
4. Embryo culture and pollen culture.
5. Callus Culture and propagation, organogenesis, transfer of plants to soil.
6. Protoplast isolation and culture.
7. Preparation of animal cell culture media.
8. Extraction and quantification of secondary metabolite.

No. of Credits: 04

Duration of Paper: 3Hrs

BT BIT 707P (BBT)

Papers: 25 Marks

Process Equipment Drawing

Drawing of various types of accessories such as valves, storage tanks, jackets, coils, supports, agitators, air filters for fermenters and bioreactors.

BT BIT 708P (BBT)

Seminar/Industrial Training and Tour Report

To be submitted by student to the Institute well in time in two Copies at the end of the Eighth Semester when the marks are awarded in that Semester only.

Teaching Scheme B.Tech (Biotechnology)

EIGHTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 801T (BBT)

Downstream Processing

Unit 1: Introduction: Role and Importance of downstream processing in biotechnological processes. Problems and requirements for bio-product purification. Economics, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products). Concept of integrated bioprocessing and recovery of byproduct.

Unit 2: Cell harvesting and disruption: physicochemical and enzymatic methods. Removal of insoluble biomass and particulate debris. Separation techniques- flocculation, sedimentation, centrifugation and filtration methods. Recovery methods for recombinant proteins.

Unit 3: Membrane-based separations (micro and ultra-filtration): design and configuration of membrane separation equipment, applications. Precipitation methods for proteins (salts, organic solvents, and polymers).

Extractive separations: aqueous two phase extraction & supercritical extraction.

Unit 4: Applications of separation techniques for downstream processing: Chromatographic (adsorptive, affinity and gel permeation) and electrophoretic (including capillary electrophoresis) separation. **Hybrid separation technologies:** membrane chromatography, electrochromatography. Electro-dialysis and crystallization.

Unit 5: Effluent treatment and isolation of value added products from waste. Eg. Recovery of whey proteins, biomass from waste, biofuels (hydrogen and methane), fertilizer, biopolymers such as PHB, acetic acid, lactic acid and bioleaching of minerals.

Unit 6: New and emerging techniques: Pervaporation, Foam based separation

Case Studies: Case studies on purification of lactic acid, penicillin, microbial lipase and protease, recombinant insulin. Economics of downstream processing in biotech industries.

Books Recommended:-

1. Principles of Fermentation Technology:- Stanbury, Whittaker and Hall, 2nd Ed. 1997. Aditya Books.
2. Fermentation Microbiology and Biotechnology :- El-Mansi and Bryce, 2002
3. Process Biotechnology Fundamental :- Mukhopadhaya
4. Biochemical Engineering and Biotechnology :- Atkinson B and Mavituna F

Teaching Scheme B.Tech (Biotechnology)

EIGHTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 802T (BBT)

Computational Techniques and Process Modeling

Unit 1: Modeling fundamentals, mathematical formulation of the problem, examples in processes. Numerical methods of solution of nonlinear algebraic and transcendental equations to biochemical engineering.

Unit 2: Methods of solution of simultaneous linear and nonlinear algebraic equations and curve fitting techniques in biotechnology process.

Unit 3: Formulation and numerical solution of ordinary and partial differential equations with emphasis on chemical process system and computer applications.

Unit 4: Introduction to computer aided design, strategies for computer aided balances. Steady state simulation, sequential modular approach, equation based approach, commercial simulators etc.

Unit 5: Dynamic simulation, computer aided application in design/simulation of biochemical process engineering systems/operations eg. Mass transfer and fluid flow.

Unit 6: Computer aided application in design/simulation of biochemical process engineering systems/operations eg. Reaction engineering and heat transfer.

Books Recommended:

1. Mathematical Methods in Chemical Engineering, V.G. Jenson & G. V. Jeffrey, Academic Press.
2. Applied Mathematics for Chemical Engineers, H.S. Mickley, T. K. Sherwood, C.E. Reed, McGraw Hill.
3. Chemical Process Simulation. Asghar Husain, Wiley Eastern.
4. Computer aided process plant design, M. E. Leesley, Gulf Pub. Co., Houston, 1992.
5. Introductory numerical methods of numerical analysis. S. S. Shastri, Prentice Hall.

Teaching Scheme B.Tech (Biotechnology)

EIGHTH SEMESTER

Lectures: 03

Tutorials: 01

No. of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 803T (BBT)

Bioinformatics

Unit 1. Introduction to Bioinformatics

The Internet and Biology: Internet basics, FTP, Gopher, World Wide Web. The Gen Bank Sequence Database: Introduction, Primary & Secondary database, Gen Bank Flat File dissection, GCG, ACDEB. Scope of Bioinformatics, Introduction to Homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace).

Unit 2. Sequencing Alignment and Dynamic Programming : Heuristic Alignment algorithms. Global sequence alignments-Neddleman-Wunsch Algorithm Smith-Waterman Algorithm-Local sequence alignments (Amino acid substitution Matrices (PAM, BLOSUM).

Unit 3. Biological Database : Introduction to Biological databases, Organization and management of databases. Searching and retrieval of information from the World Wide Web. Structure databases - PDB (Protein Data Bank), Molecular Modeling Databases (MMDB). Primary Databases NCBL,EMBL, DDBJ. Introduction to Secondary Databases Organization and management of databases Swissprot, PIR,KEGG. Introduction to BioChemical databases-organization and Management of databases. KEGG, EXGESCY, BRENDA, WIT.

Unit 4. Evolutionary Trees and Phylogeny : Multiple sequence alignment and phylogenetic analysis.CLUSTAL,W. Basic concepts in systematics, Molecular evolution,Definition and description of Phylogenetic trees and types of trees Dendograms and its interpretation

Unit 5. Introduction to Computational Molecular Biology : Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics, Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements

Proteomics

Introduction to proteins. Protein identification, structure and function determination. Structure comparison methods. Prediction of secondary structure from sequence. Protein homology modeling, Protein threading. Protein ab initio structure prediction. Protein design emphasis on structural Bioinformatics.

Unit 6. Genomics : DNA Sequence assembly and gene identification. Homology based gene prediction. SNPs and applications. Methods of studying gene expression, EST approach, Basics of Micro array .

Drug Design

Drug discovery cycle, Role of Bioinformatics in Drug discovery

Books Recommended

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Introduction to solid state physics by C. Kittel; Wiley Eastern Ltd.
3. Materials Science and Engineering by V. Raghavan; Prentice-Hall India.
4. Engineering Physics by Dr. M. Arumugam; Anuradha Agencies.
5. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
6. Engineering Physics by M.N. Avadhanulu & P.G. Kshirasagar; S. Chand & Company Ltd.
7. Nano: the essentials by T. Pradeep, Tata McGrawHill, NY.
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, By Andreas D, Baxevanis, B.F, Francis O, Wiley –Interscience , 3rd Edition, 2004.

9. Textbook of Biotechnology, H K Das, Wiley- India (P) Ltd., New Delhi (2005).
10. Sequence and genome analysis by D.W.Mount-Cold Spring Harbour Lab., 1st edition, 2004
11. Bioinformatics and the genome projects by Smith DW, Academic Press, 1993.
12. Bioinformatics: A Biological Guide to computing and the Internet by Stuart M and Brown NYU, Medical Centre, NY USA, 2000.

Teaching Scheme B.Tech (Biotechnology)

EIGHTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 804.i T (BBT) ELECTIVE II

Food Biotechnology

Unit 1: Historical Background. Micro-organisms associated with food, factors affecting growth of micro-organisms in food, food spoilage. Enzymatic and nonenzymatic changes in food spoilage.

Unit 2: Fermented Foods- Nutritional advantages of fermented foods. Types of food fermentations, natural and guided fermentation, starter culture, secondary fermentation. Fermented products vinegar and sauerkraut. Single cell proteins from petroleum as food and feed, cultivation of mushroom, and algae production.

Unit 3: Classification of alcoholic beverages, production of red and white wine, champagne, brandy, and other alcoholic beverages.

Unit 4: Production of Primary And Secondary Metabolites- The process of production of some commercially important organic acids – citric acid, lactic acid, acrylic acid, gluconic acid, amino acids and alcohol– Bio products for food industries – Natural bio-preservatives – Nisin

Unit 5: Application of enzymes in food industry. Liquefactions of starch, high fructose corn syrup, sugar conversion process, enzymes in fruit and vegetable processing, Amylase in baking and mashing, desugaring by glucose oxidase. Protein hydrolysis and meat tenderization, beer mashing and chill proofing by proteases.

Unit. 6: Newer techniques in food biotechnology- Bioconversion of whey, molasses and starch and other food waste for value addition, biomarkers for assessment of food safety.

Books Recommended:

1. Lidsay, Willis Biotechnology, Challenges for the flavour and food industries, Elsevier Applied Science, 1988.
2. Roger A., Gordan B., and John T., Food Biotechnology, 1989.
3. George j. B., Basic Food Microbiology, CBS Publishers & Distributors, 1987.
4. James M. J., Modern Food Microbiology, CBS Publishers & Publishers, 1987.
5. Freiser “ Food Microbiology”.
6. Microbiology of food fermentation Vol I and II by Pederson. C. S.
7. Biotechnology of food Fermentations Ed. Ashok Pandey and V. K. Joshi
8. Food Biotechnology: Dietrich Knorr, Inc. New York and Basel

Teaching Scheme B.Tech (Biotechnology)

EIGHTH SEMESTER

Lectures: 03

Tutorials: 01

No.of Credits: 04

Papers: 80 Marks

College Assessment- 20Marks

Duration of Paper: 3Hrs

BT BIT 804.ii T (BBT) ELECTIVE II

Pharmaceutical Biotechnology

Unit 1: Drug development process: Introduction to the history of drugs and pharmaceutical industry, a brief study about drugs from different sources like chemical, plants, animals, microbes and their therapeutic uses, Introduction to different types of dosage forms: Liquid, semisolid, aerosol, capsules, and tablets, Different routes of drug administration. Preclinical trials, Drug regulatory aspects, Genomics and its impact on medicine.

Unit 2: Pharmacodynamics and pharmacokinetics: Dose-effect relationships, drug receptor theory, mechanism of drug action. Principles of pharmacokinetics, Compartment models, Parameters: Biological half life, Apparent volume, Renal clearance, Total body clearance; Absorption, Distribution of drugs, Biotransformation and bioavailability of drugs.

Unit 3: Drug manufacturing process: Important Unit Processes and their Applications: Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture.

Unit 4: Manufacturing principles: Compressed table, wet granulation, dry granulation or slugging, direct compression, tablet presses, quality control test of tablet, coating of tablet, coating defects of tablet, capsule, hard gelatin capsule and soft gelatin capsule, Oral liquid, parental solution injection, quality control test of injection, Ointment topical application. Packing techniques, Good manufacturing practices (GMP).

Unit 5: Biopharmaceutical Products: Production and purification of monoclonal antibodies, Application of monoclonal antibodies in therapy, Production of therapeutic hormones like insulin, glucagon, human growth hormone, Cytokines – Interferons (INF), Interleukins (IL) I & II, Tumor Necrosis Factor (TNF).

Unit 6: Ethics and Regulations: Basic concepts of Intellectual Property Rights (IPR), IPR in the global economy-in international trade, Constitutional aspects of intellectual property, Patents, Principles of Patent laws, Historical background of patent laws, Non-governmental initiated community intellectual rights. Trade secrets, copyrights, trademarks, GATT and TRIPS.

Books Recommended:

1. H. A. Lieberman, L. Lachman and J. B. Schwartz, *Pharmaceutical Dosage forms (Vol 1, 2 and 3)*, Second edition, Informa Health Care.
2. L. Lachman, H. A. Lieberman, and J. L. Kanig, *The Theory and Practice of Industrial pharmacy*, 3rd Edn., Lea & Febiger, 1986.
3. J. P. Remington and A. Osol, *Remington's Pharmaceutical sciences*, 16th Edn., Mack Publications & Company, Easton, 1980.
4. L. S. Goodman, J. G. Hardman, L. E. Limbird, and A. G. Gilman, *Goodman & Gilman's the Pharmacological Basis of Therapeutics*, 10th Edn., McGraw-Hill, 2001.
5. Klefenz H "Industrial Pharmaceutical Biotechnology" Wiley – VCH Verlag GmbH Germany (1999).
6. Vyas S P and Dixit U K "Pharmaceutical Biotechnology" CBS Publisher New Delhi (2004).
7. Sibley Kenneth. *The Law and Strategy of Biotechnology Patents*.
8. Yali Friedman. *Building Biotechnology: Business, Regulations, Patents, Law, Politics, Science*

PRACTICALS

Teaching Scheme B.Tech (Biotechnology) EIGHTH SEMESTER

No. of Credits: 04

Duration of Paper: 3Hrs

BT BIT 805P (BBT)

Papers: 25 Marks

Bioinformatics

1. World wide web, internet applications.
2. Introduction of BLASTA/FASTA.
3. Introduction to GCG.
4. NCBI database.
5. Sequence alignment and optimal alignment method.
6. Gene bank sequence database.
7. Multiple sequence alignment.
8. Structure prediction.
9. Genome mapping.
10. **Biological Databases with Reference to Expasy and NCBI**
11. **Gene Prediction**
12. **Secondary Structure prediction**

BT BIT 806P (BBT)

Project Work/Dissertation

Project Work to be completed and submitted in two copies to the Institute for evaluation.