

**CURRICULUM AND SYLLABUS
(R2018)
CHOICE BASED CREDIT SYSTEM
(Applicable to the batches admitted from July 2018)
M.Tech – INDUSTRIAL BIOTECHNOLOGY**

I – IV SEMESTERS

SEMESTER I								
Sl. No.	Course Code	Category	Course Title	Contact Period	L	T	P	C
THEORY								
1	P18 PCBT101	PC	Advanced Biochemistry	3	3	0	0	3
2	P18PCBT102	PC	Plant and Animal Biotechnology	3	3	0	0	3
3		PE	Professional Elective I	3	3	0	0	3
4		PE	Professional Elective II	3	3	0	0	3
5	P18PRBT 101	PR	Bio Research Methodology and IPR	2	2	0	0	2
6		AC	Audit Course I	2	2	0	0	0
PRACTICAL								
7	P18PCBT1L1	PC	Biochemistry and Microbiology Lab	4	0	0	4	2
8	P18PCBT1L2	PC	Plant and Animal Biotechnology Lab	4	0	0	4	2
Total				24	16	0	8	18

SEMESTER II								
Sl.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1	P18PCBT201	PC	Down Stream Processing	3	3	0	0	3
2	P18PCBT 202	PC	Bioprocess engineering and plant design	3	3	0	0	3
3		PE	Professional Elective III	3	3	0	0	3
4		PE	Professional Elective IV	3	3	0	0	3
5		AC	Audit II	2	2	0	0	0

PRACTICAL								
6	P18PCBT2L1	PC	Bioprocess engineering Lab	4	0	0	4	2
7	P18PCBT2L2	PC	Down Stream Processing Lab	4	0	0	4	2
8	P18PRBT2P1	PR	Mini Project with Seminar	4	0	0	4	2
Total				26	14	0	12	18

SEMESTER III								
Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
THEORY								
1		PE	Professional Elective - 5	3	3	0	0	3
2		OE	Open Elective	3	3	0	0	3
PRACTICAL								
3	P18PRBT3 P1	PR	Dissertation-Phase I	14	0	0	20	10
Total				20	6	0	20	16

SEMESTER IV								
Sl.No	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PRBT4P1	PR	Dissertation-Phase II	28	0	0	32	16
Total				28	0	0	32	16

TOTAL CREDITS: 68

LIST OF ELECTIVES

PROFESSIONAL ELECTIVE - 1								
Sl.No.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT011	PE	Industrial Microbiology and Fermentation Technology	3	3	0	0	3

2	P18PEBT012	PE	Enzyme Engineering	3	3	0	0	3
3	P18PEBT013	PE	Environmental Biotechnology	3	3	0	0	3
PROFESSIONAL ELECTIVE - 2								
Sl.N o.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT021	PE	Principles of Process Engineering	3	3	0	0	3
2	P18PEBT022	PE	Dairy Technology	3	3	0	0	3
3	P18PEBT023	PE	Cancer biology	3	3	0	0	3
PROFESSIONAL ELECTIVE - 3								
Sl.N o.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT031	PE	Recombinant DNA technology	3	3	0	0	3
2	P18PEBT032	PE	Nanobiotechnology	3	3	0	0	3
3	P18PEBT033	PE	Immunotechnology	3	3	0	0	3
PROFESSIONAL ELECTIVE – 4								
Sl.N o.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT1041	PE	Stem cell and Tissue Engineering	3	3	0	0	3
2	P18PEBT042	PE	Food Process Engineering	3	3	0	0	3
3	P18PEBT043	PE	Biopharmaceutical Technology	3	3	0	0	3
PROFESSIONAL ELECTIVE - 5								
Sl.N o.	Code No.	Category	Course Title	Contact Periods	L	T	P	C
1	P18PEBT051	PE	Proteogenomics and Bioinformatics	3	3	0	0	3
2	P18PEBT052	PE	Bioreactor Design	3	3	0	0	3
3	P18PEBT053	PE	Industrial Safety Engineering	3	3	0	0	3

OPEN ELECTIVES

S.No	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18OECS001	Business Analytics	3	3	0	0	3
2	P18OEMA002	Operations Research	3	3	0	0	3
3	P18OEME003	Industrial Safety	3	-	-	-	-
4	P18OEBA004	Cost Management of Engineering Projects	3	3	0	0	3
5	P18OEME005	Composite Materials	3	3	0	0	3
6	P18OEEE006	Waste to Energy	3	3	0	0	3
7	P18OECE007	Environmental Health Engineering	3	3	0	0	3
8	P18OEBT008	Bio Entrepreneurship Development	3	3	0	0	3
9	P18OEBM009	Rehabilitation Engineering.	3	3	0	0	3
10	P18OEBM010	Bio Mechanics	3	3	0	0	3

AUDIT COURSES I & II

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	P18ACEN001	English for Research Paper Writing	2	2	0	0	0
2	P18ACCE002	Disaster Management	2	2	0	0	0
3	P18ACEN003	Sanskrit for Technical Knowledge	2	2	0	0	0
4	P18ACBA004	Value Education	2	2	0	0	0
5	P18ACLW005	Constitution of India	2	2	0	0	0
6	P18ACBA006	Pedagogy Studies	2	2	0	0	0
7	P18ACYO007	Stress Management by Yoga	2	2	0	0	0
8	P18ACBA008	Personality Development through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

		ADVANCED BIOCHEMISTRY			L	T	P	C
P18PCBT101		Total Contact Hours: 45			3	0	0	3
		Prerequisite: General biochemistry						
		Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a knowledge of biochemical components and its functions and their applications from the perspective of engineers								
COURSE OUTCOMES (COs)								
CO1		to understand the fundamentals of carbohydrates and lipids, their classification, structure and functions						
CO2		to apply the basic concept of, proteins and nucleic acids						
CO3		to get an idea about photosynthesis and its mechanism						
CO4		to know about enzymes and its applications						
CO5		to get a basic knowledge of hormones						
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		
2	CO1	H	H	H				
	CO2	H		H		M		
	CO3		M		H			
	CO4	H		M	L			
	CO5		M			H		
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)			
		√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I BIOMOLECULES I

9

Carbohydrates: structure, classification, Biological role, metabolism- glycogenesis, glycogenolysis- gluconogenesis- glycolysis- Krebs cycle- HMP shunt pathway.

Lipids: classification, structure, functions, metabolism, biosynthesis and degradation (β -oxidation) of fatty acids and cholesterol biosynthesis-biological role of cholesterol derivatives.

UNIT II BIOMOLECULES II

9

Proteins: building blocks of proteins- classification and properties- classification, biological functions and structure of proteins, protein denaturation-protein oxidation –urea cycle.

Nucleic acids: purine and pyrimidine nucleotides- structure and biosynthesis- DNA double helical structure and its biological significance.

UNIT III BIOENERGETICS OF PHOTOSYNTHESIS AND RESPIRATION 9

Photosynthesis: raw materials, photosystem I and II, mechanism, light and dark reaction,

photophosphorylation.

Respiration: oxidative phosphorylation- bioenergetics of respiration with reference to glucose- high energy compounds and free energy change of hydrolysis.

UNIT IV ENZYMES

9

Nomenclature and classification- active site- mode of action- enzyme kinetics- factors affecting enzyme activity- Michaelis- Menten equation- Line Weaver Burk representation- enzyme inhibition (reversible and irreversible) kinetics.

UNIT V HORMONES

9

Endocrine system, an overview - fat soluble hormones: structure, biosynthesis, function and general mode of action of thyroid and steroid hormones- Water soluble hormones: hypothalamic, pituitary and pancreatic hormones, biological role, signal transduction and secondary messenger system.

TEXT BOOK

1. 'Glaw A, 2008, "Clinical biochemistry" Elsevier Health Sciences, 4th edition.
2. J.L. Jain, 2004, "Fundamentals of biochemistry" S. Chand.

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

		PLANT AND ANIMAL BIOTECHNOLOGY				L	T	P	C
P18PCBT102		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Introduction to Biotechnology, Genetic engineering							
		Course Designed by : Dept of Industrial Biotechnology							
OBJECTIVES: To provide a basic knowledge about plant and animal tissue culture and its applications									
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 understand the fundamentals of animal cells and culture							
CO4		to know the large scale of cell cultures in a bioreactor							
CO5		to get a basic knowledge of the applications of animal cell in biological systems and 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			
2	CO1	H	H	H					
	CO2	M		H	L	M			
	CO3	H	M		H	L			
	CO4	M		M	L				

	CO5	H	M		H
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
		√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

Biotechnology: Definition and scope- global impact of biotechnology in agriculture, health care and environment- potentials in modern biotechnology- achievements in biotechnology.

UNIT II PLANT TISSUE CULTURE 9

Tissue culture as a source of genetic variability: Introduction-Variation: somaclonal and gametoclonal variation, sources and causes of variation, selection of variants, application in crop improvement- Protoplast: isolation, culture and fusion, selection of hybrid cells, regeneration of hybrid plants-Somatic hybridization and Cybridization- Micropropagation as a tool of in vitro multiplication- production of pathogen free plants through virus elimination- secondary metabolite production through plant cell cultures.

UNIT III TRANSGENIC TECHNOLOGY IN PLANTS 9

Genetic Transformation methods for production of transgenic plants: Direct Gene Transfer Methods, Agrobacterium mediated genetic transformation (Indirect), Chloroplast transformation, transplastomics. Production of genetically modified plants/crops: transgenic plants for biotic and abiotic stress tolerance, transgenic plants for quality traits, herbicide and pest resistance, Industrial enzymes, Molecular farming for therapeutic protein: Plantibodies, Plantigens and Edible Vaccines.

UNIT IV ANIMAL CELL CULTURE 9

Animal cell culture: history- requirements for animal cell and organ culture-culture media: natural and synthetic media-sterilization of glassware, equipment and culture media-maintenance of different cell lines-characteristics of animal growth in culture-Cultivation of animal cells in bioreactor-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-stem cell culture

UNIT V TRANSGENIC TECHNOLOGY IN ANIMALS 9

Basic steps in gene cloning-methods of gene transfer: calcium phosphate co precipitation, electroporation and microinjection-Screening of recombinants: marker inactivation technique. Cloning strategies: genomic and cDNA cloning (basic concepts)-Cloning of insulin gene-Development of transgenic animals and applications-DNA finger printing techniques-Biopharming- xenotransplantation- genetically engineered animals- mapping of human genome- ethical issues in animal biotechnology- Intellectual property rights- patenting.

TEXT BOOKS:

1. Adrian Slater, 2006, "Plant biotechnology", 3rd Ed.,
2. Fr. S. Ignacimuthu, 2000 Plant biotechnology IV ed.
3. R.C.Dubey, 2004, "Text book of Biotechnology" 3rd Ed.

REFERENCE BOOKS:

1. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009, " Plant Biotechnology"
2. Sudha Gangal , 2002, "Principles and Practice of Animal tissue culture", IV Ed
3. P. Ramadass , 2008, " Animal Biotechnology" MJP pub

P18PRBT101	BIO RESEARCH METHODOLOGY AND IPR							L	T	P	C						
	Total Contact Hours – 30							2	0	0	2						
	Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing																
	Crse Designed by – Dept. of Industrial Biotechnology																
OBJECTIVES																	
To provide basic knowledge about various instrumentation techniques and data documentation																	
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																
CO6	To prepare research articles																
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				
	CO6	H	H	H	H	H		H		M	L						
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)		Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)		Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)	
									√								
4	Approval	37 th Meeting of Academic Council, May 2015															

UNIT I INTRODUCTION

9

Meaning of Research, Objectives of Research, Motivations in Research, types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research

UNIT II DEFINING THE RESEARCH PROBLEM

9

Concept and need, Identification of Research problem, defining and delimiting Research problem- Variables and their linkages, characteristics of good Hypothesis Research question and formulation of hypotheses- directional and non-directional hypotheses, Basis for hypotheses

UNIT III RESEARCH DESIGN**9**

Meaning, Need, Features of Good Design, Concepts, Types- Basic principles of Experimental Design, various methods of Research-Survey, Philosophical, Historical, Experimental, Causal Comparative, Genetic, Case Studies

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 – contaminant levels and environmental effects- 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.

TEXT BOOKS

1. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.
2. C.R. Kothari, 1997, Research Methodology (Methods and Techniques) New age Publishers

REFERENCE BOOKS

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

		BIOCHEMISTRY AND MICROBIOLOGY LAB				L	T	P	C
P18PCBT1L1	Total Contact Hours: 60		0	0	4	2			
	Prerequisite: Introduction to Biotechnology, genetic engineering								
	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								
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, nucleic acids and enzyme metabolism								
CO3	to know the application of biomolecules in functioning of biological system								
CO4	to know the visualization of microbes by different microscopes								
CO5	to understand the source of microbes and their role 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			
2	CO1	H	H	H					
	CO2				L	M			
	CO3	H	M		H	L			

	CO4			M	L	
	CO5	H	M			H
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

List of Experiments

1. Qualitative analysis of Unknown sugar-Monosaccharides,disaccharides and polysaccharides.
2. Estimation of sugar- Benedicts method.
3. Qualitative of unknown protein-Albumin,casein and gelatin.
4. Quantitative test for protein – Biuret method.
5. Quantitative test for protein –Lowry method.
6. Quantitative test for protein – Bradford method
7. Isolation of Bacteria Soil
8. Motility of Bacteria
9. Staining techniques
10. Streak Plate techniques
11. Antibiotic sensitivity test
12. Biochemical Analysis

P18PCBT1L2	PLANT AND ANIMAL BIOTECHNOLOGY LAB	L	T	P	C
	Total Contact Hours: 60	0	0	4	2
	Prerequisite: Introduction to Biotechnology, genetic engineering				
	Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of plant biotechnology and genetic engineering, its functions and their Applications from the perspective of engineers					
COURSE OUTCOMES (COs)					
CO1	to understand the fundamentals of plant tissue culture				
CO2	to apply the basic concept of recombinant DNA				
CO3	to know the application of genetic engineering techniques				
CO4	to understand the fundamentals of animal cell cultures				

CO5		To know basic concepts of transformation				
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
2	CO1	H	H	H		
	CO2				L	M
	CO3	H	M		H	L
	CO4			M	L	
	CO5	H	M			H
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

List of Experiments

1. Sterilization techniques.
2. Plant tissue culture techniques.
3. Preparation of culture medium
4. Callus induction in *Daucus carota*.
5. Nodal bud culture.
6. Micropropagation of rose.
7. Rooting and hardening of regenerated shoots.
8. Isolation, purification and determination of viability of protoplast from *Aloe vera* leaf mesophyll cells.
9. Protoplast fusion using PEG.
10. Preparation of synthetic seeds.
11. Isolation of Rhizobium from ground nut nodules and preparation of biofertilizer

SEMESTER II

P18PCBT201	DOWNSTREAM PROCESSING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Instrumentation, separation process, chemical engineering				
	Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide basic knowledge about various separation techniques in bioprocesses					
COURSE OUTCOMES (COs)					

CO1	to understand the unit operations involved in downstream					
CO2	to know about various separation processes					
CO3	to know the application of centrifugation in product delivery					
CO4	to get a basic knowledge of crystallization					
CO5	to know about the product recovery and purification techniques					
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
2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3		M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Role of downstream processing in biotechnology-Characteristics of biotechnology products, overview of bioprocess including upstream and downstream process, Cost cutting strategies, characteristics of biological mixtures, process design criteria for various classes of byproducts.

UNIT II SEPARATION TECHNIQUES

9

Physico-chemical basis of bioseparation processes, Cell Disruption; Principle of operation, Types and applications-recent development in product isolations- Removable of insolubles- Filtration & Micro filtration, Centrifugation,

UNIT III EXTRACTION METHODS

9

Membrane separations-Enrichment operations: Precipitation methods (with salts, organic solvents and polymers), ATP method, Super critical extractions- Extraction-batch, staged, Differential, Fractional types; Adsorption- Batch, continuous stirred tank, Principles and applications.

UNIT IV CHROMATOGRAPHIC TECHNIQUES

9

Product resolution and fractionation – chromatographic techniques – Chromatofocusing – electrophoresis of protein and nucleic acids, 1D – 2D gels, types of electrophoretic techniques (capillary and pulse field)

UNIT V CRYSTALLIZATION

9

New and emerging technologies: dialysis, Pervaporation, Polishing techniques – Crystallization, Drying – Various types, principles & applications.

TEXT BOOK:

1. Siva Shankar, 2004, "Bioseparation" III Ed,

REFERENCES BOOKS

1. Raja Ghosh, Principles of Bioseparations Engineering, World Scientific Publications, 2006.

2. P.A. Belter, E.L. Cussler, W.-S. Hu, *Bioseparations: Downstream Processing for Biotechnology*, John Wiley and Sons, New York (1988).

18PCBT202	BIOPROCESS ENGINEERING AND PLANT DESIGN			L	T	P	C
	Total Contact Hours: 45			3	0	0	3
	Prerequisite: Chemical engineering, principles of Bioprocess engineering						
	Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic knowledge of bioprocesses and its usage in bioreactors and their design							
COURSE OUTCOMES (COs)							
CO1	to understand the development of bioprocess techniques						
CO2	to know about various unit operations involved in bioprocess						
CO3	to know about the instrumentation and control for bioprocess operations						
CO4	to know about design of bioreactors						
CO5	to develop a pilot plant design and their cost						
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	
2	CO1	H	H	H	M		
	CO2	H			L	L	
	CO3	H	M	M		M	
	CO4	H		M	L		
	CO5	H	L	H		M	
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
		√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016					

UNIT I BIOPROCESS AND METABOLIC STOICHIOMETRY

9

Introduction to bioprocess – historical development - overview of traditional and modern application of biotechnology industry – unit operations involved in bioprocess – stoichiometry of cell growth and product formation – elemental balances – degree of reduction – maintenance co-efficient.

UNIT II KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

9

Phases of cell growth in batch culture – simple unstructured kinetic models for microbial growth, Monod model – growth of filamentous organisms – growth associated and non-growth associated product formation kinetics – substrate and product inhibition on cell growth and product formation - structured models for growth and product.

UNIT III PROCESS PLANT DESIGN

9

General design information – material and energy balance calculation – equipment design and specifications – marketability of the product – availability of technology, raw materials, equipments, human resources, land utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production cost.

UNIT IV COST ESTIMATION

9

Capital investment – fixed capital investments including land, building, equipments and utilities, installation cost, working capital investment – manufacturing cost – direct production cost (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, etc.), fixed charges (including depreciation, taxes insurance, rental cost etc.)

UNIT V INSTRUMENTATION AND CONTROL

9

Introduction – methods of measuring process variables: T, P, pH measurement analysis, flow measurement, inlet and exit gas analysis – computer based data acquisition – LABVIEW, MATLAB, SIMULINK & ISIM Softwares.

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.

		BIOPROCESS ENGINEERING LAB				L	T	P	C
P18PCBT2L1	Total Contact Hours: 45					0	0	4	2
	Prerequisite: Instrumentation, separation process, chemical engineering								
	Course Designed by : Dept of Industrial Biotechnology								
	OBJECTIVES: To provide a basic knowledge of bioprocess, its functions and their applications								
COURSE OUTCOMES (COs)									
CO1	to understand the fundamentals of bioprocess techniques								
CO2	to understand the fundamentals of separation methods								
CO3	to know the physical parameters								
CO4	to get a basic knowledge of fermentation								
CO5	to know basic concepts of product analysis								
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			
2	CO1	H	H	H	M				
	CO2	H	H		L	L			
	CO3	H	M			M			
	CO4	H		M	H				
	CO5	H	L	H	H	M			

3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
		√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

List of Experiments

1. Estimation of biomass production.
2. Plate assay
3. Media optimization by Plackett-Burmann method.
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. Enzyme kinetics.
9. Estimation of k_{La} by sulphite oxidation method.
10. Thermal death kinetics of yeast.
11. Solid state fermentation.
12. Production of wine
13. Production of soap and analyze its properties.
14. Production of biodiesel and analyze its properties.
15. Isoelectric precipitation
16. Settling characteristics
17. Flocculation (Jar Test)

DOWNSTREAM PROCESSING LAB		L	T	P	C
P18PCBT2L2	Total Contact Hours: 45	0	0	4	2
	Prerequisite: Instrumentation, separation process, chemical engineering				
	Course Designed by : Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic knowledge of bioprocess, its functions and their applications					
COURSE OUTCOMES (COs)					
CO1	to understand the techniques				
CO2	to understand the fundamentals of separation methods				

CO3	to know the purification techniques					
CO4	to get a basic knowledge of product formulation					
CO5	to know basic concepts of product analysis					
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
2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3	H	M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

List of Experiments

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

P18PRBT2P1	MINI PROJECT WITH SEMINAR	L	T	P	C
	Total Contact Hours -60	0	0	4	2
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology				
	Course Designed by– Dept. of Industrial Biotechnology				
OBJECTIVES					
To enable students to do independent research					

COURSE OUTCOMES (COs)					
<ul style="list-style-type: none"> It is a two credit course offered in the III Semester Each student will be allocated a guide and a research topic at the end of the II semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students Two days are allocated per week for the students to do research. This will be considered for the award of internal marks. There will be three reviews to assess the progress of their research The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. The student also should publish a paper in a journal or in a conference proceeding 					
1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√
2	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

SEMESTER III

P18PRBT3P1	DISSERTATION-PHASE I	L	T	P	C
	Total Contact Hours -60	0	0	20	10
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology				
	Course Designed by– Dept. of Industrial Biotechnology				
OBJECTIVES					
To enable students to do independent research					
COURSE OUTCOMES (COs)					
<ul style="list-style-type: none"> It is a six credit course offered in the III Semester Each student will be allocated a guide and a research topic at the end of the II semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students Two days are allocated per week for the students to do research. This will be considered for the award of internal marks. There will be three reviews to assess the progress of their research The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. The student also should publish a paper in a journal or in a conference proceeding 					

1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√
2	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

SEMESTER IV

P18PRBT4P1	DISSERTATION-PHASE II				L	T	P	C
	Total Contact Hours -35 hrs per week				0	0	32	16
	Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology, Downstream process							
	Course Designed by– Dept. of Industrial Biotechnology							
OBJECTIVES: To enable students to do independent research								
COURSE OUTCOMES (COs)								
<ul style="list-style-type: none"> It is a 12 credit course offered in the IV Semester The Project phase I guide continues to guide the students in Project Phase II also. There is no course work during this semester and the student is free to do the project. There will be three reviews to assess the progress of their research The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. 								
1	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
					√			
2	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

ELECTIVES

P18PEBT011	INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY	L	T	P	C
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		Total Contact Hours: 45			3	0	0	3
		Prerequisite: General microbiology						
		Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic understanding of microbes and their applications from the perspective of engineers								
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 microscope						
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		
2	CO1	H	H	H				
	CO2	M		H	L	M		
	CO3	H	M		H	L		
	CO4	H		M	L			
	CO5	H	M			H		
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)			
		√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I INTRODUCTION

9

History and scope of Microbiology, Identification of Microorganisms, Prokaryotes and Eukaryotes, Bacterial Taxonomy, Microscopy, Bright Field, Phase contrast, Fluorescence and Electron Microscope, Specimen Preparation for Microscopy, General Structural organization of Bacteria and other microorganisms, Arachae bacteria.

UNIT II CULTURE MEDIA

9

Microbial nutrition, Growth of Microorganisms in different Media, Isolation of Pure culture, Growth curve of Microbes, Culture of Microorganisms-continuous and synchronous culture, Enumeration of Microorganisms, Preservation of Microbial Culture, Mode of Nutrition Transport in Microbes, Effect of pH, temperature, osmotic Pressure on Growth of Microbes, antimicrobial agents and disinfectants.

UNIT III FERMENTATION PROCESS

9

Historical view of Fermentation Process and products, Outline of various unit operation involved in integrated bioprocesses, Isolation, Preservation and improvement of Industrial Microorganisms, Medium Requirement for Fermentation processes, Carbon, Nitrogen, Minerals, Vitamins and Other Nutrients.

UNIT IV PRIMARYMETABOLITES

9

Production of primary metabolites, organic acids (citric acid, itaconic acid, acetic acid, gluconic acid), Amino

acids (glutamic acid, lysine, aspartic acid, phenylalanine), alcohols (Ethanol, 2,3-butanediol). Production of secondary metabolites-antibiotics-beta lactams (penicillin- cephalosporin)- Aminoglycosides (streptomycin, kanamycin)-Macrolides (erythromycin)- Vitamins, Production of Vaccines and Recombinant Proteins- Proteases, Amylases, Lipases.

UNIT VI INDUSTRIAL APPLICATIONS

9

Microorganisms in waste water treatment, Bio-fertilizers and Bio-Pesticides, Recycling of biomaterials, production of biogas, plant growth factors. Natural Bio preservatives (nisin), Bio-Polymers (Xanthan gum and PHB), Single Cell Protein

TEXT BOOKS:

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg, 2005, "Microbiology "TATA McGraw Hill, 5th Ed.

REFERENCE BOOKS:

1. Anantha Narayan, C.K. Jayaram Paniker, 2009, "Text Book of Microbiology" Orient Blackswan, 7th Ed.
2. Prescott and Dunn, 2006, "Industrial Microbiology" CBS Publishers & Distributors.

		ENZYME ENGINEERING			L	T	P	C
P18PEBT012		Total Contact Hours: 45			3	0	0	3
		Prerequisite: Introduction to Biotechnology, Biochemistry						
		Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a knowledge about enzymes and its kinetics								
COURSE OUTCOMES (COs)								
CO1		to understand the applications of enzymes in various fields						
CO2		to know about kinetics of enzyme						
CO3		to know about the applications of enzymes						
CO4		to know about immobilization and its applications						
CO5		to get ideas about various bioreactors and its uses						
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		
2	CO1	H	H	H				
	CO2	H		H	L	M		
	CO3	H	M		H	L		
	CO4			M	L			
	CO5	H	M			H		
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			

		√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION 9

Introduction to Enzyme Technology, Definition of Biochemical process, Application to pharmaceutical, medical, fine chemicals and herbal, food Industries, comparison of chemical and biochemical process, scope of chemical Engineering operations, Microbial strain cultivation, synthesis of typical biologicals.

UNIT II ENZYME KINETICS 9

Introduction to Enzyme Kinetics, Nature and Function of Enzymes, Coenzymes and cofactors Classification of Enzyme, Practical application of Enzyme in bioprocess of Industrial importance, Mechanism of Enzymatic Reaction-Michaelis Menten Equations for Non inhibiting and inhibiting reaction substrate, product inhibition classification of inhibition and their Mechanisms.

UNIT III MICROBIAL ENZYME KINETICS 9

Fundamentals of Microbial Kinetics, Growth curve of microbial cells, Factors affecting growth, Monod Model, Modelling of Continuous and Batch growth, immobilization of cells and Mechanisms with rate equations.

UNIT IV TRANSPORT PHENOMENA 9

Microbial Transport, Introduction to factors influencing transport phenomena, Newtonian and Non Newtonian behaviour of broth. Agitation and Mixing, Power consumption, Gas/Liquid transportation in cells, mass transfer coefficients and their role in scale up of Equipments, Enhancement of Oxygen transfer, Heat transport in Microbial systems, Sterilization cycle and Examples of Heat addition and removal in process

UNIT V BIOREACTORS 9

Bioreactors: Classification, Batch and continuous types, High performance bioreactors, Sterile and Non sterile operations, Reactors in series, Recycle Reactors. Applications of Enzyme technologies in Effluent treatment, downstream operation with reference to membrane separations and fermentation methods in waste treatment, waste treatment and disposal.

TEXT BOOKS:

1. Manjula, 2006, "Bio and Enzyme Engineering", III Ed.

REFERENCE BOOK:

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,

P18PEBT013	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					
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												
CO6	to know about IPR												
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	L	M
	CO2	H	M	M	H	H	H	M	H				M
	CO3	H	M		H		H	H			L	L	
	CO4	H	M		H	H	H	M			L		M
	CO5	H	M	M	H	H	H	M	M	M	L	L	
	CO6	H			H	H	H	M				L	M
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Term paper Seminar/ Internship (PR)				
					√								
4	Approval	37 th Meeting of Academic Council, May 2015											

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 Heavy metals-Bioremediation of oil spills, Bio deterioration of paper, Textile, sugar distilleries, dairy 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-Biohazardous waste-Sharps-Pathological waste-Rules and Regulations-Biosafety protocol

TEXT BOOK

1. Bruce. E.Rittaman and Perry. L. Mc Carty, 2004, "Environmental Biotechnology-Principles and

applications” McGraw Hill.

- N. Ahmed, F.M. Quershi and D. Y.Khan, 2001, “Industrial Environmental Biotechnology” Horizon press.

REFERENCE BOOKS

- W.D. Grand, P.E. Long Blakies, “Environmental Microbiology”, Glasgow London.
- T. Meenambal, 2009, “Environmental Science and Engineering”.
- Weblink: nptel

		PRINCIPLES OF PROCESS ENGINEERING			L	T	P	C
P18PEBT021		Total Contact Hours: 45			3	0	0	3
		Prerequisite: chemical engineering, bioprocess engineering, thermodynamics, heat and mass transfer						
		Course Designed by : Dept of Industrial Biotechnology						
OBJECTIVES: To provide a basic knowledge of Process engineering								
COURSE OUTCOMES (COs)								
CO1		to understand the various unit operations involved in industry						
CO2		to know the material and energy balance for a process						
CO3		to get an idea about fluid mechanics						
CO4		to know about agitation and the types of agitators						
CO5		to know about mass transfer and drying methods						
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		
2	CO1	H	H	H				
	CO2	L		H			M	
	CO3		M		H			
	CO4	H		M	L			
	CO5		M				H	
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
		√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I OVERVIEW OF PROCESS INDUSTRY

9

Unit operations & Process - Conservation of mass & Energy -Stoichiometry- SI units & Conversion

Material Balances: Overall and component material balances - Conversion -Yield - Selectivity - Material balances without chemical reactions and with chemical reactions

UNIT II ENERGY BALANCES

9

Energy- Forms of energy- Energy balances - Entropy - Latent heat -Hess's law- Standard heat of Reactions.Fluid Mechanics-Fluids-Types- Nature of flow-Bernoulli’s Equation – Manometers - Pressure losses in flow systems.

UNIT III AGITATION AND TRANSPORTATION OF FLUIDS**9**

Mixing and Agitation – Flow patterns- prevention of swirling- types of impellers- Power consumption - Pumps –Reciprocating: Single acting and double acting pump Centrifugal pump- Work of consumption.

UNIT IV HEAT TRANSFER**9**

Modes of heat transfer- Heat transfer through compound wall- Heat flow through cylinder.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 V MASS TRANSFER**9**

Diffusion: Outline of Mass transfer operations-Diffusion in Gases, Liquids and Solids. Distillation: Theory of Simple, Flash, Steam and Azeotropic distillation-McCabeThiele method. Drying: Drying equipment: Tray, Screen-conveyor, Rotary and Spray dryer-Selection of drying equipment- Time of drying.

TEXT BOOK:

1. K.A.Gavhane,2009,“Introduction to process calculations stoichiometry” NiraliPrakasham Publications 25th Ed.

REFERENCE BOOKS:

1. K.A. Gavhane, 2009, “Fundamentals of chemical engineering” NiraliPrakasham Publications 25th Ed.,
2. McCabe and Smith,2002, “Unit operations in Chemical Engineering”, Tata McHraw Hill Publications, 6th Ed.
3. Bhat & Vora,2001, 'Stoichiometry', Tata McGraw Hill Ltd, III Ed

		DIARY TECHNOLOGY				L	T	P	C
P18PEBT022	Total Contact Hours - 45	3	0	0	3				
	Prerequisite – Food Process engineering								
	Course Designed by – Dept of Industrial Biotechnology								
	OBJECTIVES: To explore the different techniques involved in dairy science								
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			
2	CO1		H	H	M				
	CO2	H	H		L	M			
	CO3	H	M			M			
	CO4	H		L	H				

	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)		Project/ Term Paper/ Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Market milk – market milk industry in India – Collection, Transportation of milk- milk reception – Clarification- Chilling – Homogenisation – 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- Gulab jamun – Rasagolla – preparation of paneer – kulfi – utilization of skim milk – butter milk – whey.

UNIT V QUALITY CONTROL & 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

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” .

REFERENCES

1. Andrews,2004, “Biochemistry of Milk Products” Black rabbit books, 2nded.
2. Ananthkrishnan C P., and Padmanabhan “ The technology of milk processing” Shrilakshmi publications

P18PE2BT023	CANCER BIOLOGY	L	T	P	C
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		Total Contact Hours - 45	3	0	0	3
		Prerequisite – Medical Biotechnology, Animal Biotechnology				
		Course Designed by – Dept of Industrial Biotechnology				
OBJECTIVES: To provide a basic understanding of cancer and its implications						
COURSE OUTCOMES (COs)						
CO1	to understand the fundamentals of cancer cells and its constituents					
CO2	to know the concept of carcinogenesis and carcinogenic agents					
CO3	to find the environmental factors related to cancer					
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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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- metastasis, 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 ONCOGENES 9

Molecular Cell Biology of Cancer- Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Growth factors and growth factor receptors as oncogenes.

UNIT IV CANCER TYPES 9

Different sites and forms of cancer, Lung, Liver, Breast, Cervical, Blood, Prostrate, Ovarian cancers – epidemiology, 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

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

		RECOMBINANT DNA TECHNOLOGY				L	T	P	C
P18PEBT031		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Introduction to Biotechnology							
		Course Designed by : Dept of Industrial Biotechnology							
OBJECTIVES: To provide a basic understanding of recombinant DNA Technology									
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 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			
2	CO1	H	H	H					
	CO2	H	L		L	M			
	CO3	H	M	M	H	L			
	CO4	H		M	L				
	CO5	H	L	H		H			
3	Category	Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	

		√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I DNA MODIFYING ENZYMES

9

RDNA technology: Introduction, Basic systems: enzymes in genetic engineering: restriction endonucleases: Types and characteristic features, Nomenclature, Modification of cut ends: linkers, adapters and homopolymers-DNA ligases- methylase-alkaline phosphatase-topoisomerase-Polynucleotide kinase-Exonuclease III-DNase I-DNA polymerase and Klenow fragment- Terminal nucleotidyl transferase- RNA dependent DNA polymerase

UNIT II VECTORS/CLONING VEHICLES

9

Introduction: features of an ideal vector- types of vectors: cloning and expression vectors- Plasmids: pBR322, pUC18, phage vectors-cosmid vectors-phagemids-YAC vectors-BAC vectors-Shuttle vectors-Yeast vectors-Ti plasmid vector-Plant viral vectors (CaMV)-Animal viral vectors- SV 40 (3 types)- Expression vectors in Prokaryotes and Eukaryotes

UNIT III RDNA TECHNIQUES

Genomic DNA libraries-transformation methods-transfection-selection and screening of recombinants-direct and indirect selection methods, blue-white selection-GUS expression-colony hybridization-in vitro translation-blotting techniques: Southern, Northern and Western blotting-PCR-DNA labeling techniques-RFLP and RAPD-DNA sequencing-genome mapping: physical and genetic mapping, chromosome walking and chromosome jumping.

UNIT IV APPLICATIONS OF RDNA TECHNOLOGY IN ANIMALS

Animal cloning-Transgenic animals-production of insulin, interferon, vaccines, growth hormones and other pharmaceutical production-IVF-embryo transfer-nuclear transplantation-embryonic stem cells-knockout mice-animal bioreactor and molecular pharming- Gene therapy types; somatic cell and germline gene therapy, applications, problems and prospects

UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN PLANTS

Transgenic plants with reference to disease and pest resistances, herbicide tolerance, biotic and abiotic stress tolerance-transgenic plants for crop improvement-cytoplasmic male sterility-delay in fruit ripening-Biopharmaceuticals and secondary metabolite production

TEXT BOOK:

1. Brown TA,2000, "Gene cloning-and introduction" VNR (U.K) Co Ltd.
2. R.C. Dubey, A Textbook of Biotechnology, S. Chand publishers, 2013

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.

		NANOBIOTECHNOLOGY			
P18PEBT032	Total Contact Hours - 45	L	T	P	C
	Prerequisite – Introduction to Biotechnology				
	Course Designed by – Dept of Industrial Biotechnology				
	OBJECTIVES: To provide basic knowledge about nanoscience involved in biotechnology				
COURSE OUTCOMES (COs)					

CO1	to understand the various nanoparticles					
CO2	to understand the various nanodevices					
CO3	to know about nanomolecules					
CO4	to know about various techniques for nanoparticle analysis					
CO5	to know about applications of nanomolecules in various fields					
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
2	CO1		H	H	M	
	CO2	H	H		L	M
	CO3	H	M			M
	CO4	H		L	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION 9

Introduction to nanomaterials and nanobiotechnology –Classification of nanomaterials, Physicochemical properties at nanoscale- General applications of nanomaterials- Nanotoxicity.

UNIT II SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS 9

Synthesis methods: physical, chemical, biological- Stabilization- Nanofabrication: Lithographic techniques—Characterization techniques: SEM, TEM, STM, AFM, XRD, XPS.

UNIT III INORGANIC NANOMATERIALS 9

Inorganic nanoscale systems – Properties of fullerene carbon nano tubes – Quantum dots – Gold nanoparticles – Magnetic nanoparticles.

UNIT IV NANOBIMATERIALS 9

Interaction of nanomaterial and biomolecule: Classification of biomaterial – Bone cement – Biointeractive hydrogels – Nanobiomaterials: Collagen, Dextran, Hydroxyapatite.

UNIT V NANOMEDICINE 9

Nanotechnology in drug delivery – Nanoscale devices for drug delivery: Micelles, Nanocapsules, Liposomes, Dendrimers –Nanobiosensors – Nanotechnology for cancer diagnosis & treatment.

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 Nanostructures: Bernd Rehm, Taylor and Francis, 2006
2. Applications of nanoparticles in biology & medicine O.V. Salata, Journal of nanobiotechnology (2004),
3. Weblink: nptel

		IMMUNOTECHNOLOGY				L	T	P	C
P18PEBT033		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Immunology, Life Science							
		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									
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			
2	CO1	H	H	H					
	CO2	M	L		L	M			
	CO3	H	M	M	H	L			
	CO4	H		M	L				
	CO5	H	L	H		H			
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)				
		√							
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I INTRODUCTION

9

Introduction-cells and organs of the immune system, origin of immune system, types of immune system, - Antigenes – antigenicity, antigenic determinants, haptens and epitopes, Antibodies-Structure, Classification,

allotypes and idiotypes.

UNIT II THE IMMUNE RESPONSE 9

Immune Response – primary and secondary-humoral and cell mediated immunity, antibacterial and antiviral immunity, Mechanism of antigen recognition by T and B-lymphocytes, Functions and synthesis of lymphokines, importance of antigen presentation and MHC class II molecules in T – cell cloning.

UNIT III ANTIGEN-ANTIBODY INTERACTIONS 9

Immune techniques- antigen–antibody reactions, cross reactivity, precipitation I actions, agglutination reactions, RIA, ELISA, Immuno-precipitation, Immuno-flourescence, synthetic vaccines and recombinant vaccines.

UNIT IV COMPLEMENT SYSTEMS 9

Complement Systems – components, nomenclature, activation of complement, complement receptors and alternate pathway, complement fixation test, immunization practices – vaccines, toxoids, killed and attenuated vaccines, Active and passive immunization, monoclonal antibodies production, purification and characterization, application of monoclonal antibodies in biomedical research

UNIT V HYPERSENSITIVITY 9

Hypersensitivity reactions, autoimmunity-organ specific and systemic autoimmune diseases, pathogenesis, diagnostic aspects and treatment, Tumor immunology- Tumor antigens, immune response to tumors, Approaches to cancer immunotherapy-immunodiagnosis

TEXT BOOKS:

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

REFERENCES BOOKS

1. Tizard, 1992, “Introduction to Immunology” Saunders collage publication, 3rded.
2. Abbas,2009, “Basic Immunology” W.B. Saunders company, 2nded.

		STEM CELL AND TISSUE ENGINEERING				L	T	P	C
P18PEBT041	Total Contact Hours: 45	3	0	0	3				
	Prerequisite: Animal Biotechnology								
	Course Designed by : Dept of Industrial Biotechnology								
OBJECTIVES: To provide a basic understanding of stem cells and their applications									
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			

2	CO1	H	H	H	M	
	CO2	H	H		L	L
	CO3		M			M
	CO4	H		M	H	
	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)	
		√				
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

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, and Stem cell marker.

UNIT II HUMAN EMBRYONIC STEM CELL

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 hESC cell lines, Developments regarding establishment of human stem cell banks and registries

UNIT III NEURO CULTURE

9

Stem cell biology-Preparation of complete human neuroculture, Culturing and subculturing human neurospheres, Differentiation of cells from human, neurospheres into neurons, astrocytes and oligodendrocytes, Immunolabelling procedures human embryonal stem cell and germ cell culture.

UNIT IV ANTENATAL DIAGNOSIS

9

Antenatal diagnosis- types of gene therapy-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 foetal 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 CULTURE OF CELLS

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

TEXT BOOK

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

REFERENCE BOOKS:

1. Sudha Gangal, 2002, "Principles and Practice of Animal tissue culture", IV Ed
2. P. Ramadass, 2008, "Animal Biotechnology" MJP publishers

P18PEBT042	FOOD PROCESS ENGINEERING				L	T	P	C
	Total Contact Hours: 45				3	0	0	3
	Prerequisite: Instrumentation, separation process, chemical engineering							
	Course Designed by : Dept of Industrial Biotechnology							
OBJECTIVES: To provide basic technologies involved in food processing								
COURSE OUTCOMES (COs)								
CO1	to understand basic concepts in sterilization of food products							
CO2	to know about various dryers							
CO3	to know about the mixing equipments for various products							
CO4	to know about various preservation techniques for food products							
CO5	to understand the microbiological aspects in food process							
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		
2	CO1		H	H	M			
	CO2	H	H		L	M		
	CO3	H	M			M		
	CO4	H		L	H			
	CO5	H	L	H	H	M		
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I INTRODUCTION

9

Food processing industries in India: status, scope- categorization of food processing industries- food preservation–National food processing policy of India – tenth plan initiatives

UNIT II FOOD SPOILAGE, PREVENTION, FOOD SAFETY

9

Food spoilage causes – biological changes – factors effecting bacterial growth – yeasts – mold – food borne diseases – control of microorganism- prevention of microorganisms sterilization techniques – Thermal death time – food additives: uses, types – HACCP- definition, principle, guidelines.

UNIT III POST HARVEST PROCESSING

9

Perishable foods of fruits & vegetables metabolic inhibitors- preservation – time/temp-tolerance hypothesis- Hicks theory- Ethylene biosynthesis-controlled atmosphere technique- factors effecting food storage-fruit ripening – CA generators-post harvest disease-respiratory gases- preservation of nuts of dried fruits

UNIT IV FOOD PROCESSING TECHNOLOGIES

9

Drying of food-goals-guidelines-pretreatment of fruits of vegetables-drying methods: oven drying, food dryer-sun drying-other drying method-water activity-intermediate moisture food concept-hurdle technology-

recommended additives to reduce pH, inhibition microbes to prevent burrowing-thermal treatment-freeze drying-freezing of food-food irradiation food sterilization-Extrusion technology.

UNIT V GRAIN STORAGE

9

Storage types-disinfestation of grains-controlled atmosphere storage-useful of CO₂ in one shot system-control of yeast and mold- seed viability-multiplication of lactic acid bacteria-storage of wet grains-feed back inhibition-grain storage in developing countries.

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, Newyork, 2nd ed.

REFERENCE BOOKS

1. Tucker & Woods, 1995, "Enzymes in food processing" Springer, 5thEd.
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.

		BIOPHARMACEUTICAL TECHNOLOGY				L	T	P	C
P18PEBT043		Total Contact Hours: 45				3	0	0	3
		Prerequisite: Instrumentation, separation process, chemical engineering							
		Course Designed by : Dept of Industrial Biotechnology							
OBJECTIVES: To provide a basic understanding of pharmaceutics and their applications									
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			
2	CO1		H	H	M				
	CO2	H	H		L	M			
	CO3	H	M			M			
	CO4	H		L	H				
	CO5	H	L	H	H	M			
3	Category	Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	

			√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016			

UNIT I INTRODUCTION

9

Introduction to biopharmaceutics – bioavailability – factors influencing bioavailability: factors influencing drug absorption from the gastrointestinal tract.

UNIT II DRUG FORMULATION

9

Manufacturing Principles – Compressed tablets – wet granulation – Dry granulation or slugging –Direct compression – Table presses formulation – Coating – Pills – Capsules sustained action dosage forms – Parental solutions – Oral liquids – injections – ointments – standard of hygiene and good manufacturing practice.

UNIT III DRUG BINDING

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 organs and enzymes – phase I reactions – phase II reactions – first pass effect –factors affecting biotransformation of drugs – bioactivation and tissue toxicity.

UNIT V PRODRUG

9

Bioprecursor prodrugs – carrier prodrugs – application of prodrug design: enhancement of drug stability and dissolution rate – enhancement of bioavailability – site specific drug delivery – Imitations of prodrug design.

TEXT BOOK

1. D.M. Brahmankar Sunil B.Jaiswal, 2008, “Biopharmaceutics and Pharmacokinetics” Vallabh Prakashan, 1stEd.

REFERENCE BOOKS:

1. Remington's Pharmaceutical Sciences, Mack Publishing and Co.,
2. Vyas SP,2007, “Pharmaceutical biotechnology” CBS Publishers & Distributors.
3. Grovess MJ,2006, “Pharmaceutical biotechnology” CRC Press, 2nd Ed.

1.

P18PEBT051	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				
OBJECTIES					
To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers					
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				

CO6	To know about bioinformatics tools																
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				
	CO6	H			H	H		M			L	L	M				
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)		Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)		Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)	
									√								
4	Approval	37 th Meeting of Academic Council, May 2015															

UNIT I BIO INFORMATICS

9

Introduction to bioinformatics – Databases, Classification – Biological Databases, and application – Data mining and Applications – Sequence Database search – FASTA – BLAST.

UNIT II GENOMICS

9

Genome – Organization of Eukaryotic genome – Mitochondrion and chloroplast 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 – Phylogenetic analysis – 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

Protein extraction – Separation and digestion techniques – Mass spectrometry –MALDITOF – Peptide mass finger printing – Peptide sequence analysis – SALSA and TMS

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.

3. Weblink: nptel

P18PEBT052		BIOREACTOR DESIGN						L	T	P	C						
		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																	
COURSE OUTCOMES (COs)																	
CO1	To understand the fundamentals transport phenomena																
CO2	To know about various types of reactors																
CO3	To know about instrumentation and control of reactors																
CO4	To learn the process of modulation and simulation of fermentation process																
CO5	To understand plant and animal cell reactors																
CO6	To get the knowledge of bioreactors and its Industrial																
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		M	L	L					
	CO2	H	M	M	H	H		M	H				M				
	CO3	H	M			H					L	L					
	CO4	H	M		H	H		M	H		L		M				
	CO5	H	M	M	H	H		M		H	L	L	M				
	CO6	H			H	H	L	M				L					
3	Category	Humanities & Social Studies (HS)		Basic Sciences (BS)		Engg Sciences (ES)		Professional Core (PC)		Core Elective (CE)		Non-Major Elective (NE)		Open Elective (OE)		Project/ Term paper Seminar/ Internship (PR)	
									√								
4	Approval	37 th Meeting of Academic Council, May 2015															

UNIT I BIOREACTOR DESIGN

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 II TRANSPORT PHENOMENA & GROWTH MODELS

9

Rheology; Gas-Liquid Mass Transfer- Measurement of transfer coefficients; Design of bubble columns; Three-phase flow, mixing, oxygen transfer: isobaric method, non-isobaric model, oxygen transfer in a three-phase

flow-Phases of batch growth cycle; Monod Model; Models of Product Formation and Inhibition; Introduction to structured models

UNIT III BIOREACTOR INSTRUMENTATION AND CONTROL 9

Introduction, bioreactor sensor characteristics, temperature measurement and control, principles of dissolved oxygen measurement and control, principles of pH/redox measurement and control, detection and prevention of foam, determination of biomass, ion specific electrodes, biosensors.

UNIT IV FERMENTATION CONTROL 9

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

MODELING AND SIMULATION OF FERMENTATION PROCESSES

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. Scragg A.H.,2002, “Bioreactors in Biotechnology”, Edited by, Ellis Horwood Limited, England
2. Bailey and Ollis, 2000, "Biochemical Engineering Fundamentals", McGraw Hill 3rded.

REFERENCE BOOKS

1. Stanbury PF,1984, “Principles of fermentation technology” SS Hall, 2nd.
2. Mansi El Mansi.2003 “Fermentation Microbiology & Biotechnology”.IVEd.
3. Weblink: nptel

		INDUSTRIAL SAFETY ENGINEERING			L	T	P	C
P18PEBT053	Total Contact Hours – 45				3	0	0	3
	Prerequisite –Basic biotechnology, Bioprocess Engineering, Environmental science							
	Course Designed by – Dept of Industrial Biotechnology							
OBJECTIVES: To provide a basic knowledge about Safety engineering								
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 know about safetyguards and application							
CO5	to understand various personal protective equipments and first aid							
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		
2	CO1		H	H	M			
	CO2	H	H		L	M		
	CO3	H	M			M		
	CO4	H		L	H			

	CO5	H	L	H	H	M
3	Category	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION

9

Safety in Process Plants – Hazard Analysis – Types of Hazard – hazard Identification techniques Hazard Evaluation – Important Factories Act.

UNIT II TYPES OF HAZARDS

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 & 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 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 equipments- Respiratory type-First aid – principles and methods – First aid training – Scope of first aid – Golden rules– First aid treatment : for wounds and Hemorrhage , Shock , respiration:Schafer’s Method, Shock. Fractures, Burns and Scalds, Unconsciousness, Heat exhaustion and Stroke– First aid Kit box A and B.

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.

OPEN ELECTIVE

P18OEC001	BUSINESS ANALYTICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

• **OBJECTIVES**

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module I Business analytics 9 Hours

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module II Trendiness and Regression Analysis 9 Hours

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module III Organization Structures of Business analytics 9 Hours

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module IV Forecasting Techniques 9 Hours

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor, Model, Overbooking Model, Cash Budget Model.

Module V Decision Analysis 5 Hours

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome

Probabilities, Decision Trees, The values of Information, Utility and Decision Making.

Module VI Recent Trends in

4 Hours

Recent Trends in: Embedded and collaborative business intelligence, Visual 4 data recovery, Data Storytelling and Data journalism.

Total No. of Periods: 45

References Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

P18OEMA002	OPERATIONS RESEARCH	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

OBJECTIVES

- To apply the dynamic programming to solve problems of discreet and continuous variables.
- To apply the concept of non-linear programming.
- An ability to carry out the sensitivity analysis.
- An ability to model the real world problem and simulate it.

SYLLABUS

Module I Optimization Techniques

9 Hours

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Module II Simplex Method

9 Hours

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Module III Nonlinear programming and PERT-CPM

9 Hours

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module IV Server Models and Geometric Programming

9 Hours

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module V Graphical Analysis and Simulation of Game Theory

9 Hours

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010

P18OEME003	INDUSTRIAL SAFETY	L	T	P	C
	Total Contact Hours – 45	0	0	0	0
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

• OBJECTIVES

- 1. To study about the industrial safety and types.
- 2. To know about the tools and fundamentals of maintenance.
- 3. To study about the methods of wear and corrosion and their prevention
- 4. To know about the importance of fault tracing and its concepts.
- 5. To learn about the periodic and preventive maintenance of safety.

SYLLABUS

Module I Industrial safety

9 Hours

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods.

Module II Fundamentals of maintenance engineering

9 Hours

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module III Wear and Corrosion and their prevention

9 Hours

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods

Module IV Fault tracing

9 Hours

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv.

Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module V Periodic and preventive maintenance

9 Hours

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Total No. of Periods: 45

References Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

P18OEBA004	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
	Total Contact Hours – 35	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction and Overview of Cost Management of Engineering 9 Hours

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Module II ProjectCost Management

10 Hours

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module III Cost Behavior and Profit Planning Marginal Costing

10 Hours

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance

budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module IV Quantitative techniques for cost management

6 Hours

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total No. of Periods: 35 Hours

References Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

P18OEME005	COMPOSITE MATERIALS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction

9 Hours

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module II Reinforcements

9 Hours

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Module III Manufacturing of Metal Matrix Composites

9 Hours

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Module IV Manufacturing of Polymer Matrix Composites

9 Hours

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Module V Strength

9 Hours

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydro thermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total No. of Periods: 45 Hours

Text Books:

- Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

P18OEEE006	WASTE TO ENERGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Electrical & Electronics Engineering				

Module I Introduction to Energy from Waste 9 Hours

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module II Biomass Pyrolysis 9 Hours

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III Biomass Gasification 9 Hours

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module IV Biomass Combustion 9 Hours

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module V Biogas 9 Hours

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Total No. of Periods: 45

References Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

P18OECE007	ENVIRONMENTAL HEALTH ENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Waste Management				
	Course Designed by – Dept of Civil Engineering				

Module I INTRODUCTION

9 Hours

Impact of Development and Water Pollution – Ecology and ecosystems Impact of development, land use and natural resource management, Cause and effects of environmental pollution

Module II SOURCES OF POLLTION

9Hours

Natural

Processes: Pollution due to industrial, agriculture and municipal wastes – Limitation of disposal of dilution. BOD considerations in streams- Water Pollution control legislation.

Module III AIR POLLUTION

9 Hours

Air and Noise Pollution and Control- Pollutants and their sources- Effect of pollution of human wealth, vegetation- Air pollution control legislation -noise pollution- sources and effects – Control measures.

Module IV SOLID WASTE MANAGEMENT

9 Hours

Solid Wastes Management and Water Control Sources - Characteristics Quantities – Collection methods and disposal techniques - Sanitary -landfill -Incineration and pyrolysis – composting - water borne diseases – of mosquitoes, flies, rodents.Rational control and naturalistic methods of control, uses and limitations of pesticides, engineering measures of water control.

Module V FOOD SANITATION

9 Hours

Food & Milk Sanitation : Relation of food to disease – principles of food sanitation – Sanitation of Kitchen in restaurants and other catering establishments – Quality changes in milk – Milk as carrier of infection – Pasteurization of milk – HTST and LTLT processes. Cattle shed sanitation.

TEXT BOOKS

1. Ehlws V.M. and E.W. Steel. Municipal and Rural Sanitation – McGraw Hill Co. Inc, New York, 1954

REFERENCES

1. Park J.E. and Park K.,”Text Book of Preventing and Social Medicine”,M/s. Banarsidos, Bhanot, Jabalpur, 1980.
2. Stern A.C. *ed*, “Air Pollution Vol. I, II & III”, Academic Press, New York, 1968
3. Cuniff P.E,”Environmental Noise Pollution”, John Wiley & Sons, New York. 1977.

P18OEBT008	BIO ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Bioprocess, genetic engineering, TQM				

Module I ENTREPRENEURSHIP FUNDAMENALS

9 Hours

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

Module II DECISION MAKING AND TIME MANAGEMENT

9 Hours

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

Module III ENTREPRENEURSHIP – FINANCE AND ECONOMIC FEASIBILITY

9 Hours

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

Module IV COMPANY LAWS AND REGULATIONS

9 Hours

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

Module V ENTREPRENEURSHIP IN BIOTECHNOLOGY

9 Hours

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

TEXT BOOK

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

REFERENCES

1. Entrepreneurship fundamentals by Zobias Kollmann International journal of Zechnology management,2007

P180EBM009	REHABILITATION ENGINEERING.	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Biomedical Engineering				

Module I REHABILITATION TECHNOLOGY

9 Hours

Selection, design or manufacturing of augmentive or assistive devices appropriate for individual with disability

Module II REHABILITATION SCIENCE

9 Hours

Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

Module III REHABILITATION ADVOCACY

9 Hours

Legal aspect helps the handicapped people in choosing the device, the provisions available to them in this regard.

Module IV REHABILITATION MEDICINE

9 Hours

Physiological aspects of functional recovery, neurological and psychological aspects, rehabilitation therapies, training to restore vision auditory and speech

Module V RÉHABILITATION ENGINEERING TECHNOLOGIES: PRINCIPLES OF APPLICATION 9 Hours

Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

Total No. of Periods: 45

REFERENCES

1. Reswick.J. What is Rehabilitation Engineering? ,Annual Review of rehabilitation Volume 2 Springer - Vorlage, New York, 1982.
2. Robinson.C.J, Rehabilitation Engineering, Handbook of electrical engineering, CRC Press, Boca raton, 1993.

P180EBM010	BIO MECHANICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Biomedical Engineering				

Module I INTRODUCTION 9 Hours

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, biofluid mechanics, soft tissue mechanics, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, mechanical properties of soft biological tissues.

Module II MECHANICS OF CIRCULATION 9 Hours

Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

Module III MECHANICS APPLIED TO ORTHOPAEDICS 9 Hours

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, analysis of force in orthopedic implants.

Module IV MECHANISM OF BIOLOGICAL SYSTEMS 9 Hours Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

Module V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION 9 Hours
 Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

Total No. of Periods: 45

REFERENCES

1. Y.C.Fung, Biomechanics : Mechanical properties in living tissues, Springer Verlag, Newyork1981.
 2. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
 3. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.
- Susan J.Hall , Basics Bio Mechanics 4th Edition, McGrawHill Publishing Co,2002.

AUDIT COURSES I & II

P18ACEN001	AUDIT : ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

SYLLABUS:

UNIT I:

4 Hours

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II:

4 Hours

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT III:

4 Hours

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV:

4 Hours

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V:

4 Hours

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.

UNIT VI:

4 Hours

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

P18ACCE002	DISASTER MANAGEMENT	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

OBJECTIVES: Students will be able to:

Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

SYLLABUS:

UNIT I:

4 Hours

Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II:

4 Hours

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III:

4 Hours

Disaster Prone Areas In India: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV:

4 Hours

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V:

4 Hours

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI:

4 Hours

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In

Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

P18ACEN003	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

SYLLABUS:

UNIT I:

8 Hours

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II:

8 Hours

Order, Introduction of roots, Technical information about Sanskrit Literature

UNIT III:

8 Hours

Technical concepts of Engineering-Electrical,Mechanical,Architecture, Mathematics

Suggested reading

1. “Abhyasputakam” – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood.
- Being a logical language will help to develop logic in students

P18ACBA004	VALUE EDUCATION	L	T	P	C
	Total Contact Hours – 22	2	0	0	0
	Prerequisite – NIL				

	Course Designed by – AICTE
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Course Objectives: Students will be able to

- Understand value of education and self- development.
- Imbibe good values in students.
- Let the should know about the importance of character.

SYLLABUS:

UNIT I:

4 Hours

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism .Moral and non- moral valuation. Standards and principles. Value judgements

UNIT II:

6 Hours

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT III:

6 Hours

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT IV:

6 Hours

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality ,Non violence ,Humility, Role of Women. All religions and same message. Mind your Mind ,Self-control. Honesty, Studying effectively.

Suggested reading

- Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

P18ACLW005	CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

SYLLABUS:

UNIT I: History of Making of the Indian Constitution **4 Hours**

History Drafting Committee, (Composition & Working)

UNIT II: Philosophy of the Indian Constitution **4 Hours**

Preamble, Salient Features

UNIT III: Contours of Constitutional Rights & Duties **4 Hours**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights,

Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV: Organs of Governance **4 Hours**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT V: Local Administration **4 Hours**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT VI: Election Commission **4 Hours**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

P18ACBA006	PEDAGOGY STUDIES	L	T	P	C
	Total Contact Hours – 16	2	0	0	0

	Prerequisite – NIL
	Course Designed by – AICTE

Course Objectives: Students will be able to:

- ✓ Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- ✓ Identify critical evidence gaps to guide the development.

SYLLABUS:

UNIT I:

4 Hours

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT II:

2 Hours

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT III:

4 Hours

Evidence on the effectiveness of pedagogical : Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV:

4 Hours

Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes

UNIT V:

2 Hours

Research gaps and future directions: Research design, Contexts, Pedagogy Teacher education, Curriculum and assessment, Dissemination and research impact.

Suggested reading

- ✓ Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
- ✓ Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

P18ACYO007	STRESS MANAGEMENT BY YOGA	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

SYLLABUS:

UNIT I:

8 Hours

Definitions of Eight parts of yog. (Ashtanga)

UNIT II:**8 Hours**

Yam and Niyam.

Do's and Don't's in life i) Ahinsa, satya, astheya, bramhacharya and aparigraha,ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III:**8 Hours**

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayama

Suggested reading

‘Yogic Asanas for Group Training-Part-I’ :Janardan Swami Yogabhyasi Mandal, Nagpur‘Rajayoga or conquering the Internal Nature’ by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

P18ACBA008	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
	Total Contact Hours – 24	2	0	0	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

SYLLABUS:**UNIT I:****8 Hours**

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom)

Verses- 29,31,32 (pride & heroism)

Verses- 26,28,63,65 (virtue)

Verses- 52,53,59 (dont's)

Verses- 71,73,75,78 (do's)

UNIT II:**8 Hours**

Approach to day to day work and duties.

Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35

Chapter 18-Verses 45, 46, 48.

UNIT III:**8 Hours**

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

Suggested Reading

- “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
- Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
 - The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students