Bharath
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Declared as deemed to be university under section 3 of UGC Act 1956, vide notification No.F.9-5/2000-U.3)

FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS 2018

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CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM

(Applicable to the students admitted from July 2018)

B. TECH – BIOTECHNOLOGY (INDUSTRIAL BIO TECHNOLOGY)

(FULL TIME)

I-VIII SEMESTERS

DEPARTMENT OF INDUSTRIAL BIO TECHNOLOGY

BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY

NO: 173, AGARAM ROAD, SELAIYUR,

CHENNAI -600 073, TAMIL NADU

CURRICULUM AND SYLLABUS (R2018)

CHOICE BASED CREDIT SYSTEM

(Applicable to the students admitted from July 2018)

B.TECH – INDUSTRIAL BIO TECHNOLOGY

I – VIII SEMESTERS

SEMESTER I								
Sl. No.	**Course Code**	**Category**	**Course Title**	**Contact Period**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	3	1	0	4
3	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	U18ESCS1L1	ES	Problem Solving and Python ProgrammingLab	3	0	0	3	1.5
8	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
9	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
PHYSICAL ACTIVITY BASED COURSES								
10	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
11	18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
Total				35	15	1	19	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry. The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).**

SEMESTER II								
S. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	3	1	0	4
3	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
4.	U18ESGE201	ES	Cytology and Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5
8	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
9	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
10	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
PHYSICAL ACTIVITY BASED COURSES								

11	U18MCAB203	MC	Yoga	2	0	0	2	0
12	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	14	2	20	25.5

SEMESTER III								
S. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT301	PC	Introduction to Molecular biology	2	2	0	0	2
2	U18PCBT302	PC	Principles of Chemical Engineering	3	2	1	0	3
3	U18PCBT303	PC	Biochemistry	3	3	0	0	3
4	U18PCBT304	PC	Microbiology	3	3	0	0	3
5.	U18PCBT305	PC	Instrumentation for Biotechnology	2	2	0	0	2
6	U18BSMA305	BS	Transforms and Numerical Methods	4	3	1	0	4
PRACTICAL								
7	U18PCBT3L1	PC	Biochemistry Lab I	2	0	0	2	1
8	U18PCBT3L2	PC	Cell Biology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
11	U18MCAB306	MC	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
			Total	25	15	2	8	19

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT401	PC	Plant Biotechnology	3	3	0	0	3

2	U18PCBT402	PC	Principles of Chemical Thermodynamics	3	2	1	0	3
3	U18PCBT403	PC	Unit Operations	3	2	1	0	3
4	U18PCBT404	PC	Introduction to Industrial Biotechnology	2	2	0	0	2
5.	U18PCBT405	PC	Bioorganic chemistry	2	2	0	0	2
6	U18PCBT406	PC	Immunology	3	3	0	0	3
7	U18PCBT407	PC	Recombinant DNA Technology	3	3	0	0	3
8	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
9	U18PCBT4L1	PC	Microbiology Lab	2	0	0	2	1
10	U18PCBT4L2	PC	Biochemistry Lab - II	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media –Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
			Total	29	19	2	8	21

SEMESTER V								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA501	BS	Statistics for Bio Science	4	3	0	0	3
2	U18HSBA502	HS	Organizational behaviour	3	3	0	0	3
3	U18PCBT501	PC	Principles of Bioprocess Technology	3	2	1	0	3
4	U18PCBT502	PC	Chemical Reaction Engineering	3	2	1	0	3
5.		PE	Professional Elective -I	3	3	0	0	3
6		PE	Professional Elective -II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0

PRACTICAL								
8	U18PCBT5L1	PC	Molecular biology & Genetic Engineering Lab	2	0	0	2	1
9	U18PCBT5L2	PC	Chemical Engineering lab	2	0	0	2	1
10	U18EEBT5C1	EE	Comprehension - I	0	0	0	0	1
ACTIVITY BASED COURSES								
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
			Total	29	18	3	8	21

SEMESTER VI								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT601	PC	Animal Biotechnology	2	2	0	0	2
2	U18PCBT602	PC	Enzyme Engineering and Technology	3	2	1	0	3
3	U18HSBT601	HS	Bio entrepreneurship Development	3	3	0	0	3
4	U18PCBT603	PC	Bioprocess Engineering	3	2	1	0	3
5.		PE	Professional Elective -III	3	3	0	0	3
6		OE	Open elective I	3	3	0	0	3
7	U18MCTH603	MC	Essence of Indian knowledge Tradition	2	2	0	0	0
PRACTICAL								
8	U18PCBT6L1	PC	Bioprocess Engineering Lab I	2	0	0	2	1
9	U18PCBT6L2	PC	Plant and Animal Biotechnology Lab	2	0	0	2	1
10	U18PCBT6L3	PC	Immunology Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0

12	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	29	17	2	10	20

SEMESTER VII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCBT701	PC	Down Stream processing	3	3	0	0	3
2	UI8PCBT702	PC	Research methodology and Instrumentation	2	2	0	0	2
3	U18HSBA701	HS	Total Quality management	3	3	0	0	3
4		PE	Professional elective IV	3	3	0	0	3
5		OE	Open elective II	3	3	0	0	3
		OE	Open elective III	3	3	0	0	3
PRACTICAL								
6	U18PCBT7L1	PC	Bioprocess Engineering Lab II	2	0	0	2	1
7	U18PCBT7L2	PC	Downstream processing Lab	2	0	0	2	1
8	U18EEBT7P1	EE	Project I	6	0	0	6	3
9	U18EEBT7I1	EE	In-plant Training (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
ACTIVITY BASED COURSES								
10	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
11	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
			Total	31	17	0	14	23

SEMESTER VIII								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional elective V	3	3	0	0	3
2		PE	Professional elective VI	3	3	0	0	3
3		OE	Open elective IV (MOOC)	2	2	0	0	2
PRACTICAL								
4	U18EEBT8C2	EE	Comprehension – II	0	0	0	0	1
5	U18EEBT8P2	EE	Project II	18	0	0	18	9
ACTIVITY BASED COURSES								

6	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
			Total	28	8	0	20	18

TOTAL CREDITS: 168

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE I						
COURSE CODE	**SPECIALISATION**	**COURSE NAME**	**L**	**T**	**P**	**C**
U18PEBT011	Food Processing Technology	Basic Human Nutrition	3	0	0	3
U18PEBT012	Medical Biotechnology	Medical biotechnology	3	0	0	3
U18PEBT013	Environmental biotechnology	Environmental Biotechnology	3	0	0	3
PROFESSIONAL ELECTIVE II						
U18PEBT021	Food Processing Technology	Dairy Technology	3	0	0	3
U18PEBT022	Medical Biotechnology	Cancer biology	3	0	0	3
U18PEBT023	Environmental biotechnology	Fertilizer Technology	3	0	0	3
PROFESSIONAL ELECTIVE III						
U18PEBT031	Food Processing Technology	Food Process Technology	3	0	0	3
U18PEBT032	Medical Biotechnology	Proteogenomics and Bioinformatics	3	0	0	3
U18PEBT033	Environmental biotechnology	Waste Management Technology	3	0	0	3
PROFESSIONAL ELECTIVE IV						
U18PEBT041	Food Processing Technology	Food safety and Quality control	3	0	0	3
U18PEBT042	Medical Biotechnology	Stem cell and Tissue Engineering	3	0	0	3
U18PEBT043	Environmental biotechnology	Biofuel Technology	3	0	0	3
PROFESSIONAL ELECTIVE V						
U18PEBT051	Food Processing Technology	Bioreactor design	3	0	0	3
U18PEBT052	Medical Biotechnology	Biopharmaceutical Technology	3	0	0	3
U18PEBT053	Environmental biotechnology	Industrial waste treatment and	3	0	0	3

		disposal				
PROFESSIONAL ELECTIVE VI						
U18PEBT061	Food Processing Technology	Fermentation technology and application	3	0	0	3
U18PEBT062	Medical Biotechnology	Nanobiotechnology	3	0	0	3
U18PEBT063	Environmental biotechnology	Bioremediation Technology	3	0	0	3

OPEN ELECTIVE OFFERED BY THE DEPARTMENT OF IBT					
U18OEBT001	Chemical Process Industries	3	0	0	3
U18OEBT002	Bioprocess Economics & Plant Design	3	0	0	3
U18OEBT003	Brewing technology	3	0	0	3
U18OEBT004	Biomining	3	0	0	3
U18OEBT005	Industrial Safety Engineering	3	0	0	3
U18OEBT006	Biodiversity Management	3	0	0	3

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	**Humanities & Social Sciences (HS)**	3	3			3	3	3		15	**8.93**
2	**Basic Sciences (BS)**	10	13	4		3				30	**17.86**
3	**Engineering Sciences (ES)**	7.5	9.5							17	**10.12**
4	**Professional Core (PC)**			15	21	8	11	7		62	**36.90**
5	**Professional Electives (PE)**					6	3	3	6	18	**10.71**
6	**Open Electives (OE)**						3	6	2	11	**6.55**
7	**Project Work, Seminar, Internship, Term Paper, etc. (EE)**					1		4	10	15	**8.93**
	Total Credit	20.5	25.5	19	21	21	20	23	18	168	**100**
	Total Contact Hour	**35**	**36**	**25**	**29**	**29**	**29**	**31**	**28**	**242**	

LIST OF COURSES

LIST OF HUMANITY AND SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18HSEN201	HS	Technical English	3	2	1	0	3
3	U18HSBA502	HS	Organizational behaviour	3	3	0	0	3
	U18HSBT601	HS	Bio entrepreneurship Development	3	3	0	0	3
4	U18HSBA701	HS	Total Quality management	3	3	0	0	3
TOTAL CREDITS								**15**

LIST OF BASIC SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18BSMA102	BS	Mathematics – I for Bio Engineering	4	3	1	0	4
2	U18BSPH101	BS	Waves and Optics	3	3	0	0	3
3	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
4	*U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	0
5	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
6	U18BSMA202	BS	Mathematics- II for Bio Engineering	4	3	1	0	4
7	U18BSPH203	BS	Introduction to Bio Physics	3	3	0	0	3
8	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
9	U18BSPH2L3	BS	Wave Optics and Bio Physics Lab	3	0	0	3	1.5

10	U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
11	U18BSMA305	BS	Transforms and Numerical Methods	4	3	1	0	4
12	U18BSMA501	BS	Statistics for Bio Science	4	3	0	0	3
TOTAL CREDITS								**30**

LIST OF ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
3	U18ESCS1L1	ES	Problem Solving and Python ProgrammingLab	3	0	0	3	1.5
4	U18ESGE201	ES	Cytology and Genetics	2	2	0	0	2
5	U18ESEE101	ES	Basic Electrical and Electronics Engineering	3	0	0	3	3
6	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
7	U18ESEE1L3	ES	Basic Electrical and Electronics Engineering Practices Laboratory	3	0	0	3	1.5
TOTAL CREDITS								**17**

LIST OF PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C

1	U18PCBT301	PC	Introduction to Molecular biology	2	2	0	0	2
2	U18PCBT302	PC	Principles of Chemical Engineering	3	2	1	0	3
3	U18PCBT303	PC	Biochemistry	3	3	0	0	3
4	U18PCBT304	PC	Microbiology	3	3	0	0	3
5	U18PCBT305	PC	Instrumentation for Biotechnology	2	2	0	0	2
6	U18PCBT3L1	PC	Biochemistry Lab I	2	0	0	2	1
7	U18PCBT3L2	PC	Cell Biology Lab	2	0	0	2	1
8	U18PCBT401	PC	Plant Biotechnology	3	3	0	0	3
9	U18PCBT402	PC	Principles of Chemical Thermodynamics	3	2	1	0	3
10	U18PCBT403	PC	Unit Operations	3	2	1	0	3
11	U18PCBT404	PC	Introduction to Industrial Biotechnology	2	2	0	0	2
12	U18PCBT405	PC	Bioorganic chemistry	2	2	0	0	2
13	U18PCBT406	PC	Immunology	3	3	0	0	3
14	U18PCBT407	PC	Recombinant DNA Technology	3	3	0	0	3
15	U18PCBT4L1	PC	Microbiology Lab	2	0	0	2	1
16	U18PCBT4L2	PC	Biochemistry Lab - II	2	0	0	2	1
17	U18PCBT501	PC	Principles of Bioprocess Technology	3	2	1	0	3
18	U18PCBT502	PC	Chemical Reaction Engineering	3	2	1	0	3
19	U18PCBT5L1	PC	Molecular biology & Genetic Engineering Lab	2	0	0	2	1

20	U18PCBT5L2	PC	Chemical Engineering lab	2	0	0	2	1
21	U18PCBT601	PC	Animal Biotechnology	2	2	0	0	2
22	U18PCBT602	PC	Enzyme Engineering and Technology	3	2	1	0	3
23	U18PCBT603	PC	Bioprocess Engineering	3	2	1	0	3
24	U18PCBT6L1	PC	Bioprocess Engineering Lab I	2	0	0	2	1
25	U18PCBT6L2	PC	Plant and Animal Biotechnology Lab	2	0	0	2	1
26	U18PCBT6L3	PC	Immunology Lab	2	0	0	2	1
27	U18PCBT701	PC	Down Stream processing	3	3	0	0	3
28	UI8PCBT702	PC	Research methodology and Instrumentation	2	2	0	0	2
29	U18PCBT7L1	PC	Bioprocess Engineering Lab II	2	0	0	2	1
30	U18PCBT7L2	PC	Downstream processing Lab	2	0	0	2	1
TOTAL CREDITS								**62**

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	U18EEBT5C1	EE	Comprehension - I	0	0	0	0	1
2	U18EEBT7P1	EE	Project I	6	0	0	6	3
3	U18EEBT7I1	EE	In-plant Training (Note: Students to get trained in an industry for a period of two weeks at the end of VI semester)	0	0	0	0	1
4	U18EEBT8C2	EE	Comprehension – II	0	0	0	0	1
5	U18EEBT8P2	EE	Project II	18	0	0	18	9

TOTAL CREDITS	15

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I						
COURSE CODE	**SPECIALISATION**	**COURSE NAME**	**L**	**T**	**P**	**C**
U18PEBT011	Food Processing Technology	Food science and nutrition	3	0	0	3
U18PEBT012	Medical Biotechnology	Medical biotechnology	3	0	0	3
U18PEBT013	Environmental biotechnology	Environmental Biotechnology	3	0	0	3
PROFESSIONAL ELECTIVE II						
U18PEBT021	Food Processing Technology	Dairy Technology	3	0	0	3
U18PEBT022	Medical Biotechnology	Cancer biology	3	0	0	3
U18PEBT023	Environmental biotechnology	Fertilizer Technology	3	0	0	3
PROFESSIONAL ELECTIVE III						
U18PEBT031	Food Processing Technology	Food Process Technology	3	0	0	3
U18PEBT032	Medical Biotechnology	Proteogenomics and Bioinformatics	3	0	0	3
U18PEBT033	Environmental biotechnology	Waste Management Technology	3	0	0	3
PROFESSIONAL ELECTIVE IV						
U18PEBT041	Food Processing Technology	Food safety and Quality control	3	0	0	3
U18PEBT042	Medical Biotechnology	Stem cell and Tissue Engineering	3	0	0	3
U18PEBT043	Environmental	Biofuel Technology	3	0	0	3

	biotechnology					
PROFESSIONAL ELECTIVE V						
U18PEBT051	Food Processing Technology	Bioreactor design	3	0	0	3
U18PEBT052	Medical Biotechnology	Biopharmaceutical Technology	3	0	0	3
U18PEBT053	Environmental biotechnology	Industrial waste treatment and disposal	3	0	0	3
PROFESSIONAL ELECTIVE VI						
U18PEBT061	Food Processing Technology	Fermentation technology and application	3	0	0	3
U18PEBT062	Medical Biotechnology	Nanobiotechnology	3	0	0	3
U18PEBT063	Environmental biotechnology	Bioremediation Technology	3	0	0	3

LIST OF MANDATORY COURSES

Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
1	18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
2	18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
3	U18MCAB203	MC	Yoga	2	0	0	2	0
4	U18MCAB204	MC	Physical health – NCC	2	0	0	2	0
5	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
6	U18MCAB306	MC	Culture – Intangible		0	0	2	0

			Cultural, heritage(festivals, Food ways, Local games)	2				
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
8	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
9	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
10	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
11	U18MCAB611	MC	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12	U18MCAB612	MC	Self Development - religion and Inter-faith	2	0	0	2	0
13	U18MCTH603	MC	Essence of Indian knowledge Tradition	2	2	0	0	0
14	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
15	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
16	U18MCAB713	MC	Behavioral and interpersonal skills	2	0	0	2	0
17	U18MCAB714	MC	Nature – Nature club	2	0	0	2	0
18	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
TOTAL CONTACT PERIODS				**36**				

	COMMUNICATIVE ENGLISH	**L**	**T**	**P**	**C**

U18HSEN101	Total Contact Periods – 45	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building - The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 15

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations
4. Reading different genres of texts

5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. **Practical English Usage. Michael Swan. OUP. 2005.**
6. **Remedial English Grammar. F.T. Wood. Macmillan.2007**
7. **On Writing Well. William Zinsser. Harper Resource Book. 2001**

COURSE OUTCOMES	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

MAPPING BETWEEN COURSE OUTCOMES&PROGRAMME OUTCOMES

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	S										**S**
2		**M**							**M**		
3			**S**							**S**	
4				**S**		**M**					
5					**S**		**S**	**W**			

Category	Humanities and Social Studies (HS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA102	**Mathematics I for Bio Engineering**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The aim is to develop mathematical curiosity and use inductive and deductive reasoning when solving problems, and to develop the				

	knowledge, skills and attitudes necessary to pursue further studies in Mathematics and to become confident in using Mathematics to analyze and solve problems in real – life situations.

UNIT I THEORY OF EQUATIONS (9+3)

Fundamental theory of algebra – number of roots of polynomial equations – conjugate pairs theorem (without proof) – Descartes rules of signs- symmetric functions of the roots – formation of equations – diminish the roots of an equations- Multiple roots – reciprocal equation.

UNIT II DIFFERENTIAL CALCULUS – One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions-Beta, Gamma functions and their properties.

UNIT V MATRICES (9+3)

Characteristic Equations –Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth EditionAddison-Wesley, Pearson.
5. Narayanan S., Manickavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

	COURSE OUTCOMES (COs)
CO1	Solve the equations (such as linear, factorable, quadratic and rational), applications and linear inequalities, to know the formation of equations.
CO2	Use both the limit definition and rules of differentiation to differentiate functions.The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions
CO4	Compute definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gamma
CO5	Identify Eigen value problems from practical areas using transformations;

CO/PO Mapping:S – Strong, M – Medium, W – Weak												
COs	**Programme Outcomes (POs)**											
	a	b	c	d	e	f	g	h	i	j	k	**l**
CO1	S			W	M							
CO2	S				M		W			W		
CO3	S				M				W			
CO4	S		S	W	M			M				
CO5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	**Waves and Optics**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS **9**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) BrijLal and Subramanian, "Waves and Oscillation", VikasPublishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) AjoyGhatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)												
CO1	Understand the basic concept of waves and lights											
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing											
CO3	Understand the propagation of light and geometrical optics											
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves											
CO5	Understand the concept of laser and its applications											
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**
2	CO1	S	S	M	S	M			M	S	S	
	CO2	W	S	M	M	S			M		W	S
	CO3	S	W			W			M	M		M
	CO4	S	W			W			M	M		M
	CO5	S	M	M	M				M		S	W
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				

	Course Designed by – Department of Chemistry
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications	

UNIT I WATER TECHNOLOGY **9**

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS **9**

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non- ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS **9**

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke –manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY **9**

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand&Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

CO/SO Mapping:S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S			M		S		S		W	
CO2		W	S		M		S		M		W
CO3		M		S		W				M	
CO4	S		M	W			M			S	
CO5		S		W		M				S	
Category	Basic Science (BS)										
Approval	47th Academic Council Meeting held in Aug, 2018										

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING **9**

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudocode, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

MODULE 3: CONTROL FLOW, FUNCTIONS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods;advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES **9**

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr,―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	S	S	M	S	M	W		M	W	M
	CO2	S	S	M	M		M		W			M
	CO3	M	M	W	S	M		W		W		M
	CO4	M	M	W	M	S	M	W	M	W		M
	CO5	M	S	W	M	M			M	M	W	
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet des needs, using the techniques, skills, and modern engineering tools necessary engineering practice				

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypocycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)

Principles of Orthographic Projections; Conventions; Projections of Points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to oneplane – Parallel to one plane and inclined to other plane – Inclined to both the planes;Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)

Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE 4:SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)

Sectional view of Prism, Cylinder, Pyramid, Cone (simple Position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)

Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)

Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale – Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students willgetExposure to basics of building construction
CO4	Students willgetExposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S			M			S				
	CO2	S	S	W		S	M					
	CO3			S								
	CO4											S
	CO5	S						W				
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESCS1L1	PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY	L	T	P	C
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012

2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	S	M	S	S	M	M	M	M		M
	CO2	S	S	W	S	S	M	W	M	M	M	M
	CO3	S	S	M	M	M	M		M	M	M	M
	CO4	S	M	S	S	S	M	M	M	M	W	
	CO5	S	S	M	S	M	M		M	M	W	M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSPH2L3	**Wave Optics and Bio Physics Laboratory (Common to B.Tech- IBT, GE & Agri Bio Tech)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**0**	**0**	**3**	**1.5**
	Prerequisite – Wave Optics and Bio Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To impart knowledge of practical Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Biophysics – Bio-Engineering branches

1. Determination of optical rotation using polarimeter
2. Determination of diffusion potential of biological sample
3. Analysis of viscosity of different biological sample using viscometer

4. Analysis of protein concentration using calorimeter
5. Quantification of DNA using UV-Vis spectrophotometer
6. Analysis of absorption maxima for an unknown sample

Course Outcome (CO's)												
CO1	Understand the fundamental concept of optics											
CO2	Understand the concept of production of ultrasonic waves											
CO3	Understand the estimation and functions of Biomolecules											
Mapping of Course Outcomes with Programme Outcomes (POs) S – Strong, M – Medium, W – Weak												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S		S	S				S	W	M	
	CO2	S	S	W					S	W	M	
	CO3				S				S	M	W	
3	Category	Basic Sciences (BS)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method
2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a Polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)

CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization and as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Student will be able to analyze Determination of Molecular weight of a Polymer by Viscosity Average Method
CO5	Student will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

MAPPING OF COs WITH POs: S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S		M	M		S		S		W	
CO2	W	S			M		S		M		W
CO3		M		M						M	
CO4	S		M				M				S
CO5		S		W		M				S	

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18HSEN201	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	2	1	0	3
	Prerequisite – I semester English				
	Course Designed by – Department of English				

OBJECTIVES

To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology.OrientBlackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)

Upon completion of the course, the students will be able to	
CO1	The student will acquire basic proficiency in English
CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

COs\POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1	M										**S**
2		**S**							**M**		
3			**S**							**S**	
4				**M**		**S**					
5					**M**		**M**	**W**			

Category	Basic Science (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSMA202	**Mathematics II for Bio Engineering (Common to IBT, Genetics and Agricultural Bio Tech)**	**L**	**T**	**P**	**C**

	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	To make the students learn Mathematics in order to formulate and solve problems effectively in their respective fields of engineering.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT III VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Integration of vector function - Green's theorem in a plane – Gauss divergence theorem and Stoke's theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT IV ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions,Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method –Conformal mapping : and Bilinear Transformation.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)

CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	Apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO3	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO4	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping:S – Strong, M – Medium, W – Weak											
COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO	M		W		S				M		S
CO	S	M			S				W		
CO	S	M			S			M		W	
CO	S		W				M		S		
CO	S		W	W			M				S
Cat	Basic Science (BS)										
App	47th Meeting of the Academic Council Meeting held in Aug, 2018										

U18BSPH203	**INTRODUCTION TO BIOPHYSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES:

To impart theories and methods of Physics to understand the functioning of Biological system

UNIT 1 ATOMIC PHYSICS **9**

Atom model - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - spatial quantisation - Bohr magneton - Stern and Gerlach experiment.

UNIT 2 NUCLEAR PHYSICS **9**

Nuclear size, shapes and forces: Nuclear size determination - Electron scattering method-electric moments - magnetic moments - Nuclear forces - Models of nuclei – Liquid drop model of nuclei- Atomic masses and its significance.

UNIT 3 RADIATION BIOPHYSICS **9**

Basics of Radiation Physics Atomic structure models, Constituents of atomic nuclei, Isotopes, Isobars, Isotones, Radioactivity, law of Radioactivity, General properties of alpha, beta and gamma radiations, Radiation units: Units of measurement of radioactivity. Curie, Becquerel., Interaction of radiation with matter: Excitation and ionization, Photo electric effect, Compton Effect, pair production, Characteristic radiation.

UNIT 4 MEMBRANE BIOPHYSICS 9

Membrane potentials Cell surface charge, Resting membrane potential, Action potential, Ionic transport during Action Potential, properties of action potential, Nernst equation, Hodgkin-Huxley equation, Membrane impedance and capacitance, Transmembrane potential, total electrochemical potential.

UNIT 5 MOLECULAR BIOPHYSICS 9

Nucleic acids – Purine and Pyrimidine bases, nucleosides, nucleotides basic difference in structures and functions of DNA and RNA

Proteins– Amino acids – types, planarity of peptide bond – Ramachandran map - Primary, secondary, tertiary and quarternary structures of proteins.

REFERENCE BOOKS:

1. R.Murugeshan and KrithigaSivaprasath, "Modern Physics", S.Chand publisher, 2016 (for Unit 1& 2)
2. Brij and Subramanian, "Atomic and Nuclear Physics" , S.Chand publisher, 2008 (for Unit 1 & 2)
3. JB Rajam, "Atomic Physics", 7th Edition, S.Chand publisher, 2005 (for Unit 1)
4. M.Volkenstein "General Biophysics" 1st Edition, Academic press, 1983 (for Unit 4)
5. Voet and Voet, "Introduction to Biochemistry" , 5th Edition, John Wiley & sons Inc., 2016 (for Unit 5)
6. Branden and Tooze, "Introduction to Protein Structure"2nd edition, Garland publishing, 1999
7. M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2014

Course Outcome (COs)	
CO1	Understand the fundamental concept of Atomic Physics
CO2	Understand the basic concept of Nuclear Physics
CO3	Understand the Radiation Physics and its measurement
CO4	Understand the Membrane Biophysics with functions of different potentials
CO5	Understand the Structural and molecular Biophysics

Mapping of Course Outcomes with Programme Outcomes, S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	**k**
2	CO1	W	W	W					S	W	M	
	CO2	W	W	W					S	W	M	
	CO3	W	W	W					S	W	M	
	CO4	W	W	W					S	W	M	
	CO5				M				S	W	W	
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSGE201	**CYTOLOGY AND GENETICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				

	Course Designed by – Dept of Genetic Engineering
OBJECTIVES: To provide a basic understanding of cell, its structure, function, types and about its culture	

UNIT I CELL STRUCTURE AND ORGANELLES 6

Cells - definition - eukaryotic cell and prokaryotic cell- Relationship and evolution of eukaryotic cell and prokaryotic cell- plant cells and animal cells - Cell Organelles, Structure and function – Nucleus- Endoplasmic reticulum - Golgi complex- lysosomes- cell membranes- chloroplast- mitochondria.Cell cycle-Mitosis and meiosis

UNIT II CELLULAR TRANSPORT 6

Transport across cell membranes – classification – Active and passive transport. Active – Na+ K+ ATPase Pump - Lysosomal and Vacuolar pumps - Endocytosis and Exocytosis transport across prokaryotic membrane - Cotransport – Symport, antiport.

UNIT III CELL SIGNALING AND SIGNAL TRANSDUCTION 6

Cell signaling – various kinds of Receptors and ligands –Different modes of action of ligands- different modes of signal transduction and amplification with examples- signaling through G-Proteins (Monomeric and trimeric), signaling for growth factors- secondary messengers- protein kinases- Ca ions and cAMP molecule in signaling.

UNIT IV BASICS OF GENETICS AND CHROMOSOMES 6

Mendelian Laws - Mendel's experiment - monohybrid cross-phenotype – genotype - Dihybrid inheritance - Chromosome structure and organization in prokaryotes and eukaryotes - chromosome banding - chromosome abnormalities

UNIT V ALLELES 6

Classical concepts of Pleomorphism - Multiple alleles, ABO blood groups - Rh factor - sex linkage in Drosophila- mechanism of sex determination- sex differentiation

TEXT BOOKS:

1. The Cell, Geoffrey M. Cooper & Robert E. Housman, Sinauer Associates Inc, 2015.
2. Genetics, Monroe W. Strickberger, Pearson Education India, 2015.

REFERENCE BOOKS:

1. Molecular Biology of the Cell, John Wilson and Tim Hunt, Garland science, 2014.
2. Cell Biology and Histology, Leslie P.Gartner and James L.Hiatt, Wolters Kluwer, 2014.
3. Principles of Genetics, Eldon John Gardener et al., Wiley publications, 2006.

COURSE OUTCOMES (COs)	
CO1	To understand the fundamentals of the structure of cells
CO2	To study the types and functions of cell organelles
CO3	To comprehend the methods involved in the cellular transport
CO4	To know the cause, and methods of cell signaling
CO5	To give a basic knowledge of cell culture and its applications
CO6	To understand about signal transduction
Mapping of Course Outcomes with Program outcomes (POs) S-Strong, M-Medium, W-Weak	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S					M	M	S			
	CO2	S			M			M		M		
	CO3	M	M								M	
	CO4	S		M				S				M
	CO5	S					M					S
	CO6	S			S				S		M	
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18ESEE101	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems,Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines,Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency,all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS **6**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory &Technology,Taylor& Francis Ltd, 6th, edition. 2017.

2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)												
CO1	To gain knowledge regarding the various laws and principles associated with DC Circuits.											
CO2	To gain knowledge regarding fundamentals of AC circuits.											
CO3	To gain knowledge regarding electrical machines and transformers.											
CO4	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.											
CO5	To gain knowledge on principles of digital electronics systems.											
Mapping of Course Outcomes with Programme Outcomes (POs) (S/M/W indicates strength of correlation) S-Strong, M-Medium, W- Weak												
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	W			M				S		W
	CO2	S	W			M				S		W
	CO3	S	M			M				S		W
	CO4	S	W			M				S		W
	CO5	S	W			M				S		W
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				

OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I -NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS **9**

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION **9**

Introduction and Definition - genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega diversity nation, Hot-spots of biodiversity - Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

UNIT IV-ENVIRONMENTAL POLLUTION **9**

Definition, Causes, effects and control measures of Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION **9**

Social issues: Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –

oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.
Human population: Population growth, variation among nations, population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Programme Outcomes (POs)**										
	a	b	c	d	e	f	g	h	i	j	k
CO1	S			M		S		S		W	
CO2	W	S	S		M		S		M		W
CO3		M				W			S	M	
CO4	S		M	W			M				M
CO5		S		W		M				S	

Category	Basic Sciences (BS)
Approval	47th Meeting of Academic Council held in Aug, 2018

U18ESME1L2	WORKSHOP/MANUFACTURING PRACTICES LABORATORY	L	T	P	C
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

SYLLABUS

Lectures & videos: (15 hours)

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice

2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.

3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

1. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

2. Sheet Metal working **(9 hours)**
   a) Forming &Bending:
   b) Model making–Trays, funnels, etc.
   c) Different type of joints

3. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge of the different manufacturing processes.
CO2	Students will be able to fabricate components with their own hands.
CO3	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.
CO4	Students will be able to produce small devices of their interest.

Mapping of Course Outcomes with Programme Outcomes

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1											S
	CO2			S	M							S
	CO3		M									
	CO4	S			W							S
3	Category	Engg Sciences (ES)										
4	Approval	47thMeeting of Academic Council held in Aug, 2018										

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES:

To enhance the practical knowledge on basics of electrical and electronics components and circuits.

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring

4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier.

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipments and verify current and voltage law
CO2	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits .
CO3	To understand domestic wiring procedures practically.
CO4	To analyze ac signal parameters using cathode ray oscilloscope and function generator
CO5	To understand all the fundamental concepts semiconductor Diode and Transistor
CO6	To understand all the fundamental concepts of logic Gates and Flip-Flops

Mappingof Course Outcomes (COs) with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S- Strong, M-Medium, W- Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	S	S			S				S		M
	CO2	S	S			S				S		M
	CO3	S	S			S				S		M
	CO4	S	S			S				S		M
	CO5	S	S			S				S		M
	CO6	S	S			S				S		M
3	Category	Engg Sciences (ES)										
4	Approval	47th Meeting of Academic Council held in Aug, 2018										

U18PCBT301	**INTRODUCTION TO MOLECULAR BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Basic concepts in Biology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES To provide a basic understanding of molecular level of DNA and their applications from the perspective of engineers					

UNIT I DNA STRUCTURE 6

DNA as the vehicle of inheritance-structure of DNA-forms of DNA-nucleic acid biosynthesis-experimental evidence: Griffith, McLeod, McCarty and Avery, Hershey–Chase experiments-Definition of gene-organization of genes and non coding DNA in prokaryotes- Eukaryotes–unique, moderately repetitive and highly repetitive DNA sequence-satellite DNA- Cot value-DNA binding proteins

UNIT II DNA REPLICATION 6

DNA replication in prokaryotes and eukaryotes- modes of replication-semi continuous and semi discontinuous replication- Okazaki fragments- RNA primers – enzymes of replication – DNA polymerases I, II, III, -DNA modifying enzymes: topoisomerases-helicases- binding proteins and ligases- replication in E.coli–replisomes-events at OriC (initiation), events on the replication fork (elongation) and termination- Fidelity of replication-Sigma or rolling circle mode of replication in Φ x 174-Inhibitors of replication.

UNIT III DNA REPAIR 6

Repair of DNA–types of damages- repair by direct reversal of damage- excision repair-recombination repair- SOS repair-Mutation: definition-type of mutations (spontaneous and induced) point mutation-Gene mutation and chromosomal aberrations- Cause of mutations-chemical and physical agent

UNIT IV TRANSCRIPTION 6

Transcription in prokaryotes and eukaryotes: RNA polymerases–enzyme structure- role of sigma factor- promoter-closed and open promoter complexes-Initiation-elongation and termination of RNA synthesis-Post transcriptional modification in prokaryotes and eukaryotes-transcription factors

UNIT V GENETIC CODE 6

Genetic code–Basic features of genetic code-Deciphering of genetic code-Wobble hypothesis-Protein biosynthesis-activation of amino acids- initiation-elongation and termination of translation in prokaryotes and eukaryotes-Post translational modifications-Inhibitors of translation.-Regulation of gene expression in prokaryotes and eukaryotes- operon concept

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of central dogma of biological systems
CO2	to know the concept of cell replication, transcription and translation
CO3	to comprehend DNA and its role in functioning of a cell
CO4	to know the functioning of regulatory factors and its application in maintaining cell activity
CO5	to get a basic knowledge of the DNA and RNA
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	H				H				H	H
	CO2	H			H		H						
	CO3	H	M			H		H	H		M		
	CO4	H	M									H	
	CO5	H					H			H			
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Biochemistry by Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2006
2. Lehninger, Principles of Biochemistry, David L. Nelson and Michael M. Cox, 2008
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann, Molecular Biology of the Gene (6th ed), 2007

REFERENCE BOOKS

1. R.L. Adams, J.T. Knowler, and D.P. Leader, The Biochemistry of the Nucleic Acids, 1992
2. Stephen Neidle, Principles of Nucleic Acid Structure, 2007
3. Robert Weaver, Molecular Biology, 2007
4. Weblink: nptel

U18PCBT302	**PRINCIPLES OF CHEMICAL ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics -II, basics about unit operations				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of Process engineering

UNITI BASIC STOICHIOMETRY 9

Basic stoichiomentric calculations: mole, molar mass, normality, molarity, molality, mole fraction, mass fraction, Ideal gas law, Raoult's law, Average molecular weight.

UNIT II MATERIAL BALANCES 9

Unit operation & Process - Law of conservation of mass – material balances without reaction: drying, evaporation, distillation, extraction, mixing, Material balances with chemical reactions: limiting and excess reactant-conversion -Yield – Selectivity.

UNIT III ENERGY BALANCES 9

Energy - Forms of energy- Energy balances –Heat capacity- heat capacity of gases and liquids- heat capacity of gaseous mixtures -Latent heat and sensible heat- Hess's law- Standard heat of Reactions.

UNIT IV FLUID MECHANICS 9

Fluids –Types of fluid - Nature of flow – Derivation of Bernoullis equation - Flow meters: Manometers - types of manometers —Venturi meter and orifice meter.

UNITVAGITATION AND TRANSPORTATION OF FLUIDS 9

Mixing and Agitation –Agitation equipment- Impellers and types - Prevention of swirling - Power requirement for mixing – Pumps: single acting and double acting pump -Work of consumption.

COURSE OUTCOMES (COs)	
CO1	to understand the various unit operations involved in industry
CO2	to know the material balance for a process.
CO3	to know the energy balance for a process.
CO4	to get an idea about fluid mechanics.
CO5	to know about agitation and the types of agitators

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H								
	CO3	H				H		M					M
	CO4	H	M		H	H							
	CO5	H	M	M		H		M					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.A.Gavhane, 2009, “Introduction to process calculations Stoichiometry” NiraliPrakasham Publications 22nd.

REFERENCE BOOKS

1. K.A. Gavhane, 2009, “Fundamentals of chemical engineering” NiraliPrakasham Publications 22nd.
2. McCabe and Smith,2002, “Unit operations in Chemical Enginering”, Tata McHraw Hill Pblications, 6th Ed.
3. K.A. Gavhane, 2009, “Unit operations I Fluid flow & Mechanical operations” NiraliPrakasham Publications, 17th.

4. Bhat & Vora,2001, 'Stoichiometry", Tata McGraw Hill Ltd, III Ed.
5. Weblink: nptel

U18PCBT303	BIOCHEMISTRY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Chemistry and Biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES
To provide a basic knowledge about biomolecules

UNIT I CARBOHYDRATES 9
Significance and classification of carbohydrates – Structure and properties of monosaccharides: glucose, fructose, galactose; oligosaccharides: sucrose, lactose, maltose, raffinose; polysaccharides: storage, structural, homo, hetero polysaccharides – starch, cellulose, hyaluronic acid.

UNIT II LIPIDS 9
Fatty acids: Structure, properties and classification – Lipids – Classification – Structure and functional properties of phospholipids, sphingolipids, glycolipids and steroids.

UNIT III PROTEINS 9
Structure and properties of amino acids – classification based on side chains and nutritional requirements – Peptides: Chemistry and its significance – Proteins: Various levels of structures – n classification based on composition and function.

UNIT IV NUCLEIC ACIDS 9
Structure of purine and pyrimidine bases – Nucleosides – Nucleotides – Watson-crick model of DNA – various levels of organization of DNA – superhelical DNA – Structure and functions of mRNA, tRNA and rRNA.

UNIT V METABOLISM 9
Metabolism – Glycolysis, TCA cycle and Hexose Mono Phosphate pathway; Biosynthesis and β oxidation of fattyacids. Biosynthesis of aromatic amino acid and catabolism of amino acids: Urea cycle– Biosynthesis and degradation of purines and pyrimidines.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biomolecules, their classification, structure
CO2	to apply the basic concept of carbohydrates, proteins ,lipids, nucleicacids and enzymes in metabolism.
CO3	to know the application of biomolecules in functioning of biological system
CO4	to get a basic knowledge of macromolecules in living organism and its energetic
CO5	To know basic concepts of enzymes
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M				H						L
	CO2								H			H	
	CO3	H		H		H				H	H		H
	CO4	H	M				H	H					
	CO5	H										H	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. 'Gaw A, 2008, "Clinical biochemistry" Elsevier Health Sciences, 4th.Ed.
2. J.L. Jain, 2008, "Fundamentals of biochemistry" S. Chand.8th Ed

REFERENCE BOOKS

1. J.L. Jain , , 2007 ,"Text Book Of Biochemistry' ,14th Ed
2. Zubey 2004 "Biochemistry" III Ed,
3. Voet&Voet 2006, "Biochemistry" V ed,.
4. Lehninger Nelson & Cox , , 2005 "Principles of Biochemistry",4th Ed
5. Weblink: nptel

U18PCBT304	MICROBIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic concepts in biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of microbes and their applications from the perspective of engineers

UNIT I INTRODUCTION TO MICROBIOLOGY 9

Definition-Scope and history of microbiology-prokaryotic and eukaryotic cell- different types of classification-Nomenclature-fermentation-pasteurization-role of microorganisms in pharmaceutical, food, agro and cosmetic industries-bioremedial applications-illustrations of genetically engineered strains

UNIT II GENERAL FEATURES OF MICROORGANISMS 9

Bacteria: diversity-classification-morphology-life cycle-Fungi: diversity-classification-morphology-life cycle-Algae: diversity-classification-morphology-life cycle-virus: diversity-classification-morphology-life cycle

UNIT III MICROSCOPY 9

Introduction- numerical aperture, resolving power-magnification- fixation, dyes and simple staining, differential staining- gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining-simple-compound-dark field-phase contrast-polarizing-fluorescent-laser optics-electron microscopy-scanning electron microscope-transmission electron microscope, specimen preparation-inverted microscope

UNIT IV MICROBIAL NUTRITION AND GROWTH 9

Common nutrient requirements-nutritional types of microorganisms, growth factors-uptake of nutrients by cells- culture media: synthetic or defined media-commonly used media-Types of media-selective-differential-enrichment media-aseptic techniques: disinfection-sterilization-cultivation of microbes: bacteria-fungi-viruses-pure culture: concept of pure culture-methods of pure culture of microorganisms–spread plate, streak plate and pour plate–microbial growth curve-factors affecting growth of microorganisms-measurement of growth

UNIT V MICROBIAL PATHOGENS AND DISEASES 9

Bacterial pathogens: *Staphylococcus aureus-Enterobacteriaceae*-Shigellosis-Fungal pathogens: superficial mycosis: -candidiasis- Mycetoma-subcutaneous phycomycosis: Cryptococcosis-opportunistic systemic mycosis -mycotic poisons-Viral pathogens: Pox virus, AIDS virus, influenza virus.

COURSE OUTCOMES (COs)													
CO1	to understand the source of microbes and their role in biotechnology												
CO2	to get the knowledge of microbial diversity classification and morphology												
CO3	to know the visualization of microbes by different microscopes												
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens												
CO5	to get a basic knowledge of the microbial nutrition and growth												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M			H	H	H	H		H
	CO2	H		M									
	CO3	H						H		H			H
	CO4	H		M	M			H					
	CO5	H				H	H						
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg, 2005, “Microbiology “ TATA McGraw Hill, 5thed

2. Anantha Narayan, C.K. JayaramPaniker, 2009, "Text Book of Microbiology" Orient Blackswan, 7th ed

REFERENCE BOOKS

1. Presscott and Dunn, 2006, "Industrial Microbiology" CBS Publishers& Distributors.
2. Daniel V.Lim, "Microbiology", Kendall Hunt, 2002 ed
3. Weblink: nptel

U18PCBT305	**INSTRUMENTATION FOR BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – basic principles in instrumentation				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of the working principle of instruments and their applications from the perspective of engineers

UNIT I RADIATION TECHNIQUES 6

Sources of radiation- absorptivity-Lambert Beers law, deviations, detectors, photometric accuracy, Rayleigh scattering, Fourier transform, calibration and standardization, atomisation, flame atomisation, turbidimetric and nephlometric titrations -scattering in gases.

UNIT II ELECTROCHEMICAL TECHNIQUES 6

Principles: redox potential-pH electrode-ion selective and gas sensing electrodes-Clarke oxygen electrode and its application-biosensors.

UNIT III SPECTROSCOPIC TECHNIQUES 6

Colorimetry-UV-visible spectrophotometry-ORD-CD-X-ray spectroscopy-IR spectroscopy-ESR spectroscopy-NMR spectroscopy-Mass spectroscopy

UNIT IV SEDIMENTATION TECHNIQUES 6

Centrifugation principles-centrifuges and its types-differential and density gradient centrifugation-analysis of subcellular fractions-assessment of purity and determination of relative molecular mass

UNITV RADIOISOTOPE TECHNIQUES 6

Nature of radioactivity-Detection and measurement of radioactivity-GM counter-Scintillation counting-photographic emulsions-radiotracer techniques-autoradiography

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of instruments and their different mode of applications
CO2	to know the principle, working concept and its applications
CO3	to find the various laboratory work based on instruments
CO4	to know the different types of instruments based on various parameters

CO5	to get a basic knowledge of equipments and their role in biological systems in relevant industries												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H				H					
	CO2	H	H	H	H					H		H	
	CO3	H						H					
	CO4	H						H			M		
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Willard and Merrit, "Instrumental Methods of Analysis", VI Edition, CBS Publishers and Distributors.
2. Asokan, Practical Biochemistry, IV edition

REFERENCE BOOKS

1. Ewing GW, "Instrumental Methods of Chemical Analysis", McGraw Hill Book Company, 1989.
2. Braun H., "Introduction to Chemical Analysis", McGraw Hill, 1987.
3. Keith Wilson and Walker, Practical Biochemistry, V edition, Cambridge editions.

U18BSMA305	**TRANSFORMS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Mathematics I & II				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms.

UNIT I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORMS **12**

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier sine and cosine transform – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS 12

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan , Jacobian and Gauss-Siedel methods.

UNIT IV FINITE DIFFERENCES AND INTERPOLATION 12

Finite differences -Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT V NUMERICAL DIFFERNTIATION AND INTEGRATION 12

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve many problems in automobile, medicine, electronic engineering by applying Fourier transform with the possible special cases with attention to their applications.
CO3	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO4	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO5	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			H					M			
	CO2	H			H			M	M				
	CO3		M		M								L
	CO4		M		M					M			L
	CO5		M					L		L			
3	Category	BS											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5^{th} edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42^{nd} Edition, 2016.

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4^{th} Ed., Prentice Hall, 1998.
2. Curtis F.Gerald. "Applied Numerical Analysis" 7th Edn. Pearson Education.
3. Dennis G.Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jo& Bartlett Publishers, UK. 1992

4. P.Kandasamy, K.Thilagavathy, K.Gunavathi- Numerical methods, S.Chand& Company, 2nd Edition 2010.
5. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications(reprint),2006.

U18PCBT3L1	BIOCHEMISTRY LAB I	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Basic concepts in chemistry and biology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of biochemical components and its functions and their Applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Preparation of normal, molar and percent solutions.
2. Preparation of different buffer solution and measure pH.
3. Qualitative analysis of Unknown sugar- Monosaccharides,disaccharides and polysaccharides.
4. Estimation of sugar- Benedicts method.
5. Qualitative of unknown protein- Albumin,casein and gelatin.
6. Quantitative test for aminoacids- Ninhydrin method.
7. Quantitative test for protein – Biuret method.
8. Quantitative test for protein –Lowry method.
9. Quantitative test for protein – Bradford method
10. Spectrophotometric analysis of DNA.

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COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biomolecules, their classification,structure and functions
CO2	to apply the basic concept of carbohydrates, proteins,lipids, nucleicacids and enzymes in metabolism
CO3	to know the application of biomolecules in functioning of biological system
CO4	to get a basic knowledge of macromolecules in living organism and its energetics
CO5	To know basic concepts of enzymes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H					H			H	H	L
	CO2	H				M		H			H	H	
	CO3		H	M				H	L			H	
	CO4	H	H					H			H	H	

	CO5	H					M	H			H	H	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT3L2	CELL BIOLOGY LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – basic cell biology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge about cell biology					

LIST OF EXPERIMENTS

1. Study of Microscope
2. Spotters
3. Permanent Slide preparation
4. Killing and Fixing
5. Mitosis on onion root tip
6. Cryopreservation
7. Preparation of Blood smear
8. Separation of plasma and serum from blood sample
9. Total RBC and WBC Count
10. Osmosis
11. Extraction of pigments

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of instruments and their different mode of applications
CO2	to get idea about slide preparation
CO3	to know about blood grouping
CO4	to get knowledge about mitosis
CO5	to get a basic knowledge of extraction of plant pigments

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H	H			H					
	CO2	H	H					H	M				
	CO3	H			H	H	H	H					
	CO4	H						H					
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB305 Learning an Art Form **0 0 2 0**

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306 Intangible Cultural Heritage (Festivals, Food ways, Local Games) 0 0 2 0

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-

ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

To study and document the prevalent social practices and beliefs regarding traditional foods;

To study and document the feasts on religious and social occasions of different communities;

To identify and document the food items consumed by different communities and determine their nutritional values;

To conduct chemical analysis of food ingredients;

To identify and document the kitchen generated health ingredients used by different communities;

To find out the uses of leftover food stuff of different communities;

To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and

To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

U18PCBT401	PLANT BIOTECHNOLOGY	L	T	P	C

	Total Contact Hours - 45	3	0	0	3
	Prerequisite – General biology, Cell biology, Microbiology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge about plant tissue culture and its applications					

UNIT I PLANT MOLECULAR BIOLOGY 9

Plant genome organization – mitochondrial genome – cytoplasmic male sterility – chloroplast genome – post transcriptional and translational modifications – transcription factors – gene silencing – regulation of gene expression – transposable elements

UNIT II PLANT GENETIC ENGINEERING 9

Vectors: viral vectors –Ti plasmid vectors – promoters– methods of gene transfer:direct and indirect-biolostics-Agrobacterium mediated gene transfer–newer methods of gene transfer in plants– selection of transformants/recombinants – RFLP, RAPD – plant pathogen interactions.

UNIT III PLANT TISSUE CULTURE 9

Basic terminologies – requirements of a plant tissue culture laboratory – Types of culture – selection of explants – sterilization techniques – Types of media – direct and indirect regeneration – micropropagation – haploid culture – protoplast culture – somatic hybridization and cybridization – embryo rescue – artificial seeds.

UNIT IV BIOFERTILIZERS, BIOCONTROL AND BIOREMEDIATION 9

Biofertilizers and its applications: Rhizobium-BGA-Frankia-VAM-applications–biocontrol of insect pests–genetic engineering of biocontrol agents–Biopesticides-Bioremediation– effluent treatment and using plant materials (Phytoremediation).

UNIT V APPLICATIONS 9

Transgenic plants for insect, disease, stress & herbicide resistance – edible vaccines and antibodies – methods of crop improvement through genetic engineering - DNA finger printing – production of secondary plant metabolites through suspension cultures.

COURSE OUTCOMES (COs)	
CO1	to understand basic concepts in organization of plant genome
CO2	to know about the genetic engineering concepts involved in plant
CO3	to know about plant tissue culture
CO4	To know about bioremediation.
CO5	to understand the various applications of plant tissue culture

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	L	L	H

	CO2	H	M	M	H		H	M	H	H	M	H	H
	CO3	H			H	H	H	M	M	M	L	L	M
	CO4	H	M	H		H	M	M	L		L	M	H
	CO5	H	M	M	H	H	M	M	M	M	H	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Adrian Slater, 2006, "Plant biotechnology", 3rd Ed,
2. Fr. S. Ignacimuthu, 2000 Plant biotechnology IV ed.

REFERENCE BOOKS

1. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009," Plant Biotechnology"
2. Veereshem C, 2006, "Medicinal plant biotechnology" CBS Publishers & Distributors.

Weblink: nptel

U18PCBT402	**PRINCIPLES OF CHEMICAL THERMODYNAMICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Basic concepts in chemical engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of thermodynamics					

UNITI BASIC CONCEPTS IN THERMODYNAMICS 9

Scope and limitations- Definitions and Fundamental concepts - Calculation of force, pressure and energy - Phase rule -Zeroth law- Heat reservoirs & Heat engine -First law- First law for non-flow process- enthalpy- First law for flow process.

UNIT II PVT BEHAVIOUR AND FIRST LAWOF THERMODYNAMICS 9

PVT behavior of pure liquids - Equations of state- Constant volume process , constant pressure process and constant temperature process- Vander Waals equation- Virial equation.

Second law- Mathematical statement of second law- Kelvin and Clausius statement- Clausius inequality

UNIT III THERMODYNAMIC PROPERTIES OF PURE LIQUIDS 9

Classification of properties- Helmholtz free energy - Gibb's free energy-Fundamental property relations- Maxwell equations - Clapeyron equation -Relationship between Cp and Cv- Fugacity and fugacity coefficient- Effect of temperature and pressure on fugacity- Activity and Activity coefficient-Effect of temperature and pressure on Activity.

UNIT IVCHEMICAL REACTION EQUILIBRIUM 9

Reaction stoichiometry -Equilibrium constant and standard free energy change - Effect of temperature on equilibrium constant- Evaluation of equilibrium constant - Effect of pressure on equilibrium - Other factors affecting equilibrium conversion.

UNITV APPLICATIONS OF THE LAWS OF THERMODNAMICS 9

Energy equation - Ejectors - Throttling process - Compressors - Adiabatic and Isothermal compression - Refrigeration - Choice of refrigerant -Absorption refrigeration- COP- Carnot cycle- Heat pumps.

COURSE OUTCOMES (COs)	
CO1	to understand the basic concepts in thermodynamics
CO2	to know the properties of fluid
CO3	to know to get an idea about application of thermodynamics in various field
CO4	to get knowledge about reaction equilibrium
CO5	to know about applications of thermodynamics law

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		H				H	M				M
	CO2	H				L		H			H		
	CO3	H			L			H	H	H	H	H	
	CO4						L						L
	CO5	H	H		H			H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.V.Narayanan, 2004, “Chemical engineering thermo dynamics” Prentice Hall of India Pvt Ltd.

REFERENCCE BOOKS

1. K.A.Gavhane, 2009, “Chemical engineering thermodynamics” NiraliPrakasham Publications, 20th.
2. T.M.Letcher, 2004, “Chemical thermodynamics for industry” R.S.C Publication 3rd.

Weblink: nptel

U18PCBT403	**UNIT OPERATIONS**	**L**	**T**	**P**	**C**

	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I& III, Principles of Chemical Engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To give a knowledge of heat and mass transfer					

UNIT I HEAT TRANSFER 9

Modes of heat transfer- Derivation of Heat transfer through compound wall and cylinder-Definition of Boiling, condensation and its types.

UNIT II HEAT EXCHANGERS AND EVAPORATOR 9

Heat exchanger- Theory of Shell and Tube heat exchanger and double pipe heat exchanger-Derivation of Overall heat transfer coefficient - LMTD.

Evaporator- Types: falling film- Climbing film. Forced circulation and Agitated film evaporator-Methods of feeding

UNIT III MASS TRANSFER 9

Outline of Mass transfer operations- Derivation of Diffusion in Gases, Liquids & Solids. Distillation- Theory of Simple, Flash, Steam and Azeotropic distillation-McCabeThiele method

UNIT IV LEACHING 9

Leaching- Theory of Moving bed leaching and Dispersed solid leaching. Liquid extraction-Mixer settler- Spray and packed extraction tower-Agitated extraction tower.

UNIT V DRYING AND SIZE REDUCTION 9

Drying- Drying equipment: Tray, Screen-conveyor, Rotary and Spray dryer-Selection of drying equipment.

Size reduction -Laws- Work index-Size reduction equipment: Jaw crusher. Smooth roll crusher-Tumbling mill - Fluid energy mill - Knife cutters-open and Closed circuit operation

COURSE OUTCOMES (COs)	
CO1	to understand the basic concepts in heat transfer
CO2	to know basic concepts of evaporation
CO3	to know about mass transfer operations
CO4	to know about leaching and extraction
CO5	to know about various drying

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H				H		H		L	L		L
	CO2	H	H					H					
	CO3	H	H					H		M			M

	CO4		H	H	H						H	M	
	CO5	H			H			H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Gavahnee, 2009,"Heat & Mass Transfer" NiraliPrakasham Publications, 20th Ed

REFERENCE BOOKS

1. K.A. Gavhane, 2009, "Unit operations II Heat & Mass Transfer" NiraliPrakashamPyblications, 23rd Ed
2. G.S. Sawhney, 2008,"Heat & Mass Transfer" I.K. International Publishing House
3. McCabe W. L & Smith J. C., "Unit operations in chemical Engineering". V.Ed..McGrawHillInt Ed.,
4. Robert e.Treybal,2000, "Mass Transfer Operations", McGraw Hill International III edition.
5. Christie J. Geankoplis,2000 " Transport Processes and Unit Operations", Prentice Hall India PvtLtd, III Edtion,
6. Weblink: nptel

	INTRODUCTION TO INDUSTRIAL BIOTECHNOLOGY	**L**	**T**	**P**	**C**
U18PCBT404	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Basic cell biology, genetics and biology				
	Course Designed by – Dept. of Industrial Biotechnology				

UNIT I INTRODUCTION 6

Introduction to Industrial Biotechnology - Objectives and Scope of IBT - Characteristics and comparison of bioprocessing with chemical processing – Isolation, screening, preservation and improvement of industrial microorganisms

UNIT II PRODUCTION OF PRIMARY METABOLITES 6

Process Technology, Industrial production of primary metabolites: ethanol, acetone-butanol, citric acid, acetic acid (vinegar), L-glutamic acid, vitamin B_{12}

UNIT III PRODUCTION OF SEONDARY METABOLITES 6

Microbial production of secondary metabolites: penicillin, streptomycin, tetracyclines, carotenoids, riboflavin

UNIT IV PRODUCTION OF INDUTRIAL ENZYMES AND OTHER PRODUCTS 6

Microbial production of industrial enzymes - glucose isomerase, proteases- Mushroom culture – Biofertilizer: bacteria, cyanobacteria, mycorrhizal fungal inoculants – Micropesticides: bacterial, viral, mycopesticides

UNITV APPLICATIONS OF BIOTECHNOLOGY 6

Human health care products: insulin, human growth hormone, interferon, monoclonal antibodies-Development of vaccines for immunity

COURSE OUTCOMES (COs)	
CO1	to understand the objective and scope of biotechnology
CO2	to know the concept of cell culture techniques
CO3	to comprehend DNA and its role in functioning of a cell
CO4	to know the microbial production
CO5	to get an idea about the applications of biotechnology

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H	H				H
	CO2	H				H		H				H	
	CO3	H	H	H				H					
	CO4	H		H				H		H		H	M
	CO5	H								H	H	M	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK:

R.C. Dubey, ATextbook of Biotechnology, S. Chand & Company Ltd.

S.N. Joganand, 2003, "Environmental Biotechnology"Himalaya publishing House, IV ed.

REFERENCE BOOKS:

1. Saha BC,2003, “Fermentation biotechnology” Americal Chemical Society.
2. Vyas SP,2002, “Methods in biotechnology and bioengineering” CBS Publishers & Distributors.
3. Acharya R, 1999, “The emergence and growth of biotechnology” E.Elgar.
4. Jain PC, 2004, “Microbiology and biotechnology for sustainable development” CBS Publishers & Distributors.
5. Stanbury Whittaker, 2002, "Principles of fermentation technology" - II Edn.
6. Weblink: nptel

U18PCBT405	**BIOORGANIC CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2

	Prerequisite – Basics of biochemistry
	Course Designed by – Dept. of Industrial Biotechnology

OBJECTIVES

To provide a basic understanding of biochemical reactions, mechanisms and their applications from the perspective of engineers

UNITI INTRODUCTION TO BIOORGANIC CHEMISTRY 6

Basic considerations, Proximity effect, Molecular adaptation, Molecular recognition, supramolecular chemistry, Chemistry of living cells, Analogy between biochemical transformations and bioorganic reactions.

UNIT II BIOORGANIC CHEMISTRY OF AMINO ACIDS AND PEPTIDES 6

Chemistry of Peptide bond synthesis- Asymmetric synthesis of amino acids - different models, Transition state analogous, chemical mutations, site specific mutagenesis, Molecular recognition and drug design, Catalytic antibodies.

UNIT III ENZYME CHEMISTRY 6

Introduction to enzymes, Types of enzymes- Immobilized enzyme- Semi synthetic enzymes- Mechanism of enzyme action- Allosteric regulatory enzymes.

UNIT IVMETAL IONS IN BIOLOGICAL SYSTEMS 6

Metal ions in proteins -Role on Zinc in carboxy peptidase- Iron and oxygen transport in Haemoglobin- Metal ion act as co-enzymes & Co factors in a biological reaction & Respiratory chain

UNIT V MEMBRANE CHEMISTRY 6

Structure- Active & Passive transport- ATP driven pumps – Ligand gated channels – Voltage gated channels.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biochemical reactions in living organism
CO2	to apply the concept of structural relationship between chemical and biochemical reactions
CO3	to create the drug formulation and its structural analogs in living systems comprehend genetics and the immune system
CO4	to know the role of metal ions in biological components and their importance in living systems
CO5	to get a basic knowledge of membrane transport and their permeability

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H		H					
	CO2	H							H		H	H	H
	CO3	H		H	H	H	H	H				M	

	CO4	H						M					
	CO5	H						H					
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Dugas. H, Bio-Organic Chemistry - A chemical approach to enzyme action, Springer Verlag, 2002, revised edition.

REFERENECE BOOKS

1. Faber. K, Biotransformations in Organic Chemistry- A text book, 4th Edition, Springer
2. Zubay .G. Bio chemistry, Max well Macmillan Publications, 2003 edition.
3. Weblink: nptel

U18PCBT406	**IMMUNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – basics of immune system				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers

UNIT I **9**

THE IMMUNE SYSTEM

Introduction - antigens &their classification, complement and their biological functions, types of immune responses, Primary and secondary lymphoid organs-thymus, bone marrow and spleen

UNIT II **9**

HUMORAL IMMUNITY

B-lymphocytes and their maturation, activation &differentiation, structure and function of immunoglobulin, immunoglobulin classes, antibody mediated immune response and major histocompatibility complex.

UNIT III **9**

CELLULLAR IMMUNOLOGY

T -Lymphocytes their classification, maturation, activation & differentiation, antigen presenting, cells (APC), macrophages, langerhans cells, their origin and function, mechanisms of phagocytosis,Cell mediated immune response

UNIT IV **9**

ANTIGEN - ANTIBODY INTERACTION

Principle and application: Precipitation- Immuno diffusion &widal test, Agglutination reactions, Radio ImmunoAssay, ELISA, Immuno fluorescence technique, Immunoelecctrophoresis

UNITV **9**

TRANSPLANTATION AND AUTO IMMUNITY

Graft rejection, mechanisms of graft rejection and its prevention –hypersensitivity- Auto antibodies in humans,diseases- treatment of auto immune disorders

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of immune system
CO2	to apply the techniques for antigen and antibody reaction
CO3	to give the mechanism of immune response against antigens
CO4	to know the natural barrier against pathogens
CO5	to get a basic knowledge of the applications of immunology in transplantation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H		H			
	CO2	H		H				H		H			
	CO3	H		H				H		H			
	CO4	H		H	M			H		H			
	CO5			H		H	H	H	H				H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Janis Kuby,2007, “Immunology” W.H. Freeman & Co. 6th ed.
2. Roitt I, 2001, "Essential Immunology". Blackwell Scientific Publications, Oxford,.

U18PCBT407	**RECOMBINANT DNA TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Molecular biology, Cell biology, Microbiology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers

UNIT I CLONING **6**

Introduction to Genetic engineering- Restriction enzymes, Restriction sites, Linkers and adapters. Markers for screening. Vectors- Characteristics- plasmid: EcoIi -.pBR 322, Cosmid-Shuttle vectors, Pblue script vectors ,Expression vectors, BAC, YAC, MAC. Characterization of recombinant clones by Southern, Northern, Western Blotting

UNIT II CONSTRUCTION OF LIBRARIES AND NUCLEIC ACID LABELLING 6

Polymease Chain Reaction – types and applications. Semi quantitative and Real time PCR . Construction of genomic and cDNA libraries, Nucleic acid sequencing methods-Maxam Gilbert, Sanger dideoxy sequencing, Nick translation, RNA labeling and Fluorescent labeling. Genome mapping.

UNIT III APPLICATION OF rDNA TECHNOLOGY IN PLANTS 6

Method of gene transfer to plants- agrobacterium mediated / chemical mediated, Biolistics. Transgenic plants- Ri and Ti plasmids, Screening of recombinants-Direct and indirect methods, Single cell proteins using fungi.

UNIT IV APPLICATION OF rDNA TECHNOLOGY IN ANIMALS 6

Animal cloning, Ethical aspects of animal cloning,-Transgenic animals- sheep, goat, cattle, fish etc-Methods of gene transfer to animals-embryo transfer.

UNITV APPLICATIONS OF rDNA TECHNOLOGY IN INDUSTRY 6

Health care: Vaccines- DNA Vaccine, Recombinant vaccine. Hormones- insulin, Growth Hormone. Antibiotics - Streptomycin, Pencillin. Industrial enzymes – Amylase, protease

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of genetic engineering
CO2	to apply the concept of recombinant DNA IN plant, animal and microbial systems and growth in real life situations
CO3	to get the knowledge of molecular scissors and its role in creating transgenic products
CO4	Toknow the techniques related to screen the recombinant products
CO5	to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	H	L	H
	CO2	H	M	M	H	H	M	M	H		L		
	CO3	H	M		H					H	M	L	H
	CO4	H	M			H	H	M	M		M	M	M
	CO5	H	M	M		H		M		M		L	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Brown TA, 2000, "Gene cloning-and introduction" VNR (U.K) Co Ltd.

REFERENCE BOOKS

1. Setlow JK,2004, "Genetic engineering: principles and methods" Springer.
2. Fridal R,2006, "Genetic engineering" Lerner publications.
3. LeVine H,2006, "Genetic engineering-A reference handbook" ABC-CLIO.
4. Levine AD,2009, "Cloning" The Rosen publishing group, 1st.
5. Weblink: nptel

U18MCTH402 Constitution of India – Basic features and fundamental principles 2 0 0 0

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ownancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

Meaning of the constitution law and constitutionalism
Historical perspective of the Constitution of India

Salient features and characteristics of the Constitution of India

Scheme of the fundamental rights

The scheme of the Fundamental Duties and its legal status

The Directive Principles of State Policy – Its importance and implementation

Federal structure and distribution of legislative and financial powers between the Union and the States

Parliamentary Form of Government in India – The constitution powers and status of the President of India

Amendment of the Constitutional Powers and Procedure

The historical perspectives of the constitutional amendments in India

Emergency Provisions : National Emergency, President Rule, Financial Emergency

Local Self Government – Constitutional Scheme in India

Scheme of the Fundamental Right to Equality

Scheme of the Fundamental Right to certain Freedom under Article 19

Scope of the Right to Life and Personal Liberty under Article 21

U18PCBT4L1	**MICROBIOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite- Microbiology, Molecular biology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES To provide a basic understanding of microbes and their applications from the perspective of engineers					

LIST OF EXPERIMENTS

1. Laboratory rules and regulations
2. Isolation of Bacteria Soil
3. Motility of Bacteria
4. Staining techniques
5. Streak Plate techniques
6. Antibiotic sensitivity test
7. Isolation of Fungi
8. Water analysis by MPN
9. Milk Analysis
10. Biochemical Analysis

COURSE OUTCOMES (COs)	
CO1	to understand the source of microbes and their role in biotechnology
CO2	to get the knowledge of microbial diversity classification and morphology
CO3	to know the visualization of microbes by different microscopes
CO4	to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens

CO5	to get a basic knowledge of the microbial nutrition and growth

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M		L					H		H	
	CO2	H						H					M
	CO3	H	H			H						H	
	CO4									L	H		
	CO5			M			L						L
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT4L2	**BIOCHEMISTRY LAB II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Biochemistry, Bioorganic chemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biochemical reactions, mechanisms and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. Preparation of casein from milk.
2. Separation of starch from potato.
3. Extraction of chlorophyll in plant tissue.
4. Extraction of lactose from milk.
5. Estimation of glucose from grapes.
6. Extraction of fructose from honey
7. Extraction of lycopene from tomato.
8. Acetylation of D-glucose.
9. Preparation of methyl salicylate from aspirin.
10. Preparation of aspirin from salicylic acid.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of biochemical reactions in living organism
CO2	to apply the concept of structural relationship between chemical and biochemical reactions
CO3	to create the drug formulation and its structural analogs in living systemscomprehend genetics and the immune system
CO4	to know the role of metal ions in biological components and their importance in living systems
CO5	to get a basic knowledge of membrane transport and their permeability

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	H		H	H				H
	CO2		H	H			M					M	
	CO3	H		M	M	H					M		
	CO4		L	L				L	L	L			L
	CO5			H	H		M			H		M	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB407 Literature, Cinema and Media (workshop, reading multiple news sources,analyze ads**)**

0 0 2 0

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description.

Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not just the literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even

promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408 Literature & Media Group Reading (saamuhikvaachan) of classics 0 0 2 0

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

U18BSMA501	**STATISTICS FOR BIOSCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engg Mathematics-I &II				
	Course Designed by – Dept. of Mathematics				
OBJECTIVES To provide a basic knowledge of probability and statistics					

UNIT I - INTRODUCTION TO BIO-STATISTICS (numerical problems only) 9

Introduction to Biostatistics - Applications of Biostatistics. Handling univariate and bivariate data – Measures of central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression.

UNIT II - PROBABILITY & THEORETICAL DISTRIBUTIONS 9

Probability concepts – conditional probability – Bayes' theorem – one dimensional random variables – expectation, variance, moments. Theoretical distributions: Binomial, Poisson, Normal (Problems only).

UNIT III - TESTING OF HYPOTHESIS 9

Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportions, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, independence of attributes.

UNIT IV - ANALYSIS OF VARIANCE 9

Small sample tests based on t and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances, ANOVA – one way classification, Two-way classification.

UNIT V- STATISTICAL QUALITY CONTROL AND RELIABILITY 9

Process control – control charts for variables - $\bar{X}$ and R, $\bar{X}$ and s charts. Control charts for attributes: p chart, np chart, c chart, Stability and Capability.

Reliability concepts, Failure rate analysis-calculation of MTFR and MTPR.

COURSE OUTCOMES (COs)													
CO1	Understand the computation of basic measures in Statistics												
CO2	Understand the importance and the application of Probability in Engineering.												
CO3	Various tools for testing the parameters based on samples.												
CO4	How Design of Experiments are to be analysed.												
CO5	Concepts of Process Control and various Charts to control the quality of products.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H	M		M		L			L	M	
	CO2	H	H	H	L		L		M				
	CO3	H	M								M		
	CO4	H	M	M					M	L			
	CO5	H		H	M			M		M	L		
3	Category	BS											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

(a) S.C.Gupta & V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2003. [Units I to III].

(b) S.C. Gupta and V.K. Kapoor, "Applied Statistics". Sultan Chand and Sons, New Delhi 2004 [Units IV & V].

(c) Douglas C. Montgomory. "Design and Analysis of Experiments, Student Solutions Manual", 8th Edn: Wiley India Pvt Ltd., New Delhi-2. 2012.

REFERENCE BOOKS

1. Veerarajan T. "Probability Statistics and Random Process" Tata McGraw Hill, New Delhi 2003.
2. W.W. Daniel, "Biostatistics-A foundation for Analysis of Health Sciences", John Wiley and Sons, New Delhi 2000.
3. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability For Engineers", 6th Edition. Wiley India Pvt Ltd., New Delhi-2. 2010.

4. Tirupathi R.Chandrauptta. “Quality and Reliability in Engineering”. Book Vistas, New Delhi.

U18HSBA502	ORGANIZATIONAL BEHAVIOR	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite :				
	Course Designed by: Dept of Management Studies				

OBJECTIVES

1. Knowledge on theories of Personality
2. Clear sight on the Decision Making in Groups
3. Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour. Assess the potential effects of organizational - level factors (such as structure, culture and change) on organizational behaviour

UNIT **9**

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area - Application of Organizational Behavior in Business.

UNIT II **9**

Individual behaviour – personality, perception, learning, attitudes inter-personal behavior – Group and inter-group behaviour.

UNIT III **9**

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – Motivation – Need and Importance – Theories of Motivation

UNIT IV **9**

leadership-nature, stles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power.

UNIT V **9**

Management of change-conflict Management- Management of culture, Cross Cultural Management.

COURSE OUTCOMES (COs)	
CO1	Familiarity with the knowledge of Frame work of Organizational Behaviour
CO2	Knowledge of the Interpersonal perception
CO3	Awareness of the Merits and Demerits of Group decision making.
CO4	Understanding of the Sources of power
CO5	Familiarity with the knowledge of types of Conflicts
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		
	CO2				H	H		M		M		L	
	CO3		M				H					L	M
	CO4	H			H						L		
	CO5		M				M	M	H				M
3	Category	HS											
4	Approval	Academic Council, Aug 2018											

REFERENCE BOOKS

1. Uma Sekaran, Organizational Behavior: Text and Cases TMH Publications
2. Ashwathappa K, Organizational Behavior: Text, cases and games, Himalaya Publishers
3. Chandhan JS, Organizational Behavior, Vikas Publishers
4. Stephen Robbins, Organizatonal Behavior, Pearson Education
5. RS Diwedi, Human Relations and Organizational Behavior, Mac Millan

U18PCBT501	**PRINCIPLES OF BIOPROCESS TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics –II, Principles of chemical Engineering.				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge of Process techniques in industries

UNIT I INTRODUCTION TO BIOPROCESSES 9

Historical development of bioprocess technology, Biotechnology & Bioprocess engineering- outline of Unit Operations involved in Upstream and downstream processing, generalized process flow sheets.

UNIT II GROWTH MEDIA AND STERILIZATION 9

Medium requirements for fermentation, Carbon, Nitrogen, Minerals, Vitamins, and other complex nutrients, medium formulation – Media- Types of media – Sterilization: Batch and continuous heat sterilization of liquid media- filter sterilization of liquid media- Sterilization kinetics- Del factor.

UNIT III STOICHIOMETRY OF MICROBIAL GROWTH 9

Stoichiometry of Cell growth and product formation- elemental balances- degrees of reduction of substrate and biomass-available electron balances-yield coefficients of biomass and product formation

UNIT IV INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO_2- cell mass, cell number.

UNIT V INDUSTRIAL BIOPROCESSES

Bioprocesses: Production of lactic acid, sugar, baker's yeast, High fructose corn syrup, bioethanol, biodiesel, biogas, Pharma product: penicillin, aspirin

COURSE OUTCOMES (COs)	
CO1	to understand the development of bioprocess techniques.
CO2	to know about the instrumentation and control for bioprocess operations
CO3	to get idea about media formulations
CO4	to know about stoichiometry of bioprocess.
CO5	to know about various bioreactors

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Shuler and Kargi, 2005 "Bioprocess Engineering",Prentice Hall

REFERENCE BOOKS

1. Bailey and Ollis, 2000, "Biochemical Engineering Fundamentals", McGraw Hill 3rd ed.
2. Stanbury PF,1984, "Principles of fermentation technology" SS Hall, 2nd.
3. Dr.Mansi El Mansi.2003 "Fermentation Microbiology & Biotechnology".IVEd.
4. P.T. Kalaichelvan and I. Arul Pandi. 2007 "Bioprocess technology" MJP Pub, 1st ed.

U18PCBT502	**CHEMICAL REACTION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3

	Prerequisite – Engg Mathematics-I &II, Unit operations
	Course Designed by – Dept. of Industrial Biotechnology
OBJECTIVES: To provide a basic knowledge of Reaction engineering	

UNITI KINETICS OF HOMOGENEOUS REACTIONS 9

Scope of chemical kinetics, various types of reaction Basic terms and Definition: Rate, Rate law, Order, Molecularity , Elementary and Non Elementary reaction. Testing kinetic model for Non Elementary reaction theories of chemical reaction- temperature dependency theories.

UNIT II INTERPRETATION OF BATCH REACTOR DATA 9

Arrhenius law, Calculation of Activation energy, Rate, Rate constant-Constant Volume Batch reactor – Integral and Differential method of analysis- Analysis of total pressure data in constant volume system- Rate Equation: Irreversible Unimolecular I and II order and irreversible bimolecular II order (Equimolar and Non equimolar) .

UNIT III DESIGN OF SINGLE IDEAL REACTORS 9

Half-life period – Variable volume batch reactor .Constant Density & Changing Density Batch and Flow system – Design of ideal batch reactor – Space time and Space velocity – Design of MFR & PFR calculation of X_A, $\tau_{MFR,}$,τ_{PFR}

UNIT IV MULTIPLE REACTOR SYSTEM FOR SINGLE REACTIONS 9

Significance of choice of reactor system- Comparison of MFR with PFR I order & II order – Reactor in series: CSTR in series –Unequal size CSTR in series, Equal size CSTR in series – PFR in series. Non ideal reactors.

UNITV BIOREACTOR 9

Biochemical reaction: Bioprocess &Bio reaction- Cell multiplication kinetics- types of bioreactors- Some industrial application of bioprocess: Aerobic and anaerobic bioprocess.

TEXT BOOK:

1. K.A.Gavhane, 2009, "Chemical Reaction Engineering I" NiraliPrakasham Publications, 19th.

REFERENCE BOOKS:

1. K.A.Gavhane, 2009, "Chemical Reaction Engineering II" 21sted.
2. Octave Levenspiel, 2006, "Chemical Reaction Engineering" Wiley-India, 3rd Edition
3. Weblink: nptel

COURSE OUTCOMES (COs)	
CO1	to understand basic concepts in homogenous reactions
CO2	to know about various order reaction
CO3	to know about the plug flow and mixed flow reactor
CO4	to know about multiple reactors
CO5	to know about design of bioreactors

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	H	H	H	M	L	M
	CO2	H	M	M	H							L	M
	CO3	H				H			H	L			
	CO4	H	M				M	M				L	
	CO5	H	M	M		H				M	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCTH503 UNIVERSAL HUMAN VALUES **2 0 0 0**

The objective of the course is four fold:

Sensitization of student towards self, family (relationship), society and nature.

Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
Strengthening of self reflection.
Development of commitment and courage to act.

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

U18PCBT5L1	**MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Molecular biology,rDNATechnology,Microbiology.				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers					

LIST OF EXPERIMENTS

1. Extraction of plant genomic DNA by Dellaporta method.
2. Extraction of animal DNA.
3. Extraction of bacterial genomic DNA.
4. Isolation of plasmid DNA by alkaline lysis method.
5. Extraction of fungal DNA.
6. Quantitative estimation of DNA.
7. Effect of UV radiation on bacterial survival.
8. Agarose gel electrophoresis.
9. Restriction digestion and ligation of DNA.
10. DNA amplification by PCR.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of genetic engineering												
CO2	to apply the concept of recombinant DNA IN plant, animal and microbial systems and growth in real life situations												
CO3	to get the knowledge of molecular scissors and its role in creating transgenic products												
CO4	to know the techniques related to screen the recombinant products.												
CO5	to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		H	M	H	H	L	L	M
	CO2	H	M				L		H	M	L		
	CO3	H	M	H	H	H	H	M	H	H	L		
	CO4	H			H	H	H	M	M	M		L	M
	CO5	H	M	M	H					L	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT5L2	**CHEMICAL ENGINEERING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – principles of chemical engg, chemical reaction engg, mechanical operations, Mass &Heat Transfer				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a knowledge about heat, mass transfer and reaction kinetics					

LIST OF EXPERIMENTS

1. Batch Reactor I & II
2. Multiple reactor system
3. Drying studies in Tray dryer
4. Simple Leaching
5. Adsorption
6. Heat transfer through Natural convection
7. Heat transfer through Forced convection
8. Heat transfer through composite wall
9. Size reduction and Sieve Shaker Analysis
10. Magnetic Separator
11. Analysis of chloride content in Cement
12. Analysis of chlorine content in Bleaching Powder

COURSE OUTCOMES (COs)	
CO1	to get knowledge about reactor kinetics
CO2	to know about drying equipment
CO3	to get idea about heat transfer
CO4	to know about mass transfer operations
CO5	to understand about mechanical operations

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H						H	L		H		L
	CO2			L		M				L		L	
	CO3	H	L		M		H	H			H		L
	CO4								M	L			
	CO5	H		M							H		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

Self Development

U18MCAB509 SPIRITUAL, MINDFULNESS AND MEDITATION 0 0 2 0

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness. The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta -cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more) Sessions:
multiple 10-day sessions may be organized over a semester.

U18MCAB510 RELIGION AND INTER-FAITH 0 0 2 0

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under ‘book reading’.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

U18PCBT601	ANIMAL BIOTECHNOLOGY	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Molecular biology, Genetic engineering, Microbiology, Immunology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological mechanisms and their applications from the perspective of engineers

UNIT I INTRODUCTION 9

History of animal cell and organ culture-requirements for animal cell and organ culture-characteristics of animal growth in culture-substrates for cell culture and its treatment-culture media-natural and synthetic media- sterilization of glassware, equipment and culture media.

UNIT II ANIMAL CELL CULTURE 9

Equipment required for animal cell culture-isolation of animal material- disaggregation of tissue by physical and enzymatic methods- establishment of cell culture-evolution of cell lines-primary and secondary cell culture-types of cell lines-factors affecting subculture in vitro.

UNIT III SUSPENSION CULTURE 9

Cultivation of animal cells in bioreactor-Suspension cultures-methods of scaling up of cell culture-roller bottle-spinner culture-immobilized cell culture-insect cell culture-somatic and organ cell culture- organ culture on plasma clots, agar and liquid medium-whole embryo culture-production of commercially valuable products obtained from animal and insect cell culture-hybridoma technology.

UNIT IV MANIPULATION OF REPRODUCTION 9

Manipulation of reproduction in animals-artificial insemination-semen collection and storage-ovulation control-embryo transfer-multiple ovulation and embryo transfer-embryo splitting and sexing-in vitro fertilization-nuclear transplantation-problems related to test tube babies-infertility in humans.

UNIT V TRANGENICS 9

Techniques of gene transfer in animals-transgenic animals- transgenic sheep and fish-knockout mice-animal bioreactor and molecular farming-diagnosis, elimination and breeding strategies of genetic diseases-PCR based markers-xenotransplantation-mapping of human genome-bioethics in animal genetic engineering.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of animal cells and culture
CO2	to apply the techniques for animal cell culture and its types
CO3	to comprehend genetics system
CO4	to know the large scale of cell cultures in a bioreactor
CO5	To know about the immune system

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H			L	L	
	CO2	H	M	M	H	H		M		M	L		M
	CO3	H			H	H	M	H	H			L	M
	CO4	H	M		H			M			L		
	CO5	H	M	M	H	H		M	M	M	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. R.C. Dubey, 2005, "A textbook of Biotechnology", 3rd ed.

REFERENCE BOOK

1. Stewart Sell, 2004, "Stem Cells Hand Book" Humana Press.
2. John R.W. Masters, 2000, "Animal Cell culture a practical approach" Oxford University Press, 3rd ed.
3. YoshitoIkada, 2006, "Tissue engineering fundamentals and applications" Academic Press, 3rd ed.
4. John P. Fisher et al, 2007, "Tissue engineering" CRC Press.
5. Nigel Jenkins,2007, "Animal Cell Biotechnology" Hamana press, 2nd ed.
6. P. Ramadass. 2008 "Animal Biotechnology", MJP Pub.
7. Weblink: nptel

U18PCBT602	**ENZYME ENGINEERING AND TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Biochemistry, Unit operation, Chemical reaction engg.				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a knowledge about enzymes and its kinetics

UNITI INTRODUCTION **9**

Introduction- chemical nature of enzyme, coenzyme, cofactor, holoenzyme - Naming and classification- advantages and disadvantages of enzyme catalysis- historical highlights- application of enzymes in Pharma, food and other industries.

UNITII ENZYME KINETICS **9**

Mechanism of enzymatic reaction – Michaelis -Menten Kinetics, Briggs-Haldane approach – Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot - Enzyme inhibition – kinetics of competitive and non-competitive inhibition-un competitive inhibition.

UNIT III CELL GROWTH

Typical growth characteristics of microbial cells: Phase of growth curve, factors affecting growth- Monod model.

UNIT IV IMMOBILIZATION OF ENZYME AND CELL 9

Immobilization Of Enzymes: Carrier binding: physical adsorption, ionic binding, covalent binding – cross linking method- Entrapping of enzyme- Uses of immobilized enzymes. Immobilization of cell.

UNIT V PRODUCTION AND PURIFICATION

Fermentation- Types: submerged fermentation, solid state fermentation, advantages and disadvantages- scale up – scale down. Purification: precipitation, drying, crystallization.

COURSE OUTCOMES (COs)													
CO1	to understand the applications of enzymes in various fields												
CO2	to know about enzyme inhibition												
CO3	to know about kinetics of enzyme												
CO4	to know about immobilization and its applications												
CO5	to get knowledge about transport in cell												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	L	M	L	L	M
	CO2	H	M	M	H	H						L	M
	CO3	H	M		H	H		M	H	H	L		
	CO4	H	L		H			M			L	L	M
	CO5	H	M	M	H	H					L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Manjula, 2006, “Bio and Enzyme Engineering”, III Ed.

REFERENCE BOOKS

1. J.B.Bailey and D.F. Ollis, 2005, "Biochemical Engineering Fundamentals" McGraw Hill, New York.
2. Dr.Mansi El Mans, 2006 "Fermentation microbiology and biotechnology" IV Ed,
3. Weblink: nptel

U18HSBT601	BIOENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about Entrepreneurship					

UNIT I ENTREPRENEURSHIP FUNDAMENALS 9

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

UNITII DECISION MAKING AND TIME MANAGEMENT 9

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

UNIT III FINANCE AND ECONOMIC FEASIBILITY 9

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

UNIT IV COMPANY LAWS AND REGULATIONS 9

Forming company – Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9

Various business opportunities in Biotechnology – Development of Biotech companies in India – Case studies on Biotech companies and its growth

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of Entrepreneurship
CO2	to know about time management
CO3	to explore the avenues for financing a business venture
CO4	to know about various company laws
CO5	to understand Entrepreneurship in biotechnology

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	H	M	M	M				L	
	CO2	H	M	M	H	H		M		M	L	L	M

	CO3	H	M	M	H	H	L		H		L		M
	CO4	H	M			H		M			L	L	M
	CO5	H	M	M	H	H		M		M	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Exploring Entrepreneurship: D. Allan Barefield and George F. Smith, Ettmae Westbrook, Tennesse State University, 2006

REFERENCE BOOK

1. Entrepreneurship fundamentals by ZobiasKollmann International journal of Technology management,2007

U18PCBT603	**BIOPROCESS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	2	1	0	3
	Prerequisite – Chemical reaction engg., Unit operation, Animal biotechnology, Plant biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide a knowledge about various bioprocesses and the designing of reactor					

UNIT I MASS TRANSFER IN BIOPROCESS SYSTEM 9

Role of diffusion in bioprocess- Film theory- Oxygen uptake in cell culture, factors affecting cellular Oxygen demand, Oxygen transfer from gas bubble to cell, Measuring DO concentration, measurement of K_La .

UNIT II DESIGN AND ANALYSIS OF BIOPROCESSES 9

Methods of on-line and off-line biomass estimation; microbial calorimetre; Flow injection analysis- -Biosensor.-PIDcontrol, computers in Bioprocess control. Homogeneous Reaction: Production kinetics in cell culture-Substrate Uptake rate-Effect of culture condition on cell kinetics-determination of cell kinetic parameters from batch data

UNIT III MIXED CULTURE IN BIOPROCESS 9

Introduction: competition, neutralism, mutalism, commensalism, predation, parasitism- mixed culture in nature- industrial utilization of mixed culture: waste water treatment, advanced waste water treatment process – conversion of waste water to useful product

UNIT IV MODERN BIOTECHNOLOGICAL PROCESSES 9

Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures.

UNITV MODELLING AND SIMULATION OF BIOPROCESSES 9

Study of Structured models for analysis of various bioprocesses; Computer based data acquisition, Monitoring and control- Lab view software, MATLAB-SIMULINK

COURSE OUTCOMES (COs)													
CO1	to know basic concepts in bioprocess engineering												
CO2	to know different types of plant and animal cell bioreactors												
CO3	to understand basic concepts in transport phenomena in bioprocessing												
CO4	to get knowledge about bioreactor design												
CO5	to know about modern biotechnological processes												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H		L	L	
	CO2	H	M	M	H	H		M		M	L	L	
	CO3	H	M		H	H		M				L	M
	CO4	H	M		H		L				M	L	M
	CO5	H	M	M	H	H		M	M		L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Shuler and Kargi, 2004, "Bioprocess Engineering Fundamentals", McGraw Hill 2nd Ed.

REFERENCES

1. Sameer A. Zodgkar,2008, “Bioprocess” ICFAI University Press, 1st.
2. P.T. Kalaichelvan and I. Arul Pandi. 2007 “Bioprocess technology”. MJP Pub.
3. FunshangYabgJuming Tang, 2002, “Advances in Bioprocess Engineering” World scientific publishing company 2nd.
4. Syed Tanveer Ahmed Inamdar, 2007, “Biochemical Engg principles & concepts” Prentice Hall of India,2ndEdition.

U18MCTH604 Essence of Indian knowledge Tradition 2 0 0 0

ESSENCE OF INDIAN KNOWLEDGE TRADITION-Pt-1

भारतीयविद्यासार - 1

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-1 focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course contents

- Basic Structure of Indian Knowledge System: अष्टादश विद्या – ४ वेद, ४ उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्व वेद, स्थापत्य आदि), ६ वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद), ४उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health Care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai.5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan.
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan.
- Fritzof Capra, *Tao of Physics*.
- Fritzof Capra, *The Wave of Life*.
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliamad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkatta.
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, VidyanidhiPrakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, VidyanidhiPrakashan, Delhi 2016
- P B sharma (English translation),*ShodashangHridayam*

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern s

	BIOPROCESS ENGINEERING LAB 1	L	T	P	C
U18PCBT6L1	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Bioprocess Engg., Unit Operation				

	Course Designed by – Dept. of Industrial Biotechnology
OBJECTIVES: To provide basic knowledge about bioprocessing	

LIST OF EXPERIMENTS

1. Culturing of different types of microorganism
2. Estimation of biomass production.
3. Enzyme kinetics.
4. Effect of temperature on enzyme activity.
5. Effect of pH on enzyme activity.
6. Effect of substrate concentration on growth of *E.coli.*
7. Immobilization of enzyme.
8. Estimation of k_La by sulphite oxidation method.
9. Thermal death kinetics of yeast.
10. Thermal death kinetics of bacteria.

COURSE OUTCOMES (COs)	
CO1	to get knowledge on biomass
CO2	to know about enzyme kinetics
CO3	to understand about immobilization of enzyme
CO4	to get idea about mass transfer
CO5	to know about death kinetics

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	H	H	M		M		H	L		M
	CO2	H	M	M	H	H			M			L	
	CO3	H	M	M	H			M			L	L	M
	CO4	H	M	H	H	H			H	M		L	M
	CO5	H	M	M		H	L	M			L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT6L2	**PLANT AND ANIMAL BIOTECHNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Plant biotechnology, Animal biotechnology, Genetic engineering				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of plant and animal cell culture techniques

LIST OF EXPERIMENTS

1. Sterilization techniques.
2. Plant tissue culture techniques.
3. Preparation of culture medium
4. Callus induction in *Daucuscarota.*
5. Nodal bud culture.
6. Micropropagation of rose.
7. Rooting and hardening of regenerated shoots.
8. Isolation and purification of protoplast from *Aloe vera*leaf mesophyll cells.
9. Determination of protoplast viability using Evan's blue staining.
10. Protoplast fusion using PEG.
11. Preparation of synthetic seeds.
12. Isolation of Rhizobium from ground nut nodules.
13. Preparation of Rhizobialbiofertilizer.
14. Aseptic techniques for animal cell culture.
15. Establishment of a primary culture.
16. Resuscitation of frozen cell lines.
17. Subculture of adherent cell lines.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of plant biotechnology
CO2	to know about sterilization techniques
CO3	to know about plant tissue culture
CO4	to know about animal cell culture
CO5	to get a basic knowledge of the applications using plant biotechnology

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M	H	H	L	M			
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H	M	H	L	M	L		M
	CO4	H	M		H	H		M			L	L	
	CO5	H	M	M	H	H	H	H		M	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT6L3	**IMMUNOLOGY LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Immunology				

	Course Designed by – Dept. of Industrial Biotechnology

OBJECTIVES

To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers

LIST OF EXPERIMENTS

1. SDS- Slab gel electrophoresis of immunoglobulins
2. Western blotting
3. Immunoelectrophoresis
4. Countercurrent Electrophoresis
5. Rocket Immunoelectrophoresis
6. Single radial immunodiffusion
7. Double immunodiffusion
8. Dot- ELISA
9. DEAE cellulose chromatography for IgG.
10. Affinity chromatography for antiserum purification.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of immune system
CO2	to apply the techniques for antigen and antibody reaction
CO3	to give the mechanism of immune response against antigens
CO4	to know the natural barrier against pathogens
CO5	to get a basic knowledge of the applications of immunology in transplantation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	M	M		L
	CO2	H	M	M		H		H				L	
	CO3	H			H			H	M	H			M
	CO4	H	M					M				L	
	CO5	H	M	M	H	H	H	H	L		L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB611 SOCIAL AWARENESS (Artisans-relates to engg., visit to hospitals, orphanages, policestation, courts, trauma centers, consumer forums) **0 0 2 0**

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in *BanarasiSaari*, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end

of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of actions.

U18MCAB612 SOCIAL SERVICE (teach in neighborhood, adopt an underprivileged school, villagestay / visit (NSS), cleanliness drive, and skill transfer**)** **0 0 2 0**

U18PCBT701	**DOWNSTREAM PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Unit Operation, Bioprocess engineering				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES To provide basic knowledge about various separation techniques in bioprocesses					

UNIT I ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY 9

Role and Importance of downstream processing in biotechnological processes- Problems and requirements of bioproduct purification-Economics of downstream processing in Biotechnology, cost - cutting strategies, characteristics of biological mixtures, Downstream processing steps for various classes of bioproducts (high volume, low value products and low volume, high value products), physico- chemical basis of bioseparation processes.

UNIT II PRIMARY SEPARATION AND RECOVERY PROCESSES 9

Cell distribution methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods. Basic problems to calculate time of filtration, medium and cake resistance – centrifugation problem.

UNIT III ENRICHMENT OPERATIONS 9

Membrane separations (micro and ultrafiltration theory, and configuration of membrane separation equipment) applications, precipitation methods - extractive separations, aqueous two phase extraction, supercritical extraction- *insitu* product removal, integrated bioprocessing.

UNIT IV PRODUCT RESOLUTION/FRACTIONATION 9

Adsorptive chromatographic separation processes, electrophoretic techniques.

UNIT V PRODUCT POLISHING 9

Gel Permeation Chromatography, dialysis, Crystallization: nucleation, crystal growth and crystallization equioment.

COURSE OUTCOMES (COs)	
CO1	to understand the unit operations involved in downstream
CO2	to know about various separation processes
CO3	to know about the product recovery and purification techniques

CO4	to understand the unit operations involved in downstream												
CO5	to know about various separation processes												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M				L	M
	CO2	H	M	M	H	H			H	M	L	L	
	CO3	H	M		H	H		H				L	M
	CO4	H	M		H			M	L		L	L	M
	CO5	H	M	M	H	H		H		M	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. SivaShankar , 2004, “BioSeparation” III Ed,

REFERENCE BOOKS

1. Wankat P.C, 2003, "Rare Controlled Separations", Elsevier,.
2. Better PA and Cussier E, 2002,"Bioseparations", Volley,
3. Weblink: nptel

U18PCBT702	**RESEARCH METHODOLOGY AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about various instrumentation techniques and data documentation

UNIT I BASIC PRINCIPLES FOR BIOCHEMICAL ANALYSIS 9

Introduction – preparation of organ and tissue samples for analysis – cell disruption methods – physiological solutions: buffers and growth media for plants, animals and microbes –cell sorting, isolation and enumeration techniques – cryopreservation – elucidating metabolic pathways by tracer studies.

UNIT II SPECTROSCOPIC AND MICROSCOPY TECHNIQUES 9

Introduction – UV – visible spectroscopy – NMR spectroscopy – IR and Raman spectroscopy – atomic spectroscopy - Introduction to microscopy – Electron microscopy –ultramicrotome- phase contrast microscopy – Fluorescent and confocal microscopy.

UNIT III SEPARATION TECHNIQUES 9

Introduction to chromatography and electrophoresis – gel filtration – ion exchange – affinity – GC – HPLC - partition chromatography – electrophoresis of proteins and nucleic acids – immune precipitation techniques – ELISA.

UNIT IV ETHICAL ISSUES IN BIOTECHNOLOGY 9

Legal and socio economic impacts of biotech research – bio safety regulation – r-DNA guidelines- issues involved in experimenting with animals – Experimental protocol approvals – impact of GM organisms and GM foods – IPR and patents.

UNIT V DATA ANALYSIS AND DOCUMENTATION 9

Sampling concepts for statistical analysis – Mean, median, standard deviation, standard error – ANNOVA – Guidelines for thesis writing: literature collection methods – writing of abstract, introduction and review of literature – results, discussion and summary – guidelines to publish articles in journals.

COURSE OUTCOMES (COs)	
CO1	to understand the biochemical analysis
CO2	to know about spectroscopic and microscopic techniques
CO3	to know about the separation techniques
CO4	to get ideas about ethical issues related to research
CO5	to know about data documentation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H	H	H	M	M	M
	CO2	H	M	M	H	H		H			L	L	
	CO3	H	M	H	H	H		M	H		M		M
	CO4	H	M	H	H	H	H	H		M		M	H
	CO5	H	M	M	H	H		M	H		L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Keith Wilson and John Walker,2004, Practical biochemistry, Principles and techniques – Cambridge publication
2. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.

REFERENCE BOOKS

1. P. Ramadass, 2009, Research and writing: Across the disciplines, MJP publishers.

U18HSTH701	TOTAL QUALITY MANAGEMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Professional ethics& Professional Courses				
	Course Designed by – Dept of Management studies				

OBJECTIVES:
To study about the management methods involved in quality assessment of a product

UNIT I INTRODUCTION 9

Definition of Quality, Dimensions of quality, Quality planning, Quality costs- Analysis – Techniques for quality costs, Basic concepts of total Quality Management, Historical Review, Principles of TQM, Leadership- Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation

UNIT II TQM PRINCIPLES 9

Customer satisfaction-Customer Perception of Quality, Customer complaints, Service Quality, Customer Retention and, Employee Involvement- Motivation, Empowerment, Teams, Recognition Reward, Performance Appraisal, Benefits, Continuous process improvement- Jurantrlogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership- Partnering, sourcing, Supplier selection, Supplier rating, relationship development, Performance measure- Basic concepts, Strategy, Performance measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals- Measures of central Tendency and Dispersion, Population and sample, Normal curve, Control charts for variables and attributes, Process capability, Concept of six sigma, New seven management tools.

UNIT IV TQM TOOLS 9

Benchmarking- Reasons to Benchmark, Benchmarking process, Quality function Deployment (QFD)- House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)- Concept, Improvement Needs, FMEA- Stages of FMEA.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and other Quality Systems, ISO 9000:2000 Quality system- Elements, Implementation of Quality systems, Documentation, Quality Auditing,
QS 9000, ISO 14000- Concept, Requirements and Benefits.

COURSE OUTCOMES (COs)	
CO1	to study the basic definition of quality
CO2	to study the importance of customer satisfaction
CO3	to study the statistical methods of quality control
CO4	to explore the methods of benchmarking
CO5	to classify the products into quality standards
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M	L		L	L	M
	CO3	H	M		H	H	L	M		M	L	L	M
	CO4	H	M		H	H		M	M		L	L	M
	CO5	H	M	M	H	H		M		L	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. R.Ramakrishnan, 2004, "A Text Book of Total Quality Management" V Ed.

REFERENCE BOOKS:

1. Ronald A. Armstrong , 2006, "Total Quality management", Chapman and Hall,
2. Suresh Lulta, 2002"Total Quality management" Vol. I and ll, ShahTrust, Mumbai

U18PCBT7L1	**BIOPROCESS ENGINEERING LAB II**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Microbiology, Bioprocess Engineering, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide knowledge about production of bioproducts					

LIST OF EXPERIMENTS

1. Plate assay
2. Media optimization by Plackett-Burmann method
3. Solid state fermentation.
4. Production of wine
5. Estimation of alcohol concentration in wine.
6. Estimation of acid concentration in wine.
7. Production of soap and analyze its properties.
8. Production of biodiesel and analyze its properties.
9. Production of citric acid
10. Production of biofertilizer.

COURSE OUTCOMES (COs)	
CO1	to know about media formulation
CO2	to know about media sterilization
CO3	to understand about Solid State Fermentation
CO4	to get basic idea about production of natural wine and biofuel
CO5	to get basic idea about production of soap

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M				M		L	M
	CO2	H	M	M	H	H		M			L	L	
	CO3	H	M		H			M	M	L		L	M
	CO4	H	M			H	M				L		M
	CO5	H	M	M	H	H		M		L	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18PCBT7L2	**DOWNSTREAM PROCESSING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Downstream Processing, Microbiology, Unit Operation				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide knowledge about purification of bioproducts					

LIST OF EXPERIMENTS

1. Isoelectric precipitation
2. Settling characteristics
3. Flocculation (Jar Test)
4. Solids Recovery by Centrifugation
5. Paper chromatography
6. Thin Layer Chromatography
7. Ion –Exchange Chromatography
8. Affinity Chromatography
9. Gel Filtration
10. Desalting of Protein Sample by Gelfiltration
11. Sonication
12. Crystallization
13. Aqueous Two Phase Extraction Of Proteins
14. Enzyme Purification by Salt precipitation Method.

COURSE OUTCOMES (COs)	
CO1	to know about precipitation technique
CO2	to understand about flocculation and settling
CO3	to get basic idea about chromatographic techniques
CO4	to get basic idea cell disruption
CO5	to know about extraction

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M					H			L	M
	CO2	H	M	M	H	H		M		M	L		
	CO3	H	M		H	H		M			L		M
	CO4	H	M						M	L	L	L	
	CO5	H	M	M	H	H		M			L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

U18MCAB713 Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

0 0 2 0

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing different

aspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.

To help the students to understand the importance of non-verbal aspects of effective communication.

To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.

To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

Motivational lectures

Group Discussions/activities

Case Study

Games/Stimulation Exercises

Role-Playing
Mindfulness training.

U18MCAB714 NATURE CLUB (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity) **0 0 2 0**

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18MCAB815 INNOVATION **0 0 2 0**

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural

and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance.

PROFESSIONAL ELECTIVE I

U18PEBT011	**BASIC HUMAN NUTRITION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers

UNIT I NUTRITIONAL SCIENCE 9

Nutritional science – historical perspective, Importance and functions of food, Food constituents : carbohydrates, proteins, lipids

UNIT II IMPORTANCE AND FUNCTION OF FOOD 9

Importance and functions of food minerals and vitamins-their role and functions, dietary requirements of food for infants, pre-school children, adults, Pregnant and nursing mothers. Under nutrition and malnutrition.

UNIT III NUTRITION AND GENETICS 9

Nutrition and aging, Nutrition and human genetics– genetic determinants of nutrient needs, genetic abnormalities, racial differences in nutrient needs.

UNIT IV NUTRITION AND IMMUNE SYSTEM 9

Nutritional processing, the frequency of genetic abnormalities, gene stability, genetic change and carcinogenesis, genetic basis of obesity, nutrition and immune system, nutritional disorders, Food in relation to health and diseases.

UNIT V FOOD POLICIES 9

Inborn errors of metabolism. Losses of vitamins and minerals due to food processing. Food pattern. Food policies – applied nutrition programme.

COURSE OUTCOMES (COs)													
CO1	To know about importance of food												
CO2	To give knowledge about functions of food												
CO3	To understand about human nutrition and genetics												
CO4	To give knowledge about food and immune system												
CO5	To understand about various policies about food												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	M		L		M
	CO2	H		M	H	H		M			L	L	M
	CO3		M		H	H	H	M		M	L	L	M
	CO4	H	M		H	H		M	L		L	L	
	CO5	H	M	M	H	H		M		L	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Text Book of Human Nutrition by Bamji M.S., Oxford IBH.

REFERENCE BOOKS

1. Human Nutrition and Dietetics by Garrow, J.S., James, W.P. T. and Ralph, A. 2000. Churchill Livingstone, Edinburgh.
2. Human Nutrition by Barasai.
3. Food Science and Human Nutrition by Swaminathan Vol.1-2.

U18PEBT012	**MEDICAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Immunology, physiology, animal biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of biological systems and their applications from the perspective of engineers

UNIT I HUMAN GENETICS 9

Genes and Chromosome- structure, function and inheritance- Repetitive DNA in human genome- Alu, LINE and SINE repeats- Congenital abnormalities, Clinical aspects of autosomal and sex chromosomal disorders. Gene therapy and its types

UNIT II HUMAN PHYSIOLOGY 9

Structure, types and functions of tissues and muscles-Biological functions and abnormalities of digestive system, circulatory system, excretory system and central nervous system

UNIT III HORMONES 9

Hormones- structure, classification, biosynthesis and circulation in blood- Synthesis transport and biological functions of pituitary hormones, thyroid hormones and pancreatic hormones

UNIT IV CLINICAL BIOCHEMISTRY 9

Blood sugar level in diabetes mellitus- Blood pressure and cholesterol level in heart attack- Clinical significance of diagnostic enzymology- Evaluation of renal, pancreatic, liver and intestinal function

UNIT V GERM LINE ENGINEERING 9

Characteristics and diagnostic applications ofstem cell culture, organ culture, embryo culture – Artificial blood- Genetic counseling-Artificial insemination, IVF and embryo transfer in humans- Egg and sperm Preservation banks

COURSE OUTCOMES (COs)

CO1	to understand the fundamentals of genetics and their relationship to hereditary disorders
CO2	to apply the concept of plant, animal and microbial systems in discovery of medicine
CO3	to comprehend genetics and the immune system
CO4	to know the cause, symptoms, diagnosis and treatment of common diseases
CO5	to know the cause, symptoms, diagnosis and treatment of common diseases

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M

	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lehninger Nelson &Cox., 2009 "Principles of Biochemistry",5th edition
2. Chatterjee and Raneshinde2009 "Clinical Biochemistry"7th edition.

REFERENCE BOOKS

1. Guyton,2010 "Medical physiology", 12th edition
2. Devlin, 2005 "Biochemistry with clinical correlation", 10th edition
3. Weblink: nptel

U18PEBT013	**ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Microbiology, Environmental Studies				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide basic knowledge about environmental issues related to bioprocess and its remedial measures

UNIT I MICROBIOLOGY OF AIR AND WATER 9

Microbial Contamination of air-Enumeration of bacteria in air-Air Sampling devices-Air Sanitation and purification methods-Determination of Water quality-Bacteriological examination of water-indicator organisms-Water borne pathogens

UNIT II MICROBIOLOGY OF SOIL 9

Microbial flora of soil, Growth, Ecological adaptation, Interaction among soil microorganisms-Microorganisms involved in nitrogen fixation, Positive and negative role of microbes.

UNIT III DETOXIFICATION 9

Detoxification of Hazardous chemicals-Biocatalyst for pesticide Detoxification- Bioremediation: Bioremediation of Persistent chemicals-Improving catabolic processes, Biosorption of

Heavymetals-Bioremediation of oil spills, Bio deterioration of paper, Textile, sugar distilleries, diary industries.

UNIT IV BIOWASTE UTILIZATION 9

Biotechnology for biowaste conversion in to bioresources-Single cell protein, Mushroom, Algal growth for fisheries, and Aqua culture- Industrial waste recycling -Waste fueled furnaces.

UNIT V BIOSAFETY AND IPR 9

Intellectual Property, Rights in bioremediation, Biosafety-Microbiology. Medical Laboratory-Medical waste- Bioharzardous waste-Sharps-Pathological waste-Rules and Regulations-Biosafety protocol

	COURSE OUTCOMES (COs)												
CO1	to understand the microbiological concepts in air												
CO2	to know about various bioremediation techniques												
CO3	to know about biosafety												
CO4	to know about microbiology of water												
CO5	to get idea about microbiology of soil												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Bruce. E.Rittaman and Perry. L. Mc Carty, 2004, “Environmental Biotechnology-Principles and applications” McGraw Hill.
2. N. Ahmed, F.M. Quershi and D. Y.Khan, 2001, “Industrial Environmental Biotechnology” Horizon press.

REFERENCE BOOKS

1. W.D. Grand, P.E. Long Blakies, “Environmental Microbiology”, Glasgow London.
2. T. Meenambal, 2009, “Environmental Science and Engineering”.

Weblink: nptel

PROFESSIONAL ELECTIVE II

	DAIRY TECHNOLOGY	L	T	P	C
U18PEBT021	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess, Food process engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To explore the different techniques involved in diary science

UNIT I INTRODUCTION 9

Market milk – market milk industry in India – Collection, Transportation of milk- milk reception – Clarification- Chilling – Homogenization – Sterilization- Pasteurization – UHT processing of fluid milk – aseptic packaging – Special milk – Clean Milk Production – Grading of Milk.

UNIT II DAIRY PRODUCTS 9

Fat rich Dairy products – Cream, preparation, types, defects – Butter preparation, types, defects – Butter Spreads- Preparation of Ghee , defects in ghee- AGMARG standards- Frozen dairy products – Manufacture of Ice Cream: Ingredients and their role, types and defects, Judging and grading of Cream, Butter and Ice Cream. Concentrated and dried milk Products- Condensed milk – Evaporated milk – BIS standards –defects- Manufacture of milk powder- whole milk, skim milk powder- spray drying – whey powder- whey protein concentrates- biodiesel from whey.

UNIT III CHEESE AND FERMENTED PRODUCTS 9

Cheese and fermented products- Classification- preparation of cheddar, cottage, mozzarella and processed cheese- cheese spreads- ripening – accelerated ripening- action of rennet – microbial rennet – milk coagulating enzymes – defects in cheese, causes and control measures- fermented milk products – Manufacture of Dahi- yogurt- shrikhand- therapeutic effects of fermented milk products- functional foods- probiotics - prebiotic -symbiotic.

UNIT IV INDIGENOUS MILK PRODUCTS 9

Indigenous milk products and by products – Channa – Chana based products – preparation of Khoa and Khoa based products – peda- Gulabjamun – Rasagolla – preparation of paneer – kulfi – utilization of skim milk – butter milk – whey.

UNIT V QUALITY CONTROL AND QUALITY ASSURANCE 9

Introduction- Cleaning and Sanitation – Sterilization agent- Can Washing- Manual & Mechanical washing – Washing treatments – Cleaning in Place Programmes (CIP) – Packaging of milk & Milk Products – Function- Packaging Material – Filling system – Aseptic Packaging

COURSE OUTCOMES (COs)	
CO1	To study the process involved in the marketing of milk
CO2	To learn about the processing of butter and skim milk powder
CO3	To understand the steps involved in cheese making
CO4	To learn to prepare milk sweets
CO5	To explore the quality control methods involved

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M				L	M
	CO2	H		M		H		M			L	L	M
	CO3		M		H	H				L			M
	CO4	H			H			M	L		L	L	M
	CO5	H		M		H	L	M			L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Sukumar de, 2000, "Outlines of Dairy Technology" Oxford Univ press
2. Bhattacharya A and Rajan R P, 2002 "An over view on Yogurt, beverage and food world".

REFERENCE BOOKS

1. Andrews,2004, "Biochemistry of Milk Products" Black rabbit books, 2nd ed.
2. Ananthakrishnan C P., and Padmanabhan " The technology of milk processing" Shrilakshmi publications.

U18PEBT022	**CANCER BIOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Basic Biotechnology, Molecular biology, Genetic engineering
	Course Designed by – Dept of Industrial Biotechnology

OBJECTIVES

To provide a basic understanding of biological mechanisms and their applications from the perspective of engineers

UNIT I INTRODUCTION 9

Fundamentals of Cancer Biology- Cell Cycle- regulation of cell cycle, modulation in cell cycle in cancer, Changes in signaling molecules- Effects on receptors, signal switches, Classification of stages of cancer- metasis, Metastatic cascade, common features of cancer cells, Tumor suppressor genes, Cancer genetics.

UNIT II CARCINOGENESIS 9

Principles of Carcinogenesis- Carcinogens- Targets of carcinogens, Chemical carcinogenesis, Physical carcinogenesis- X-ray radiation and radiation carcinogenesis, Viruses and Cancer, Diet and cancer

UNIT III MOLECULAR BIOLOGY OF CANCER 9

Molecular biology of cancer- Oncogenes, Identification of oncogenes, Retroviruses and oncogenes, growth factors and Growth factor receptors as oncogenes.

UNIT IV TYPES OF CANCER 9

Different sites and forms of cancer, Lung, Liver, Breast, Cervical, Blood, Prostrate, Ovarian cancers- Epidemology, causes, mutations, and features

UNIT V CANCER THERAPY 9

Cancer therapy- Cancer Immunology, Different forms of cancer therapy- Chemotherapy, radiation, Detection of cancers, advances in cancer detection and therapy, Gene therapy.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of cancer cells and its constituents
CO2	to find the environmental factors related to cancer
CO3	to know the concept of carcinogenesis and carcinogenic agents
CO4	to know the cause, symptoms, diagnosis and treatment of cancer
CO5	to give a basic knowledge of the different types of cancer

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H	M	M	H	M		M		H	L	L	M
	CO2	H	M	M	H	H		M	H				L
	CO3	H	M		H	H		M	M	M	L	L	
	CO4	H	M		H	H	L	M				L	H
	CO5	H	M	M	H	H		M	L	L	L		
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lewis J.Kleismith,2006, "Principles of Cancer Biology" Pearson Benjamin Cummings.
2. Raymond W. Ruddon,2007, "Cancer Biology" Oxford University Press, 4th.

REFERENCE BOOKS

1. G.M. Cooper,2008, "Oncogenes" Jones &barlett Publisher, 1st.
2. 'Molecular Cell Biology' Darnell, Lodish& Baltimore, IV Ed,2004
3. An Introduction to cellular and Molecular Oncology- Oxford University Press, 2003
4. Genes VII and VIII – Benjamin Lewin, 2004
5. Weblink: nptel

	FERTILIZER TECHNOLOGY	**L**	**T**	**P**	**C**
U18PEBT023	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology				
	Course Designed by – Dept. of Industrial Biotechnology				
OBJECTIVES: To provide basic technologies involved in food processing					

UNIT I NITROGENOUS FERTILIZER 9

Introduction – production of fertilizer- nitrogenous fertilizer, phosphatic fertilizer - feed stock materials for nitrogenous and phosphatic fertilizer.

UNIT II FERTLIZER PRODUCTS 9

Production of fertilizer products: Ammonia by steam reforming process, Nitric acid by ammonia oxidation process – Sulfuric acid by double absorption process – phosphoric acid.

UNIT III PROCESS AND STORAGE 9

Manufacturing, handling and storage of Ammonium nitrate, Ammonium sulfate, Calcium ammonium nitrate, Urea, Ammonium chloride -single super phosphate – Triple super phosphate.

UNIT IV POTASIC FERTILIZER 9

Manufacture of Potasic fertilizer – potassium sulfate – complex fertilizer – ammonium phosphate fertilizer – urea ammonium phosphate.

UNIT V BIOFERTILIZER 9

Developments in the technology of complex fertilizer production – pipe reaction – granulation process – fertilizer mixtures – biofertilizers.

TEXT BOOK

1. "Hand book on Fertilizer Technology" Tata McGraw Hill , III Ed, 2004

COURSE OUTCOMES (COs)													
CO1	To know about nitrogenous fertilizer												
CO2	to understand about fertilizer products												
CO3	to know about process and storage of fertilizer												
CO4	to know about potassic fertilizer												
CO5	to know about biofertilizer												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M				L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H			H				L	M	L		M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

PROFESSIONAL ELECTIVE III

U18PEBT031	**FOOD PROCESS TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology, Heat and mass transfer				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To provide basic technologies involved in food processing

UNIT I PHYSICAL TREATMETN OF FOOD 9

Thermal, electrical and rheological properties- Heat processing- Methods of applying heat to food - sterilization - Thermo bacteriology- dehydration and drying - free moisture - equilibrium moisture content- water activity- classification of dryers- tray, and freeze dryers, osmotic dehydration - foam mat drying- extrusion coking.

UNIT II BLENDING METHODS 9

Mixing of solids, Pastes and liquids - Characteristics of mixtures-Blending -emulsification- equipments - liquid, pastes, and plastic masses - dry powders - criteria of mixer effectiveness- mixing index

UNIT III PRESERVATION OF FOOD 9

Concentration - freeze concentration - freezing and storage of frozen products - low temperature preservation - irradiation of food products - microwave heating - dielectric heating of foods.

UNIT IV DAIRY FOODS 9

Physics and chemical properties of milk and their effect on design - heaters - coolers -heat exchange equipments - storage tanks - can washers - pasteurization - principles and methods - equipments - LTLT - HTST - UHT pasteurization - CIP unit -Homogenization - Theory and working of homogenizers - bottle fillers and cappers -cream separation - principles - types of separator - classifiers - butter churns - cheese plant equipments - ice cream freezers - drying equipments - drum drier and spray drier -membrane concentration equipments.

UNIT V FOOD MICROBIOLOGY 9

Food microbiology: food spoilage, food borne diseases, infections, intoxifications, utilization of microorganisms in food industries, Nutraceuticals. Quality control, Case studies on biotechnology in the evaluation of food quality.

COURSE OUTCOMES (COs)	
CO1	To know about preservation techniques
CO2	to understand basic concepts in sterilization of food products
CO3	to know about various dryers
CO4	to know about the mixing equipment for various products
CO5	to know about various preservation techniques for food products

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	L	M	L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. Lehninger and Beverlov, 2002, "Food Process Engineering". Reidal Publishing Co. Holland
2. Yin H.Hui, 2006, "Handbook of food science, technology and engineering" Wiley, New York, 2nd ed

REFERENCE BOOKS

1. Tucker & Woods, 1995, "Enzymes in food processing" Springer, 5th ed.
2. Hamm &Hammilton, 2000, "Edible oil processing" Academic Press 5th ed
3. Fellows, 2009, "Food processing technology" 21th ed
4. Heldman, 2007,"Hand book of food engineering" CRC Press 2nd ed
5. P.G. Smith, 2003, "Food Process Engineering" Academic Plenum Pub, New York 1st ed
6. Srilakshmi,2005, "Food Science" MJP Publiashers, 3rd ed
7. Weblink: nptel

U18PEBT032	**PROTEOGENOMICS AND BIOINFORMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioorganic chemistry, Basic Biotechnology				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers

UNIT I BIO INFORMATICS **9**

Introduction to bioinformatics – Biological Databases,-Sequence databases-Structural databases – Data mining and Applications –Sequence Database search – FASTA – BLAST.

UNIT II GENOMICS 9

Genome – Organization ofEukaryotic genome – Mapping strategies – Genetic mapping and physical mapping – Genome mapping – Human genome project – Gene expression – Microarrays

UNIT III SEQUENCE TECHNOLOGIES 9

Alignment of multiple sequences – Methods and applications – Tools for sequence alignment. Gene identification Methods and applications – Tools for gene prediction – Methods and applications

UNIT IV PROTEOMICS 9

Lifecycle of protein – Classification and structure visualization techniques – Protein databases – Prediction of primary and secondary structure – Prediction of 2D and 3D structure

UNIT V TOOLS OF PROTEOMICS 9

Separation of proteins by SDS-PAGE, IEF – Mass spectrometry –MALDITOF – Peptide mass finger printing – Peptide sequence analysis – SALSA and TMS.

COURSE OUTCOMES (COs)	
CO1	to understand the classification of biological databases and its role in research
CO2	to apply the concept of genomics of different organism, gene expression and mapping situations
CO3	to know the tools for gene identification and prediction
CO4	to know the structural elucidation and prediction of proteins
CO5	to get a basic knowledge of techniques related to proteomics

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	M		L	L	M
	CO4	H	M		H	H		M		M	L	L	M
	CO5	H	M	M	H	H		M	L		L	L	M
3	Category	PC											

4	Approval	Academic Council, Aug 2018

TEXT BOOK

1. S.C. Rastogi, 2007, "Bioinformatics methods and applications ", Prentice – Hall of India Publication

REFERENCE BOOK

1. Lesk AM, 2007, "Introduction to Genomics", Oxford University Press, IV Ed.
2. Brownstein M.J, 2003, "Functional genomics methods and protocols", Humana Press, III ed.

U18PEBT033	**WASTE MANAGEMENT TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic of waste and its disposal				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES

To give a basic knowledge of waste handling and utilization

UNIT I INTRODUCTION 9

Introduction: Definition and Classification- Disposal methods: Land fill and Incineration – Recycling methods: biological reprocessing and Energy recovery-. Avoidance and Reduction Methods- Waste handling and Transport – Waste management Concepts

UNIT II AGRICULTURAL WASTE 9

Introduction- Waste Consistency- Waste Management Function: Production ,Collection, Storage, Treatment , Transfer, Utilization- Waste Management system Design – Waste Management System: Dairy Waste, Beef Waste, Swine Waste, Poultry Waste, Other animal – Municipal and Industrial Sludge- Food Processing – Agri-Chemical Waste Management- Handling.

UNIT III BIOMEDICAL WASTE 9

Introduction- Overview – Characterization of Medical Waste- Waste Generation Methodology – Sterilization- Chemical Disinfection – Thermal Inactivation- Irradiation- Microwave Treatment – Grinding and Shredding – Compaction- Current Practice – Standards .

UNIT IV INDUSTRIAL WASTE MANAGEMENT 9

Paper and Pulp Industry – Leather Industry – Cement Industry – Chemical Industry – fertilizer Industry – Pharmaceutical Industry – Textile industry – Iron and Steel industry – Mining Industry – Lignite industry – Petroleum Industry – Nuclear Industry.

UNIT V REMEDIAL MEASURES 9

Bioremediation – Phyto-remediation- Recycling of Plastic and Paper

COURSE OUTCOMES (COs)													
CO1	to understand the various types of waste												
CO2	to know the various technologies to handle the waste material												
CO3	to know the remedial measures for waste disposal												
CO4	To get idea about industrial waste management												
CO5	To know about bioremediation of waste												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

REFERENCE BOOKS

1. Agricultural Waste Management Hand Book by USDA, III Ed,2005
2. Industrial Biotechnology Problems and Remedies by Indu Shekhar Thakur, VI Ed,2006

PROFESSIONAL ELECTIVE IV

	FOOD SAFETY AND QUALITY CONTROL	**L**	**T**	**P**	**C**
U18PEBT041	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Food process engineering, Microbiology, Bioprocess Engineering, Biochemistry				
	Course Designed by – Dept. of Industrial Biotechnology				

OBJECTIVES: To know about the safety regulations of food industries

UNIT I FOOD SAFETY REGULATIONS 9

History of food regulations in India- Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973),Edible Oils Packaging, 1998, Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

UNIT II FOOD SAFETY MANAGEMENT 9

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

UNIT III FOOD QUALITY MANAGEMENT 9

Principles of food quality assurance, total quality management (TQM)–good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

UNIT IV MICROBIAL CONTAMINATION 9

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry Food safety and Standards Act 2006: salient provision and prospects

UNIT V FOOD SAFETY STANDARDS 9

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarious commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

COURSE OUTCOMES (COs)	
CO1	To study the history of food safety regulations
CO2	to know about food adulteration
CO3	to understand about food management practices

CO4	to get basic idea about food hygiene												
CO5	to get basic idea about microbial quality control												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOKS

1. V. K. Kaushik (1999),Nutrition And Food Safety, Neha Publishers
2. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

REFERENCE BOOKS

1. Andre, Gordan (2015), Food Safety and Quality Systems in Developing Countries, Elsevier
2. YasmineMotarjemi(2013), Food Safety Management, 1st Edition, Elsevier.

	STEM CELL AND TISSUE ENGINEERING	**L**	**T**	**P**	**C**
U18PEBT042	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Animal Biotechnology, G3enetic Engineering, Molecular Biology				
	Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of stem cells and their applications from the perspective of engineers					

UNIT I ORIGIN AND CHARACTERISTICS OF HUMAN STEM CELLS 9

Origin and characteristics of human stem cell, plasticity of human somatic stem cells research, Novel stem cell based therapies, Scientific and technical obstacles to overcome before realizing the potential clinical uses of novel human stem cell based therapy, Cord blood,-Stem cell marker.

UNIT II HUMAN EMBRYONIC STEM CELL RESEARCH 9

Possible sources for human embryonic stem cell, growing human ESC in laboratory, Current advantages and limitations of hESC and human somatic cells-Examining the need for new hES cell lines, Developments regarding establishment of human stem cell banks and registries.

UNIT III ISOLATION AND IDENTIFICATION OF STEM CELLS 9

Preparation of complete human neuroculture, Culturing and subculturing human neurospheres, Differentiation of cells from human, neurospheres into neurons, astrocytes and oligodendrocytes; Immunolabelling procedures

UNIT IV GENE THERAPY 9

Possibilities to overcome immuno-rejection responses in stem cell therapy, Haematopoietic stem cell transplantation - A new therapy for autoimmune disease, Prenatal diagnosis of genetic abnormalities using fetal CD34+ stem cells, Stem cells in treatment for major diseases and reparative medicine, ESC a promising tool for cell replacement therapy, germ line therapy.

UNIT V TISSUE ENGINEERING 9

Basic principles and consideration - Cell type and source, Metabolic requirements of cells, Reconstruction of connective tissues, Reconstruction of epithelial or endothelial surfaces - cells embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Bioreactor design on tissue engineering - Hollow fiber systems, Microcarrier based systems-Tissue engineering of the liver.

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of stem cells and its types
CO2	to apply the techniques for preservation of stem cells
CO3	to give the information about embryonic stem cell research
CO4	to know the role of stem cells in medicine
CO5	to get a basic knowledge of the applications of stem cells in gene therapy

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	L		L		M
	CO2	H	M	M	H	H		M		H	L	L	M
	CO3	H	M		H	H		M				L	M
	CO4	H	M		H	H			H		L	L	
	CO5	H	M	M	H	H		M		M		L	M

3	Category	PC
4	Approval	Academic Council, Aug 2018

TEXT BOOK

1. R.C.Dubey, 2004, "Text book of Biotechnology" 3rd Ed.

REFERENCE BOOKS

1. SudhaGangal , 2002, "Principles and Practice of Animal tissue culture", IV Ed
2. P. Ramadass , 2008, " Animal Biotechnology" MJP pub.
3. Weblink: nptel

U18PEBT043	**BIOFUEL TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Bioprocess				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES:

To provide a basic understanding of fuel and biofuel concepts and its production techniques

UNIT I INTRODUCTION 9

Introduction – Potential of biomass – biofuel policies: Policy in EU – Biofuel standardization – International Trade of biofuel-Biofuel Life Cycle – Energy balance -& Efficiency of biofuel – Biofuel emission: Greenhouse gas emission – Vehicle emission standards – other environmental Impacts of Biofuel – economy of biofuel – Consideration of Co-Products.

UNIT II BIOETHANOL 9

BioEthanol – Feed stock production: sugar Crops, Starch crops , Cellulosic feed stock – Bioethanol Production : Sugar to ethanol Process, Starch to ethanol process, Cellulose to Ethanol Process – Distillation & Dehydration process – Properties – Application –standardization – Energy balance – Bioethanol Emission : Greenhouse gas emission, toxic exhaust emission – Other environmental impacts: water issues, land use & biodiversity, human Health.

UNIT III LIPID BIOFUELS 9

Lipid derived Biofuel – Feed stock production -: Oil seed crops, Micro algae , Animal fats, waste oils – Fuel production : Oil Extraction , Oil Refining, Transesterification – Properties & Use :

Properties of Pure Plant Oil (PPO) , Properties of Biodiesel – Application – Energy balance – Emissions of lipid biofuel – Other Environmental Impacts – Economy.

UNITIV BtL FUELS 9

BtL Fuel: Feed Stock production – BtL production – Gasification, Gas Cleaning – Synthesis process-Biohydrogen: Processing – Use – The Future of Biofuel.

UNIT V BIOMETHANE 9

Biomethane – Feed stock Production- BioMethane Production : Digestion Process- Digester types- biogas Purification – Properties & Use – Application – Standardization – BioMethane Emission – Other Environmental Effects – Economy.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of biofuel												
CO2	to know the various source for biofuel												
CO3	to apply the technique in large scale												
CO4	to study about lipid derived biofuel												
CO5	to give a basic knowledge of the applications biofuel												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H		M		H		L	M	M
	CO2	H	M	M	H	H		M		H			
	CO3	H	M		H	H		M	M		M	L	M
	CO4	H	M		H		M	M		H			
	CO5	H	M	M	H	H			M			M	H
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Dominik Rutz& Rainer Janssen, 2007, “Hand Book on BioFuel Technology”, II ED.

REFERENCE BOOKS

1. SoetaertErlckI. Vandamme, 2009, “Biofuels” John Wiley & Sons, 1st.ed.
2. Hand Book on “ BioFuel Technology” by Dominik Rutz& Rainer Janssen, 2007
3. “Bioprocess technology” – P.T. Kalaichelvan and I. Arul Pandi. 2007. MJP Pub.

4. CayeDrapcho, John Nghiem, Terry Warker, 2007, "Biofuel Engg& Process Technology" Mc-Graw Hill, 1st ed

PROFESSIONAL ELECTIVE V

	BIOREACTOR DESIGN	L	T	P	C
U18PEBT051	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Fermentation Techniques, Chemical reaction engineering, Bioprocess engineering				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide knowledge about the designing of reactor

UNIT I REACTOR ENGINEERING 9

Reactor engineering in Perspective- Mechanical aspect of bioreactor design: Guidelines for configurations:- Batch Bioreactor- Fluidized bed reactor- Air lift bioreactor- Trickle bed bioreactor- Hollow fibre reactor- and wave bioreactor (Disposable bioreactor) Practical considerations for bioreactor construction

UNIT II BIOREACTORS AND DESIGN CONSIDERATIONS 9

Batch reactors; Continuous Stirred Tank Bioreactors (Chemostat); Enzyme Catalysis in Chemostat; Age Distribution Models; Fed Batch Reactors; Recycle Systems, Design of airlift bioreactors

UNIT IIISELECTION, SCALE-UP, OPERATION AND CONTROL 9

Process scale up - general considerations-Simple calculation for scale up and scale down.Strategies for bioreactor design for cost-determining factors

Fermentation Control Introduction to control: control loop, analogue and digital control, control algorithm-PID control, time-proportional control. Physical control of fermentation

UNIT IV MODELING AND SIMULATION OF FERMENTATION PROCESSES 9

Unstructured Non-Segregated Model-substrate limited growth-Models with growth inhibitors-Logistic equation-growth models for filamentous organism.

Modeling, digital simulation, digital simulation programming languages, ISIM(interactive simulation language)

UNIT V PLANT AND ANIMAL CELL BIOREACTORS 9

Introduction, plant cells: plant cell bioreactors, characteristics of plant cell suspensions, plant cell bioreactor requirements, plant cell bioreactor design, plant cell bioreactor operation, alternative cultures for plant cells. Animal cells: Animal cell bioreactors, animal cell bioreactor operation, animal cell bioreactor design

TEXT BOOKS

1.Michael L.Shuler&Fikret Kargi.,2008,"Bioprocess Engineering",Editedby,Prentice-Hall of India Pvt New Delhi

2.Paulin M. Doran.,2011," Bioprocess Engineering Principles",Academic Press

REFERENCE BOOKS

1. Scragg A.H.,2002, "Bioreactors in Biotechnology", Edited by, Ellis Horwood Limited, England
2. Bailey and Ollis, 2000, "Biochemical Engineering Fundamentals", McGraw Hill 3rded.
3. Stanbury PF,1984, "Principles of fermentation technology" SS Hall, 2nd.
4. Mansi El Mansi.2003 "Fermentation Microbiology & Biotechnology".IVEd.
   Weblink: nptel

U18PEBT052	BIOPHARMACEUTICAL TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biochemistry, Bioorganic chemistry, Basic biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES:

To provide a basic understanding of pharmaceutics and their applications from the perspective of engineers

UNIT I INTRODUCTION 9

Introduction to bio pharmaceutics – Various route of drug administration- drug absorption, factors influencing drug absorption from the gastrointestinal tract.

UNIT II FORMULATION OF DRUGS 9

Manufacturing Principles - Compressed tablets - wet granulation - Dry granulation or slugging - Direct compression - Tablet presses formulation - Coating - Pills - Capsules - Parental solutions - injections

UNIT III PHARMACODYNAMICS 9

Binding of drugs to blood components - tissue binding of drugs - factors affecting protein drug binding - significance of protein/tissue binding of drugs - kinetics of protein-drug binding

UNIT IV BIOTRANSFORMATION 9

Biotransformation - drug metabolizing enzymes - phase I reactions - phase II reactions - first pass effect - factors affecting biotransformation of drugs - bio activation and tissue toxicity.

UNITV PRODRUGS 9

Bio precursor prodrugs - carrier prodrugs - application of prodrug design: - enhancement of bioavailability - site specific drug delivery - limitations of prodrug design.

COURSE OUTCOMES (COs)													
CO1	to understand the fundamentals of drugs and its absorption												
CO2	to know the manufacturing process of drugs and its bioavailability												
CO3	to comprehend drugs and its binding mechanism												
CO4	to know the drug metabolism and biotransformation												
CO5	to get a basic knowledge of the applications of prodrugs in biological systems												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	H	H	L	L	
	CO2	H	M	M	H	H					H	L	M
	CO3	H	M		H	H		M	M	M	M		M
	CO4	H	M			H		M				L	
	CO5	H	M	M	H	H		M	L	L			M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Brahmankar, D.M. "Biopharmaceutical and pharmacokinetics: A Treatise", VallabhPrakashan, 1995.

REFERENCE BOOKS

1. Remington's Pharmaceutical Sciences, Mack Publishing and Co.,
2. Weblink: nptel

U18PEBT053	**INDUSTRIAL WASTE TREATMENT AND**	**L**	**T**	**P**	**C**

	DISPOSAL				
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Environmental biotechnology, Waste management				
	Course Designed by – Dept of Civil Engineering				

OBJECTIVES

To provide knowledge on sources and characteristics of industrial wastewater, techniques and approaches for minimizing the generation and application of physio chemical and biological treatment methods for recovery, reuse and disposal

UNIT I INTRODUCTION 9

Effects of industrial wastes on streams, land and air, waste water treatment plants, water quality criteria – effluent standards : Process modification, method and material changes, housekeeping etc., to reduce water discharges and strength of the waste and established recovery methods for bye products within the plant operations.

UNIT II CHARACTERISTICS OF WASTE 9

Characteristics of major industrial waste water (liquid wastes) Chemical Industries: Petrochemicals & refineries, pharmaceuticals. Apparel Industries: Textile, synthetic fibres, leather, paper-Agro Industries: Fertilizer Food Industries: Heat – packing pickles, canning poultry and eggs, distillers, sugar. Metallurgical Industries: Thermal power station, nuclear power plants.

UNIT III WASTE TREATMENT 9

Conventional methods of treatment and disposal of industrial wastes-Equalization and neutralization, separation of solids – sedimentation and filtrations

UNIT IV BIOLOGICAL TREATMENT 9

Removal of organic contents: Biological treatment methods, aerobic and anaerobic, digestion, tickling filters, stabilization ponds, activated sludge process – oxidation ditch.

UNIT V PHYSICOCHEMICAL TREATMENT 9

Physico Chemical Treatment Method – Neutralization, coagulation, flocculation, adsorption and precipitation. Combined treatment of industrial and municipal wastes.

COURSE OUTCOMES (COs)	
CO1	Have a fundamental knowledge of the effluent discharge standards and waste minimization technology

CO2	Have a well-founded knowledge of characteristics of industrial wastewaterand treatment methods
CO3	Acquire knowledge about conventional methods of treatment for industrial waste
CO4	Understand various biological treatment methods
CO5	Have a fundamental knowledge of combined treatment of industrial and municipal wastes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M	H	M	L		L	L	M
	CO2	H	M	M	H	H	H	M		H	L	L	M
	CO3	H	M		H	H	M	M	H		L	L	M
	CO4	H	M		H		H	M	M	M	L	L	M
	CO5	H	M	M	H	H	M	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. EckenfalderW.W,"Industrial Water Pollution Control", McGraw Hill, New York, 1989

REFERENCE BOOKS

1. Arceivala S.J &ShyamAsolekarR,"Waste Water Treatment and Pollution Control Tata McGraw Hill, 1998.
2. Nelson Leonard Nemerow, "Theories and practice of industrial waste treatment", Addison Wesley Pub. Co., 1963
3. World Bank Group "Pollution prevention and Treatment Hand Book" World Bank and UNEP Washington DC, 1998

PROFESSIONAL ELECTIVE VI

U18PEBT061	**FERMENTATION TECHNOLOGY AND APPLICATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Process engineering in biotechnology, Microbiology				

	Course Designed by – Dept. of Agricultural Biotechnology

OBJECTIVES:

To provide a basic knowledge of Biological processes.

UNIT I INTROCTION TO FERMENTATION

History of fermentation - medium optimization - Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.

UNIT II INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO_2- cell mass, cell number, solid-substrate fermentation and its applications.

UNIT III FERMENTATION TECHNIQUES 9

Fermentation- Definition & types - Submerged and Solid state. Fermentors & its types (Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation.

UNIT IV FERMETATION PRODUCT 9

Production of beverages – beer and wine- vitamin B12–Antibiotics- penicillin - Bakers yeast, Details of mushroom development-Oyster (Pleurotus) and Button (Agaricus) mushroom.

UNIT V DOWNSTREAM PROCESSING 9

Downstream process- Intercellular and extracellular- Centrifugation, filtration, Floatation-solvent extraction, precipitation- cell disruption- physical and Chemical methods.

COURSE OUTCOMES (COs)	
CO1	To understand the development of bioprocess techniques.
CO2	To know about the instrumentation and control for bioprocess operations
CO3	To get idea about media formulations
CO4	To know about stoichiometry of bioprocess.
CO5	To know about various bioreactors

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		H			L	L	
	CO2	H	M	M	H	H		M		M	L		M

	CO3	H			H	H	M	H	H			L	M
	CO4	H	M		H			M			L		
	CO5	H	M	M	H	H		M	M	M	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Stanbury P T and Whitaker 1984, Principles of Fermentation Technology,

Pergamon Press. NY

REFERENCE BOOKS

1. Casida, L E JR 1968 Industrial Microbiology. New Age International Publishers.

2. Prescott and Rehm 1979. Industrial Microbiology. Wiley and Sons.

U18PEBT062	**NANOBIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Molecular biology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES:

To provide basic knowledge about nanoscience involved in biotechnology

UNIT I INTRODUCTION 9

Introduction to nanobiotechnology –Synthesis & characterization of nanoscale molecules – Nanoarchitecture – Fabrication technologies – Self-assembly systems

UNIT II NANODEVICES 9

Inorganic nanoscale systems – Properties of fullerene carbon nano tubes – Quantum dots – Gold nanoparticles – Magnetic nanoparticles – Nanopores.

UNIT III NANOBIOMATERIALS 9

Interaction of nanomaterial and biomolecule: Classification of biomaterial – Bone cement – Biointeractive hydrogels – Nanobiomaterials: Collagen, Dextran, Hydroxyapetite – Role of nanoparticles in blood clotting – Nanomotors.

UNIT IV MICROBIAL NANOTECHNOLOGY 9

Nanotechnology and microorganisms: PHA – Magnetosomes – Cyanophycin inclusions – Alginates – Bacteriophages – Bacterial spores – S-layer proteins – Bacteriorhodopsin.

UNIT V NANOMEDICINE 9

Nanotechnology in drug delivery – Nanoscale devices for drug delivery: Micelles, Nanocapsules, Lipososmes, Dendrimers –Nanobiosensors – Nanotechnology for cancer diagnosis & treatment.

COURSE OUTCOMES (COs)	
CO1	to understand the various nano devices
CO2	to know about nano molecules
CO3	to learn the applications of nanotechnology in proteins, lipids and nucleic acids
CO4	to know about the applications of nanotechnology in microbiology
CO5	to know about nano technology involved in drug delivery system

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		H				L	M
	CO2	H	M	M	H	H		M			L		L
	CO3	H	M		H	H		M			L	L	M
	CO4	H	M		H	H					L	L	M
	CO5	H	M	M	H	H		M				L	L
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. K.K. Jain , 2006, "Nanotechnology in molecular diagnostics – current techniques & applications", Horizon Bioscience publishers

REFERENCE BOOKS

1. Microbial bionanotechnology:Biological Self-Assembly Systems and Biopolymer-Based Nanostructuresed: Bernd Rehm, Taylor and Francis, 2006
2. Applications of nanoparticles in biology & medicine O.V. Salata, Journal of nanobiotechnology (2004),
3. Weblink: nptel

U18PEBT063	**BIOREMEDIATION TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Bioprocess technology, Microbiology
	Course Designed by – Dept. of Industrial Biotechnology

OBJECTIVES:

To provide basic knowledge about the bioremediation techniques

UNIT I BIOREMEDIATION **9**

Types of Bioremediation, Factors affection Bioremediation .Bioremediation Mechanisms.Limitations of Bioremediations. Microbes for Bioremediation :Essential Chararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques : Insitu & Exsitu bioremediation techniques. Phytoremediation

UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES **9**

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation.

UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS **9**

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

UNIT IV NUCLEAR WASTE BIOREMEDIATION **9**

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION **9**

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance &tolerance ;Microbial transformation; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – Biosurfactants. Advantages of biosurfactants over chemical surfactants- Biotechnology and oil spills; Improved oil recovery.

COURSE OUTCOMES (COs)

CO1	To know about the types of bioremediation
CO2	to understand basic techniques in bioremediation
CO3	to know about bioremediation of chlorinated compounds
CO4	to know about the nuclear waste bioremediation
CO5	to know about remediation of oil spills

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M		L	L	L	M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M	L	M	L	L	M
	CO4	H	M		H	H		M			L	L	M
	CO5	H	M	M	H	H		M	M	H	L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

REFERENCE BOOKS

1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles and Applications"* McGraw-Hill, 2001.
2. Phillip L. Buckingham , Jeffrey C. Evans," *Hazardous Waste Management"* Waveland Pr Inc; Reissue edition 1, 2010.
3. S. K. Agarwal, *"Environmental Biotechnology*", APH Publishing, 2000
4. Martin Alexander, "*Biodegradation & Bioremediation",* Academic press, 1999.
5. Karrely D., Chakrabarty K., Omen G.S, "*Biotechnology and Biodegradation*", Portfolio Pub. Co., 1990.
6. P. Rajendran, P. Guansekaran, "*Microbial Bioremediation*", Mjp Publishers, 2011.

OPEN ELECTIVE OFFERED BY THE DEPARTMENT OF IBT FOR OTHER DEPARTMENT

U18OEBT001	CHEMICAL PROCESS INDUSTRIES	L	T	P	C
	Total Contact Hours – 45	3	0	0	3

	Prerequisite – Bioprocess Engineering, Principles of chemical engineering
	Course Designed by – Dept of Industrial Biotechnology

OBJECTIVES

To provide a basic understanding of chemical process industries

UNIT I FERTILIZER AND BIOFERTILIZER INDUSTRIES 9

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries - Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate- Biofertilizer.

UNIT II PULP AND PAPER INDUSTRIES 9

Pulp – Methods of production: sulphite and sulphate- Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production- wet process.

UNIT III SUGAR AND STARCH INDUSTRIES 9

Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivatives: dextrin.

UNIT V OIL, SOAPS AND DETERGENTS INDUSTRIES 9

Oil- constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils- Soap: definitions- continuous process for the production of fatty acids, glycerine and soap- production of detergents- Enzymes in detergent.

UNIT V DYES AND PIGMENT INDUSTRIES 9

Introduction- types of dyes- classification-Production: azo dyes, natural dye- Pigments

COURSE OUTCOMES (COs)	
CO1	to understand the fundamentals of process industries
CO2	to apply the concept biotechnology in process
CO3	to classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers.
CO4	to know the production processes
CO5	to know the biotechnology processes

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	M	M	H	M		M			L	L	M

	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		L	L	L	M
	CO4	H	M		H	H		M	L		L	L	M
	CO5	H	M	M	H	H	L	M			L	L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

production.

TEXT BOOK

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.

2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001. 1

REFERENCE BOOKS

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.

2. Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd

U18OEBT002	**BIOPROCESS ECONOMICS AND PLANT DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite – Basic Biotechnology, Chemical Reaction Engineering, Bioreactors				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide knowledge about process economics and plant design

UNIT I PROCESS DESIGN DEVELOPMENT 9

Technical feasibility survey, process development, flow diagrams, equipment design and specifications

UNIT II GENERAL DESIGN CONSIDERATION 9

Marketability of the product, availability of technology, raw materials, equipment, human resources, land and utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production cost.

UNIT III COST ESTIMATION 9

Capital investment-fixed capital investments including land, building, equipment and utilities, installation cost(including equipment, instrumentation, piping, electrical installation and other utilities), working capital investment.

UNIT IV COST ESTIMATION 9

Manufacturing costs-Direct Production cost(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties etc) fixed charges (including depreciation, taxes insurance, rental cost etc).,

UNIT V LIABILITIES 9

Plant overheads-Administration, safety and auxiliary services, payroll overheads, ware house and storage facilities etc. Profitability Analysis-return on original investment, interest rate of return, accounting for uncertainty and variations and future developments- Optimization techniques-Linear and Dynamic programming, Optimization strategies

COURSE OUTCOMES (COs)													
CO1	To understand basic principles of process design												
CO2	To know about marketing of products												
CO3	To know about capital and fixed cost												
CO4	To study the cost involved in human resources												
CO5	To understand about the administration of a plant												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M			L		
	CO2	H	M	M	H	H		M		M		L	M
	CO3	H	M		H	H		M	M		L		
	CO4	H	M		H	H	L	M			L	L	M
	CO5	H	M	M	H	H		M				L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Peters and Timmerhaus, "Plant design and Economics for Chemical Engineers ",McGraw Hill 4th Edition, 2002.

REFERENCES BOOKS

1. Rudd and Watson, "Strategy of Process Engineering ", Wiley, 2003.

U18OEBT003	BREWING TECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Principles of Bioprocess Technology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To give in depth knowledge on Beer Production

UNIT I OUTLINE OF BREWING **9**

Introduction – Malts – Brewing liquors – Milling and Mashing- Processing of Beer – types of beer – malting – water, effluents and wastes.

UNIT II SCIENCE OF MASHING **9**

Introduction – Mashing schedules – Altering Mashing Conditions – Mashing Biochemistry – Mashing and Beer flavour – Spent Grains – Preparation of grists – Mashing technology.

UNIT III WORT BOILING **9**

Introduction – Chemistry of wort boiling – Clarification, Cooling and Aeration.

UNIT IV WORT FERMENTATION **9**

Basic principles – Bottom and top Fermentation Systems – Continuous Fermentation – Fermentation Control Systems, Beer Maturation– flavour and aroma changes - Stabilization against nonbiological haze – Carbonation – Clarification and filtration – Special beer treatments.

UNIT V CHEMICAL AND PHYSICAL PROPERTIES OF BEER **9**

Chemical Composition – Nutritive value – Colour – Haze – Viscosity – foam Characteristics – gurting flavour – Semors analysis – Packaging.

COURSE OUTCOMES (COs)	
CO1	To make the students to understand brewing
CO2	To know about wort boiling
CO3	To know about mashing
CO4	To make the students to get knowledge about wort fermentation
CO5	To make them to understand the physical and chemical properties of beer and packaging
Mapping of Course Outcomes with Program outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		M
	CO2	H			H	H		M		M	L	L	
	CO3		M				H		H			L	M
	CO4	H			H			M		M	L		
	CO5		M	M			M	M	H			L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK:

1. Brewing – Science and Practice by Dennis E. Briggs, Chris A. Boulton, Peter A. Brookers and Roger Sterens, Wood head Publishing Limited, 2004.

U18OEBT004	**BIOMINING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biotechnology, Bioprocess, Microbiology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To create basic awareness about biomining

UNIT I BIOLEACHING 9

Introduction, Copper processing technologies- in situ leaching, smelting, concentrate leaching, Heap and dump leaching. Thermophilic Heap bioleaching – Basic heap design and importance of heat generation, sulfur availability, microbial activity, inoculation, pH, inhibitory factors, heat retention, air-flow rate and irrigation rate.

UNIT II GEOBIOTICS 9

Introduction, the GEOCOAT AND GEOLEACH technologies, complementary Geobiotics technologies, the GEOCOAT process, advantages of the GEOCOAT process, the Agnes mine GEOCOAT project, developing technologies.

UNIT III BIOMINING MICROORGANISMS 9

Introduction, Biooxidation of minerals, General chemistry of mineral biooxidation, advantages of biooxidation, types of organisms, general physiology of mineral-degrading bacteria,

autotrophy, nitrogen, phosphate and trace elements. Energy production- iron, sulfur oxidation, adaptability of biomining microorganisms, metal tolerance and resistance.

UNIT IV ACIDOPHILIC MICROORGANISMS 9

Biodiversity of acidophilic microorganisms, techniques for detecting and quantifying microbial life in mineral oxidizing environments, cultivation dependent approaches, PCR based microbial identification and community analysis, PCR independent molecular detection and identification of acidophiles, future perspectives on molecular techniques for detection and identification of acidophiles.

UNIT V GENETICS OF BIOLEACHING 9

Introduction, relevant biochemical and chemical reactions, Genetics of bioleaching microorganisms, Iron and sulfur oxidation and reduction in Acidithiobacillus ferrooxidans, sulfur oxidation, ferric iron and sulfur reduction in Acidiothiobacillus ferrooxidans. Iron oxidation in other bioleaching microorganisms – Ferroplasma spp., Leptospirillum spp, Metallosphaera sedula, sulfur oxidation in other bioleaching microorganisms.

COURSE OUTCOMES (COs)													
CO1	To introduce biomining												
CO2	To know basics of geobiotics												
CO3	To create complete knowledge about the bioleaching of copper												
CO4	To learn about biodiversity microorganisms												
CO5	To know about bioleaching microorganisms												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M		M	H				L		M
	CO2	H			H	H		M		M	L	L	
	CO3		M				H		H			L	M
	CO4	H			H			M		M	L		
	CO5		M	M			M	M	H			L	M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Nagina Parmar and Ajay Singh, "Geomicrobiology and Biogeochemistry" Spinger publications.

REFERENCE BOOK

1. Douglas E. Rawlings, D. Barrie Johnson, "Biomining" Springer Science & Business Media, 18-Dec-2006.

U18OEBT005	**INDUSTRIAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess, Enzyme Engineering & Technology, Basic Biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES

To provide a basic knowledge about Safety engineering

UNIT I INDUSTRIAL HAZARDS 9

Safety in Process Plants – Hazard Analysis – Types of Hazard – hazard Identification techniques Hazard Evaluation – Important Factories Act.

UNIT II CHEMICAL HAZARD 9

Hazards in work place: safety in the use of chemicals at work – Chemical hazard - Air-Borne Contaminants – particulate matter – Hazard and safety methods – hazards and Safety measures in Refineries , Paper and Pulp Industries- Safety Conditions in tanneries –Hazards of Pesticide – Sugar industry.

UNIT III SAFETY MANAGEMENT AND FIRE SAFETY 9

Introduction- Safety policy- Safety in electrical installation: Electrical shock and prevention-safety precautions for residential and commercial installation - Case study-Four stages of Fire-types of Fire Detectors – Fire safety in Industry – chemistry of fire- Types of Combustion- Fire Triangle- Fire extinguishing Technique – Engineering consideration for safety consideration

UNIT IV INDUSTRIAL ACCIDENTS 9

Industrial accidents – Classification – prevention – accident cost – Steps of investigation – Analysis of Accidents – Remedial Measures – Methods of Prevention – Safety Slogans – Case study

UNIT V PROTECTIVE EQUIPMENTS 9

Personal protective Equipment and personal Protection – Aim – Need – Types: Non Respiratory Protective equipment- Respiratory typeFirst aid – principles and methods – First aid training – Scope of first aid – Golden rules– First aid treatment : for wounds and Hemorrage , Shock , respiration :Schafer's Method, Shock. Fractures, Burns and Scalds, Unconsciousness, Heat exhaustion and Stroke– First aid Kit box A and B.

COURSE OUTCOMES (COs)	
CO1	to understand basic concepts in hazard analysis
CO2	to know about safety and its management
CO3	to know about accidents and its preventive measures
CO4	to understand various personal protective equipment and first aid
CO5	to know about personal protective equipment

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M	M	H	M		M	M		L		M
	CO2	H	M	M	H	H		M			L	L	M
	CO3	H	M		H	H		M		M	L	L	M
	CO4	H	M		H	H		M	L		L	L	
	CO5	H	M	M	H	H		M		L	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT BOOK

1. Nicholas, 2008, "Practical Guidance to Industrial Safety" 3rd ed
2. Prof.M.H.Fulekar, 2007, "Industrial Hygiene & chemical Safety" 2nd ed

REFERENCE BOOKS

1. Rudd,2005, "Strategy of process engineering" Willey
2. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

U18OEBT006	**BIODIVERSITY MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite- Botany, Environmental studies				

	Course Designed by – Department of Industrial biotechnology

OBJECTIVES

To learn about the conservation of biodiversity

UNIT I TYPES, FUNCTIONS AND BENEFITS OF BIODIVERSITY 9

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Megadiversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - Use of Biodiversity: Source of food, medicine, raw material, aesthetic and cultural uses – Biodiversity Prospecting: Significance of Indigenous Knowledge Systems

UNIT II THREATS TO BIODIVERSITY 9

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

UNIT III CONSERVATION STRATEGIES 9

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agro-forestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies

UNIT IV SUSTAINABLE MANAGEMENT OF BIORESOURCES 9

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

UNIT V POLICIES, PROGRAMMES AND ACTS FOR CONSERVATION 9

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere

Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration

COURSE OUTCOMES (COs)	
CO1	to understand what is diversity
CO2	to learn about the threats to diversity
CO3	to know the methods of conservation of diversity
CO4	to learn the sustainable methods of diversity
CO5	to have a knowledge about various policies

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M		H	M		M	M		L		M
	CO2	H	M	M		H		M			L	L	
	CO3				H	H				M	L	L	M
	CO4	H	M		H				L		L	L	
	CO5	H	M	M	H	H		M		L	L		M
3	Category	PC											
4	Approval	Academic Council, Aug 2018											

TEXT/REFERENCE BOOK

1. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
2. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
3. Kumar HD (1997) General Ecology. Vikas Publishing House (P) Ltd., New Delhi.
4. Muthuchelian K (2013) Uyir Virimam (Tamil), Pranisha Pathippagam, Madurai.
5. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.
6. Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.

Web References

1. www.iucn.org
2. www.cites.org
3. www.cbd.int
4. www.fao.org/Ag/agp/agpc/doc/Publicat/TAPAFON/TAP_7.pdf
5. www.wri.org/biodiv/bp-home.html