ADHIYAMAAN COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to Anna University, Chennai)

(Accredited by NAAC)

Dr.M.G.R. NAGAR, HOSUR, KRISHNAGIRI (Dt) – 635 130, TAMIL NADU, INDIA

REGULATION 2018

CHOISE BASED CREDIT SYSTEM

B. Tech BIOTECHNOLOGY

VISION

To develop competency with innovative practices of lifelong learning to achieve excellence in the field of biotechnology.

MISSION

- To enable students to acquire knowledge in core aspects of biotechnology by effective teaching learning procedures and apply the manual are as of biotechnology
- To inculcate high quality of education to the students to build their capacity and to sharpen their skills to make them globally competitive and to help in holistic development of their personality
- To train students to serve society taking cognizance of ethical values and noble ideas for the welfare of the society

I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 Graduates of B.Tech (Biotechnology) should provide engineering insight on Mathematical, Physical, Computational, Environmental, Bioengineering, Bioresource Utilization, Life Sciences and expose them to industrial environment.

PEO2 Graduates of B.Tech (Biotechnology) should be able to identify, analyse and to solve problems in the areas of Bioprocess Engineering, Bioenergy, Downstream Processing, Enzyme Technology, Health and Pharmaceutical Biotechnology, etc and to understand the emerging precepts of project management and finance.

PEO3 Graduates of B.Tech (Biotechnology) should be able to acquire skills to become commercial biotechnology entrepreneurs, solve industrial problems, develop professional and ethical attitude, good communication skills and adapt to current

trends by engaging in lifelong learning.

II. PROGRAMMEOUTCOMES (POs)

PO 1: An ability to apply knowledge of mathematics, science, and engineering fundamentals in the areas of biotechnology such as Bioprocess engineering, Genetic engineering, Enzyme technology, Bioinformatics, Downstream processing, etc.,

PO 2: An ability to identify and analyze complex biotechnology-oriented problems and to solve the problems by providing appropriate solutions.

PO 3: An ability to design a bio-based system, component to address the essential issues related to public health, environment and society.

PO 4: An ability to design, analyze and interpret biological data and draw conclusions using broad research-based knowledge.

PO 5: An ability to make the appropriate selection and application of current/ modern engineering techniques/ tools in the area of biotechnology.

PO 6: An ability to inculcate awareness among the students about the impact of various biological issues related to society, ethics, health, culture and safety.

PO 7: An ability to understand and demonstrate the need for the development of sustainable biotechnological solutions for addressing the environmental issues in society.

PO 8: An ability to realize, commit and apply professional ethics by means of technology practice.

PO 9: An ability to inculcate the habit among students to function efficiently as individuals or in multidisciplinary teams.

PO 10: An ability to communicate effectively through verbal and written mode with technical audience.

PO 11: An ability to recognize the need for life- long learning for sustaining professional career.

PO 12: An ability to be competent in engineering management, financeprinciples and its application in multidisciplinary projects.

III. PROGRAMMESPECIFICOUTCOMES (PSOs)

PSO1: To empower students to understand/interpret the fundamental concepts and methodologies of biotechnology and to enhance skills in the areas of cellular, molecular and biochemical technologies

PSO2: To understand and apply major qualitative, computational and business skills in various domains of biotechnology like Genetic Engineering, Bioprocess Engineering,

Immunology, etc., and to excel in a variety of entry level positions in biotechnology industry

PSO3: To develop ability/skills both in theoretical and practical knowledge to pursue higher studies to be an entrepreneur and to serve in different manufacturing facilities like food, pharmaceuticals, healthcare industry, etc.

MAPPING OF PEOS WITH PO AND PSO

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
PEOs1	1	3	1	-	3	3	1	-	-	3		-	3	-	-
PEOs2	3	2	3	2	-	2	-	3	2	-	-	2	1	2	-
PEOs3	3	-	3	-	3	-	3	2	-	-	3	-	-	1	3

NOTE: 1 - LOW, 2 - MEDIUM, 3 - HIGH

MAPPING OF CO WITH PO AND PSO

Course code	Course Name	Category	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
118ENT01	Technical English	HSMC	2		1		2		2		1		1	2	1	2	2
118MAT02	Engineering Mathematics - I	BSC	2		1		2		2		1		1	2	1	2	2
118PHT03	Engineering Physics	BSC	2		1		2		2		1		1	2	1	2	2
118CYT04	Engineering Chemistry	BSC		1	2	1		1		1	2	2		1		1	1
118EGT05	Engineering Graphics	ESC		1	2	1		1		1	2	2		1		1	1
118ESE01	Basic Civil AndMechanical Engineering	ESC		1	2	1		1		1	2	2		1		1	1
118CYP07	Engineering Chemistry Lab	BSC		1	2	1		1		1	2	2		1		1	1
118EPP08	Engineering Practices Lab	ESC		1	2	1		1		1	2	2		1		1	1
118ESE02	Basic Civil, Electrical, And Electronics Engineering	ESC		1	2	1		1		1	2	2		1		1	1
118ESE03	Basic Mechanical, Electrical, And Electronics Engineering	ESC	2		1		2		2		1		1	2	1	2	2
118ESE04	Elements Of Mechanical Engineering	ESC	2		1		2		2		1		1	2	1	2	2
218ENT01	Communicative English	HSMC	2		1		2		2		1		1	2	1	2	2
218MAT02	Engineering Mathematics-II	BSC	2		1		2		2		1		1	2	1	2	2
218GET03	Environmental Science And Engineering	BSC	2		1		2		2		1		1	2	1	2	2
218EMT04	ENGINEERING MECHANICS	ESC		1	2	1		1		1	2	2		1		1	1
218PPT05	Problem Solving And Python Programming	ESC	2		1		2		2		1		1	2	1	2	2
218PHP07	Engineering Physics Laboratory	BSC	2		1		2		2		1		1	2	1	2	2
218BSE01	MATERIAL SCIENCE	BSC	2		1		2		2	3	1		1	2	1	2	2
218BSE02	Quantum Mechanics For Engineers	ESC	2		1		2		2	3	1		1	2	1	2	2
218BSE03	Chemistry For Technologists	ESC	2		1		2		2	3	1		1	2	1	2	2
218BSE04	Energy To Rage Devices And Fuel Cells	ESC	2		1		2		2	3	1		1	2	1	2	2
318BTT02	Biochemistry	PCC	2		1		2		2		1		1	2	1	2	2
318BTT03	Cell Biology	PCC	2		1		2		2		1		1	2	1	2	2

318BTT04	Microbiology	PCC	2		1		2		2		1		1	2	1	2	2
318BTT05	Instrumental Methods Of Analysis	PCC		1	2	1		1		1	2	2		1		1	1
318BTT06	Basic Industrial Biotechnology	PCC		1	2	1		1		1	2	2		1		1	1
318BTP07	Biochemistry Lab	PCC		1	2	1		1		1	2	2		1		1	1
318BTP08	Cell Biology Lab	PCC		1	2	1		1		1	2	2		1		1	1
318BTP09	Microbiology Lab	PCC		1	2	1		1		1	2	2		1		1	1
418BTT02	Molecular Biology	PCC	2		1		2		2		1		1	2	1	2	2
418BTT03	Stoichiometry And Process Calculations	PCC	2		1		2		2		1		1	2	1	2	2
418BTT04	Fundementals Of Unit Operations	PCC	2		1		2		2		1		1	2	1	2	2
418BTT05	Enzyme Technology	PCC		1	2	1		1		1	2	2		1		1	1
418BTT06	Environmental Biotechnology	PCC	2		1		2		2		1		1	2	1	2	2
418BTP07	Molecular Biology Lab	PCC	2		1		2		2		1		1	2	1	2	2
418BTP08	Instrumental Methods Of Analysis Lab	PCC	2		1		2		2		1		1	2	1	2	2
418BTP09	Enzyme Technology Lab	PCC	2		1		2		2		1		1	2	1	2	2
518BTT01	Bioinformatics	PCC	2		1		2		2		1		1	2	1	2	2
518BTT02	Genetic Engineering	PCC	2		1		2		2		1		1	2	1	2	2
518BTT03	Bioprocess Engineering I	PCC		1	2	1		1		1	2	2		1		1	1
518BTT04	Fundamentals Of Mass Transfer	PCC		1	2	1		1		1	2	2		1		1	1
518BTT05	Chemical Thermodynamics & Biothermodynamics	PCC	2		1		2		2		1		1	2	1	2	2
518BTP07	Genetic Engineering Lab	PCC		1	2	1		1		1	2	2		1		1	1
518BTP08	Bioprocess Engineering Lab I	PCC		1	2	1		1		1	2	2		1		1	1
518BTP09	Chemical Engineering Laboratory For Biotechnologists	PCC	2		1		2		2		1		1	2	1	2	2
618BTT01	Protein Engineering	PCC		1	2	1		1		1	2	2		1		1	1
618BTT02	Chemical Reaction Engineering	PCC		1	2	1		1		1	2	2		1		1	1
618BTT03	Bioprocess Engineering II	PCC	2		1		2		2		1		1	2	1	2	2
618BTT04	Health & Pharmaceutical	PCC		1	2	1		1		1	2	2		1		1	1

	Biotechnology																
618BTT05	Immunology	PCC	2		1		2		2		1		1	2	1	2	2
618BTP07	Bioprocess Engineering Lab II	PCC	2		1		2		2		1		1	2	1	2	2
618BTP08	Health & Pharmaceutical Biotechnology Lab	PCC		1	2	1		1		1	2	2		1		1	1
618BTP09	Immunology Lab	PCC	2		1		2		2		1		1	2	1	2	2
618BTP10	Analytical Techniques In Biotechnology Lab	PCC	2		1		2		2		1		1	2	1	2	2
718BTT01	Downstream Processing	PCC		1	2	1		1		1	2	2		1		1	1
718BTT03	Animal Biotechnology	PCC	2		1		2		2		1		1	2	1	2	2
718BTT04	Genomics And Proteomics	PCC	2		1		2		2		1		1	2	1	2	2
718BTT02	Plant Biotechnology	PCC	2		1		2		2		1		1	2	1	2	2
718BTP07	Downstream Processing Lab	PCC	2		1		2		2		1		1	2	1	2	2
718BTP08	Plant Biotechnology Lab	PCC	2		1		2		2		1		1	2	1	2	2
718BTP09	Entrepreneurship Development Lab	PCC	2		1		2		2		1		1	2	1	2	2
718BTE01	Clinical Research And Database Management	PEC		1	2	1		1		1	2	2		1		1	1
718BTE02	Transport Phenomena In Bioprocess	PEC		1	2	1		1		1	2	2		1		1	1
718BTE03	Biosimilar Technology	PEC	2		1		2		2		1		1	2	1	2	2
718BTE04	Rational Drug Discovery	PEC	2		1		2		2		1		1	2	1	2	2
718BTE05	Bioterrorism And National Security	PEC		1	2	1		1		1	2	2		1		1	1
718BTE06	Fundamentals Of Nanobiotechnology	PEC		1	2	1		1		1	2	2		1		1	1
718BTE07	Cancer Biology	PEC	2		1		2		2		1		1	2	1	2	2
718BTE08	Disaster Management	PEC	2		1		2		2		1		1	2	1	2	2
718BTE09	Process Equipment And Plant Design	PEC		1	2	1		1		1	2	2		1		1	1
718BTE10	Principles Of Food Processing	PEC	2		1		2		2		1		1	2	1	2	2
818BTT01	Bioethics, IPR And Entrepreneurship	PCC	2		1		2		2		1		1	2	1	2	2
818BTE01	Tissue Engineering	PEC	2		1		2		2		1		1	2	1	2	2
818BTE02	Tele Medicine	PEC		1	2	1		1		1	2	2		1		1	1
818BTE03	Molecular Pathogenesis	PEC	2		1		2		2		1		1	2	1	2	2
818BTE04	Industrial Safety	PEC	2		1		2		2		1		1	2	1	2	2

818BTE05	Stem Cells In Health Care	PEC		1	2	1		1		1	2	2		1		1	1
818BTE06	Total Quality Management	PEC		1	2	1		1		1	2	2		1		1	1
818BTE07	Agricultural Biotechnology	PEC	2		1		2		2		1		1	2	1	2	2
818BTE08	Medical Coding	PEC	2		1		2		2		1		1	2	1	2	2
818BTE09	Computational Biology	PEC	2		1		2		2		1		1	2	1	2	2
818BTE10	Bio Safety	PEC	2		1		2		2		1		1	2	1	2	2

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CHOISE BASED CREDIT SYSTEM
B.Tech BIOTECHNOLOGY
CURRICULUM AND SYLLABI FOR I TO VIII

SEMESTER I

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
118ENT01	Technical English	HSMC	2	0	2	4	2
118MAT02	Engineering Mathematics-I	BSC	3	0	0	3	3
118PHT03	Engineering Physics	BSC	2	0	0	2	2
118CYT04	Engineering Chemistry	BSC	3	0	0	3	3
118EGT05	Engineering Graphics	ESC	2	0	4	6	4
118ESE0X	Elective (Group I)	ESC	3	0	0	3	3
PRACTICALS							
118CYP07	Engineering Chemistry Laboratory	BSC	0	0	2	2	1
118EPP08	Engineering Practice Laboratory	ESC	0	0	2	2	1
		Total	15	0	10	21	19

ELECTIVE (GROUP1)

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
118ESE01	Basic Civil and Mechanical Engineering	ESC	3	0	0	3	3
118ESE02	Basic Civil Electrical and Electronics Engineering	ESC	3	0	0	3	3
118ESE03	Basic mechanical Electrical and Electronics Engineering	ESC	3	0	0	3	3
118ESE04	Elements of Mechanical Engineering	ESC	3	0	0	3	3

SEMESTER II

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
218ENT01	Communicative English	HSMC	3	0	2	5	3
218MAT02	Engineering Mathematics-II	BSC	3	1	0	4	4
218GET03	Environmental Science and Engineering	BSC	2	0	0	2	2
218EMT04	Engineering Mechanics	ESC	3	0	0	3	3
218PPT05	Problem Solving and Python Programming	ESC	3	0	0	3	3
218ESE0X	Elective (Group I)	ESC	2	0	0	2	2
PRACTICALS							
218PHP07	Engineering Physics Lab	BSC	0	0	2	2	1
218PPP08	Problem Solving and Python Programming Lab	ESC	0	0	2	2	1
		Total	16	1	6	23	19

ELECTIVE (GROUP II)

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
218BSE01	Material Science	ESC	2	0	0	2	2
218BSE02	Quantum Mechanics For Engineers	ESC	2	0	0	2	2
218BSE03	Chemistry for Technologists	ESC	2	0	0	2	2
218BSE04	Energy Storage Devices and Fuel Cells	ESC	2	0	0	2	2

SEMESTER III

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
318MAT01	Engineering Mathematics III	BSC	3	1	0	4	4
318BTT02	Biochemistry	PCC	3	0	0	3	3
318BTT03	Cell Biology	PCC	3	0	0	3	3
318BTT04	Microbiology	PCC	3	0	0	3	3
318BTT05	Instrumental Methods of Analysis	PCC	2	0	0	2	2
318BTT06	Basic Industrial Biotechnology	PCC	2	0	0	2	2
PRACTICALS							
318BTP07	Biochemistry Laboratory	PCC	0	0	2	2	1
318BTP08	Cell Biology Laboratory	PCC	0	0	2	2	1
318BTP09	Microbiology Laboratory	PCC	0	0	2	2	1
	Total		16	1	6	23	20

SEMESTER IV

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
418PST01	Probability and Statistics	BSC	3	1	0	4	4
418BTT02	Molecular Biology	PCC	3	0	0	3	3
418BTT03	Stoichiometric and Process Calculations	PCC	3	1	0	4	4
418BTT04	Fundamentals of Unit Operations	PCC	3	0	0	3	3
418BTT05	Enzyme Technology	PCC	3	0	0	3	3
418BTT06	Environmental Biotechnology	PCC	2	0	0	2	2
X18MC01	Indian Constitution	MCC	1	0	0	1	
PRACTICALS							
418BTP07	Molecular Biology Laboratory	PCC	0	0	2	2	1
418BTP08	Instrumental methods of Analysis Lab	PCC	0	0	2	2	1
418BTP09	Enzyme Technology Laboratory	PCC	0	0	2	2	1
	Total		18	2		26	22

SEMESTER V

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
518BTT01	Bioinformatics	PCC	3	0	0	3	3
518BTT02	Genetic Engineering	PCC	3	0	0	3	3
518BTT03	Bioprocess Engineering I	PCC	3	0	0	3	3
518BTT04	Fundamentals of Mass Transfer	PCC	3	1	0	4	4
518BTT05	Chemical Thermodynamics & Biothermodynamics	PCC	3	0	0	3	3
	Open Elective I	OEC	3	0	0	3	3
X18GCT01	Gender, Culture and Development	MCC	1	0	0	1	-
PRACTICALS							
518BTP07	Genetic Engineering Lab	PCC	0	0	2	2	1
518BTP08	Bioprocess Engineering Lab I	PCC	0	0	2	2	1
518BTP09	Chemical Engineering Laboratory for Biotechnologists	PCC	0	0	2	2	1
		Total	19	1	6	26	22

SEMESTER VI

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
618BTT01	Protein Engineering	PCC	3	0	0	3	3
618BTT02	Chemical Reaction Engineering	PCC	3	1	0	4	4
618BTT03	Bioprocess Engineering – II	PCC	3	1	0	4	4
618BTT04	Health and Pharmaceutical Biotechnology	PCC	3	0	0	3	3
618BTT05	Immunology	PCC	3	0	0	3	3
	Open Elective II	OEC	2	0	0	2	2
PRACTICALS							
618BTP07	Bioprocess Engineering Lab II	PCC	0	0	2	2	1
618BTP08	Health and Pharmaceutical Biotechnology Lab	PCC	0	0	2	2	1
618BTP09	Immunology Lab	PCC	0	0	2	2	1
618BTP10	Analytical Techniques In Biotechnology Lab	PCC	0	0	1	1	-
		Total	17	2	7	26	22

SEMESTER VII

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
718BTT01	Downstream Processing	PCC	3	0	0	3	3
718BTT02	Plant Biotechnology	PCC	3	0	0	3	3
718BTT03	Animal Biotechnology	PCC	3	0	0	3	3
718BTT04	Genomics and Proteomics	PCC	3	0	0	3	3
718BTE_	Professional Elective I	PEC	3	0	0	3	3
718BTE_	Professional Elective II	PEC	3	0	0	3	3
PRACTICALS							
718BTP07	Downstream Processing Lab	PCC	0	0	2	2	1
718BTP08	Plant Biotechnology Lab	PCC	0	0	2	2	1
718BTP09	Entrepreneurship Development Lab	PCC	0	0	2	2	1
718BTP10	Mini Project	PCC	0	0	2	2	1
		Total	18	0	8	26	22

SEMESTER VIII

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
818BTT01	Bioethics, IPR and Entrepreneurship	PCC	3	0	0	3	3
818BTE_	Professional Elective III	PEC	3	0	0	3	3
818BTE_	Professional Elective IV	PEC	3	0	0	3	3
PRACTICALS							
818BTP05	Project Work	PCC	0	0	18	18	9
818BTP10	Industrial Training	PCC	0	0	1	1	
		Total	9	0	19	28	18

OPEN ELECTIVE I

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
518BMO01	Human Anatomy and Physiology	OEC	3	0	0	3	3
518BMO02	Biomedical Instrumentation	OEC	3	0	0	3	3
518BMO03	Bio Control Systems	OEC	3	0	0	3	3
518BMO04	Biomaterials and Artificial Organ	OEC	3	0	0	3	3
518CHO01	Chemical Engineering Modelling and Simulation	OEC					

OPEN ELECTIVE II

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
618CHO01	Chemical Process Industries	OEC	3	0	0	3	3
618CHO02	Mechanical Operations	OEC	3	0	0	3	3
618CHO03	Process Dynamics and Control	OEC	3	0	0	3	3
518CHO04/ 618CHO04	Chemical Process Plant Safety	OEC	3	0	0	3	3
618BMO05	Biomechanics	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE I

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
718BTE01	Clinical Research and Database Management	PEC	3	0	0	3	3
718BTE02	Transport Phenomena In bioprocess	PEC	3	0	0	3	3
718BTE03	Biosimilar Technology	PEC	3	0	0	3	3
718BTE04	Rational Drug Discovery	PEC	3	0	0	3	3
718BTE05	Bioterrorism and National Security	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVE II

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIOD	CREDITS
			L	T	P		
718BTE06	Fundamental of Nanotechnology	PEC	3	0	0	3	3
718BTE07	Cancer Biology	PEC	3	0	0	3	3
718BTE08	Disaster Management	PEC	3	0	0	3	3
718BTE09	Process Equipment and Plant Design	PEC	3	0	0	3	3
718BTE10	Principles of Food Processing	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVE III

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
818BTE01	Tissue Engineering	PEC	3	0	0	3	3
818BTE02	Telemedicine	PEC	3	0	0	3	3
818BTE03	Molecular Pathogenesis	PEC	3	0	0	3	3
818BTE04	Industrial Safety	PEC	3	0	0	3	3
818BTE05	Stem Cells In Healthcare	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVE IV

COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
818BTE06	Total Quality Management	PEC	3	0	0	3	3
818BTE07	Agricultural Biotechnology	PEC	3	0	0	3	3
818BTE08	Computational Biology	PEC	3	0	0	3	3
818BTE09	Medical Coding	PEC	3	0	0	3	3
818BTE10	Biosafety	PEC	3	0	0	3	3

SYMMARY OF CREDT ALLOCATION

B. TECH. BIOTECHNOLOGY										
S.NO.	SUBJECT AREA	CREDITS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	2	3							5
2	BSC	9	7	4	4					24
3	ESC	8	9							17
4	PCC			16	18	19	20	16	12	101
5	OEC					3	2			5
6	PEC							6	6	12
8	Non credit/Mandatory	1				1			1	
TOTAL		20	19	20	22	23	22	22	19	164

118ENT01	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- To foster the ability to write convincing job applications and effective reports.
- To develop their speaking skills to make technical presentations, participate in group discussions.
- To strengthen their listening skills which will help them comprehend lectures and talk in their area of specialization.

UNIT I **9**

Listening - Ink talks and gap exercises - **Speaking** – Asking for and giving directions - **Reading** – short technical texts from journals and newspapers - **Writing** - definitions – instructions – checklists – recommendations - **Vocabulary Development** - technical vocabulary - **Language Development** – parts of speech – articles – word formation.

UNIT II **9**

Listening - longer technical talks - **Speaking** – process description - **Reading** – longer technical texts – **Writing** – graphical representation - **Vocabulary Development** - vocabulary used in formal letters/emails and reports – **Language Development** – tenses - voices - numerical adjectives – question tags.

UNIT III **9**

Listening - listening to classroom lectures - **Speaking** – introduction to technical presentations - **Reading** – longer texts both general and technical and practice in speed reading – **Writing** – process description using sequence words and sentences - **Vocabulary Development** - Misspelled words – one-word substitution - **Language Development** - embedded sentences – singular and plural nouns - compound nouns - editing

UNIT IV **9**

Listening - Listening to documentaries and making notes - **Speaking** – mechanics of presentations - **Reading**– reading comprehension – **Writing** - email etiquettes - job application – cover letter – Résumé preparation - essay writing - **Vocabulary Development** – synonyms and antonyms – paraphrasing - **Language Development** – modals– conditionals.

UNIT V **9**

Listening - TED talks - **Speaking** – brainstorming and debate – **Reading** – reading and understanding technical articles – **Writing** – reports - minutes of a meeting - **Vocabulary Development**- verbal analogies - phrasal verbs - **Language Development** - concord - reported speech.

Total Hours 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Read technical texts and write area- specific texts effortlessly.

CO2: Listen and comprehend lectures and talks in their area of specialization successfully.

CO3: Speak appropriately and effectively in varied formal and informal contexts.

CO4: Understand the basic grammatical structures and its applications.

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016.
2. Sudharshana. N. P and Saveetha. C. English for Technical Communication. (
3. Uttham Kumar. N. Technical English I (with work book). Sahana Publications, Coimbatore, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015.
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. CengageLearning, USA: 2007.

Note: The book given under Extensive Reading is meant for inculcating the reading habit of the students.

They need not be used for testing purposes.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
Co1	Read technical text sandwritearea-specifictextseffortlessly.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
Co2	Listen andcomprehend lecturesandtalksin theirarea ofspecializationsuccessfully.		**1**	**2**	**1**		**1**	**3**	**1**	**2**	**2**		**1**		**1**	**1**
Co3	Speakappropriatelyandeffectivelyinvariedformalandinformalcontexts.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**	**3**	**1**	**1**
Co4	Understandthebasicgrammaticalstructuresanditsapplications.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

118MAT02 **ENGINEERING MATHEMATICS - I** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the eigen value problems.
- To solve differential equations of certain types, including systems of differential equations that they might encounter in the same or higher semesters.
- To understand the concepts of curvatures, evolutes and envelopes and to study the maxima and minima of any function.
- To learn the partial derivations and apply the same to find maxima and minima.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.

UNIT I **9**

Eigen values and eigen vectors of a real symmetric matrix –Properties – Cayley - Hamilton theorem (Statementonly) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form–Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II **9**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes –Envelopes – Evolutes as envelope of normals.

UNIT III **9**

Partialderivatives–Euler'stheoremforhomogenousfunctions–Totalderivatives–Jacobians–Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT IV **9**

Higher order linear differential equations with constant coefficients – Method of variation of parameters

– Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients-Applications to Engineering Problems-Electric Circuits, Simple Harmonic Motions and bending of beams.

UNIT V **9**

Laplace transforms – Conditions for existence –Basic properties (without proof) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop the knowledge of basic linear algebraic concepts.

CO2: Determine the solutions of ordinary differential equations by various methods which have an

application in their core subjects.

CO3: Acquire the basic knowledge of ordinary differential calculus. CO4: Compute maxima and minima of a function.

CO5: Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th edition New Delhi 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCE BOOKS

1. T.Veerarajan, "Engineering Mathematics " Tata McGraw-Hill Publishing company, New Delhi, 2014.
2. Kandasamy.P, Thilagavathy,K., & Gunavathi.K., "Engineering Mathematics for first year "., S.Chand &Company Ltd., New Delhi,2014.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop the knowledge of basic linear algebraic concepts.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Determine the solutions of ordinary differential equations by various methods which have an application in their core subjects.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Acquire the basic knowledge of ordinary differential calculus.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Compute maxima and minima of a function.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Apply Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

118PHT03	ENGINEERING PHYSICS	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the concept of properties of matter.
- To understand the properties of sound and principles of quantization of energy.
- To understand the properties of coherent light and its importance.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress – Strain diagram – Factors affecting elasticity – Twisting couple on a wire – Torsion pendulum – Young's modulus - cantilever - Heavy cantilever – Uniform and Non uniform bending (theory and experiment)–Viscosity- Poiseuille's method for Coefficient of Viscosity.

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound, loudness, intensity – Decibel – Weber Fechner Law – Reverberation and Reverberation time –derivation of Sabine's formula for Reverberation time (Growth and Decay)– Absorption coefficient and its determination. Introduction of Ultrasonics – Production – magnetostriction effect – magnetostriction generator – piezoelectric effect–piezo electric generator– Detection of ultrasonic waves, properties–Cavitation–Applications–Depth of sea –Non Destructive Testing.

UNIT III QUANTUM PHYSICS 9

Black body radiation–Planck's theory (derivation)–Deduction of Wien's displacement law and Rayleigh–jeans' Law from Planck's theory – Compton Effect – derivation – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations– Physical significance of wave function – Particle in a one dimensional box – Degeneracy and Non Degeneracy.

UNIT IV LASER 9

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion – pumping– Einstein's A and B coefficients – derivation – Types of lasers – He-Ne, CO2, Nd-YAG, Semiconductorlasers – homojunction – Applications of Laser.

UNIT V WAVE OPTICS & FIBRE OPTICS 9

Interference – Air wedge (theory & experiment) – Polarization– Methods of polarizing light-Theory of plane circularly and elliptically polarized light. Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle – Types of optical fibers (material, refractive index, and mode) – Fiber optical communication system (Block diagram) – Fiber optic sensors – Temperature & Displacement sensors (Qualitative).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.

CO2: To understand basic concepts of high frequency sound waves and its applications.

CO3: To understand basic concepts of quantum mechanical behavior of wave and particle along with

applications.

CO4: To understand the concepts of production of laser and its behavior with diffraction principle of interference.

CO5: To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.

TEXT BOOKS

1. R.K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi (2003)
2. Jayaprakash R.N, 'Engineering Physics - I', Dhanam Publications, Chennai, (2007).

REFERENCE BOOKS

1. R. Murugeshan ,Kiruthiga Sivaprasath , Modern Physics S. Chand publications 2016,New Delhi.
2. GhatakOptics the McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
3. Dr.M.N.Avadhanulu ,Introduction to Lasers: theory and applications S.Chand publications 2012,New Delhi.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	To understand basic concepts of high frequency sound waves and its applications.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	To understand basic concepts of quantum mechanical behavior of wave and particle along with applications.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	To understand the concepts of production of laser and its behavior with diffraction principle of interference.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

118CYT04	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To recall the terminologies of electrochemistry and explain the function of batteries andfuel cells with its electrochemical reactions.
- To understand the fundamentals of corrosion, its types and polymers with its applications.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseousfuels

UNIT I WATER AND ITS TREATMENT 9

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -Alkalinity-types of alkalinity-determination of alkaninity-boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (carbonate, colloidal, phosphate and calgon conditioning) external treatment Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES 9

Electrochemical cell-single electrode potential-standard electrode potential-electrochemical series and its significance-EMF of a cell- Nernst equation -Electrodes-Reference electrodes-hydrogen, calomel, quinhydrone and glass electrodes. Determination of pH of a solution using a glass electrode. Batteries - primary and secondary cells, dry cell, alkaline, lead acid storage cell, Ni-Cd battery and lithium nano battery. Clean energy fuel cells - H_2-O_2 fuelcell.

UNIT III CORROSION SCIENCE 9

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion – Pilling Bedworth ratio - types of oxide layer (stable, unstable, volatile, porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion- differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current Cathodic protection method - electroplating - electroless plating.

UNIT IV POLYMERS AND ITS PROCESSING 9

Monomers - polymers - polymerization - functionality – degree of polymerization - classification of polymersbased on source and applications - Molecular weight determination. Types of polymerizations: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of PE, PVC, Teflon, terylene, Nylon and Bakelite. Rubber-drawbacks of natural rubber-Vulcanization-Compounding of plastics - injection and blow moulding methods.

UNIT V FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum -

manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. **Combustion of fuels:** Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.

CO2: Construct an electrochemical cell and identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.

CO3: Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.

CO4: Analyse the three types of fuels based on calorific value for selected application.

CO5: Analyse the three types of fuels based on calorific value for selected application.

TEXT BOOKS

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi,2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi,2015

REFERENCE BOOKS

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Construct an electrochemical cell and identify the components and processes in batteries and infer the selection criteria for commercial battery systems with		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

	respect to different applications.															
CO3	Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Analyse the three types of fuels based on calorific value for selected application.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Analyse the three types of fuels based on calorific value for selected application.		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**	

118EGT05 **ENGINEERING GRAPHICS** **L T P C**

2 0 4 4

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the graphical skills for drawing the object and the principle of free-hand sketching techniques.
- To understand the principle of orthographic projection of points, lines and plane surfaces.
- To study the principle of simple solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.

Concepts and conventions (Not for Examination) **3**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I **PLANE CURVES AND FREE HAND SKETCHING** **9+6**

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II **PROJECTION OF POINTS, LINES AND PLANE SURFACES** **9+6**

Projectionofpointsandstraightlineslocatedinthefirstquadrant–Determinationoftruelengthsand true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS 9+6

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9+6

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 9+3

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms,pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

Total Hours 45+30 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Recognize the conventions and apply dimensioning concepts while drafting simple objects.

CO2: Draw the orthographic projection of points, line, and plane surfaces.

CO3: Draw the orthographic projection of simple solids.

CO4: Draw the section of solid drawings and development of surfaces of the given objects.

CO5: Apply the concepts of isometric and perspective projection in engineering practice.

TEXT BOOKS

1. Ranganath G, Channankaiah and Halesh Koti, “Engineering Graphics”, Second Edition, Sahana Publishers,2015.
2. Bhatt. N.D., “Engineering Drawing” Charotar Publishing House, 53th Edition, 2014.

REFERENCE BOOKS

1. Dhananjay A. Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited, 2017.
2. Gopalakrishnana. K. R, “Engineering Drawing” (Vol. I & II), Subhas Publications, 2014.
3. Basant Agarwal and C.M.Agarwal, “Engineering Drawing”, Tata McGraw Hill, 2013.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Recognize the conventions and apply dimensioning concepts while drafting simple objects		1	2	1		1		1	2	2		1		1	1
CO2	Draw the orthographic		1	2	1		1		1	2	2		1		1	1

	projection of points, line, and plane surfaces.															
CO3	Draw the orthographic projection of simple solids.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Draw the section of solid drawings and development of surfaces of the given objects.	**2**		**1**		**2**		**2**	**3**	**1**		**1**	**2**	**1**	**2**	**2**
CO5	Apply the concepts of isometric and perspective projection in engineering practice.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

118ESE01 BASIC CIVIL ANDMECHANICAL ENGINEERING L T P C

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To gain the knowledge on civil works like masonry, roofing, flooring and plastering.
- To gain the knowledge on stress, strain of various building and foundations.
- The students should familiar with foundry, welding and forging processes.
- The students should familiarly work principle of IC engines and its types.
- To gain the knowledge about various energy recourses and refrigeration air condition systems.

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects, types, classification, principles, measurements of distances, angles, leveling, determination of areas, illustrative examples. **Civil Engineering Materials:** Bricks, stones, sand, cement, concrete, steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES 10

Foundations: Types, Bearing capacity, Requirement of good foundations. **Superstructure:** Brick masonry, stone masonry, beams, columns, lintels, roofing, flooring, plastering, Mechanics, Internal and external forces, Stress, Strain, Elasticity, Types of Bridges and Dams, Basics of Interior Design and Landscaping.

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UNIT III FOUNDRY WELDING AND FORGING 10

Foundry: Introduction - Patterns –materials. Types of pattern and pattern allowances. Molding sand, types and properties, Molding procedure. **Welding:** Definition and Classification, Gas welding, Oxy Acetylene welding, Types of flames, advantages and disadvantages of gas welding. Resistance welding - Classification, Spot welding and Seam welding. Soldering, Definition and Classification. Brazing – Definition and Classification. **Forging:** Types of Forging, Differences between Hot working

and Cold working processes.

UNIT IV **I C ENGINES& BOILERS** **8**

Internal combustion engines, working principle of Petrol and Diesel Engines, Four stroke and Two stroke cycles, Comparison of four stroke and two stroke engines, Boilers: Introduction of boilers, classification, Lancashire boiler, Babcock and Wilcox boiler, list of boiler mountings and accessories and applications (no sketches).

UNIT V **SOURCE OF ENERGY&REFRIGERATION** **8**

Sources of energy: Introduction, conventional and non-conventional sources of energy, examples, solar energy, hydro power plant. Introduction to refrigeration and air-conditioning, COP, properties of refrigerants and types of refrigerants, working principle of vapour compression & vapour absorption refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: The usage of surveying and properties of construction materials.

CO2: The stress strain of various building and material such as substructure, road transport and bridge.

CO3: The concept of manufacturing methods encountered in engineering practice such as foundry, welding and forging processes.

CO4: The working of internal combustion engines and its types.

CO5: The concept of energy conservation in practical, power plant refrigeration air condition and its types.

TEXT BOOKS

1. Ranganath G and Channankaiah, “Basic Engineering Civil & Mechanical”, S.S.Publishers, 2014.
2. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.

REFERENCE BOOKS

1. Venugopal.K and PrabhuRaja.V, “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam, 2015.
2. Ramamrutham. S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.
3. Shanmugasundaram. S and Mylsamy. K, “Basics of Civil and Mechanical Engineering”, Cenage Learning
4. India Pvt.Ltd, NewDelhi, 2012.
5. Khanna O.P, Foundry Technology, Dhanpat Rai Publishing Co. (P) Ltd, 2011.
6. Shanmugam G., “Basic Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 2010.

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	The usage of surveying and properties of construction materials.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	The stress strain of various building and material such as substructure, road transport and bridge.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	The concept of manufacturing methods encountered in engineering practice such as foundry, welding and forging processes.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	The working of internal combustion engines and its types.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	The concept of energy conservation in practical, power plant refrigeration air condition and its types.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

118CYP07 **ENGINEERING CHEMISTRY LAB** **L T P C**

0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- Students will be conversant with the estimation of various compound Bussing volumetric and instrumental analysis

LIST OF EXPERIMENTS (A minimum of TEN experiments shall be offered)

1. Estimation of Total hardness by EDTA
2. Determination of percentage of calcium in Lime Stone by EDTA
3. Estimation of chloride in water sample
4. Estimation of alkalinity of Water sample
5. Determination of DO in Water (Winkler's Method)
6. Determination of Rate of Corrosion of the given steel specimen by weight loss method (Without inhibitor)
7. Determination of Rate of Corrosion of the given steel specimen by weight loss method (With inhibitor)
8. Conduct metric titration (Simple acid base)
9. Conduct metric titration (Mixture of weak and strong acids)
10. Conduct metric titration using BaCl2vs Na2SO4
11. Potentiometric Titration (Fe2+ / KMnO4 orK2Cr2O7)
12. PH titration (acid &base)

13. Determination of water of crystallization of a crystalline salt -Copper sulphate
14. Preparation of Bio Diesel by Trans etherification method

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Carry out the volumetric experiments and improve the analytical skills.

CO2: Understand the maintenance and usage of analytical instruments and thereby develop their

CO3: skills in the field of engineering.

CO4: Understand the principle and handling of electrochemical instruments and Spectrophotometer.

CO5: Apply their knowledge for protection of different metals from corrosion by using different inhibitors

TEXT BOOKS

1. Arthur I. Vogel's, "Quantitative Inorganic Analysis including Elementary Instrumental Analysis", ELBS, Group, 7th Edition, 2000.
2. Dr. K .Sivakumar, "Engineering Chemistry lab manual", S.S publishers, 2016.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Carry out the volumetric experiments and improve the analytical skills.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Understand the maintenance and usage of analytical instruments and thereby develop their		**1**	**2**	**1**		**1**		**1**	**2**	**2**	**3**	**1**		**1**	**1**
CO3	skills in the field of engineering.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Understand the principle and handling of electrochemical instruments and Spectrophotometer.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Apply their knowledge for protection of different metals from corrosion by using different inhibitors	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

118EPP08	ENGINEERING PRACTICES LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To get the knowledge on welding techniques and its types.
- To do the fitting operation on a given material. (Specimen)
- To carry out sheet metal operation.
- To know the principle involved in plumbing work.
- To do the carpentry work on a given work piece

LIST OF EXPERIMENTS

WELDING:

Study of electric Arc welding and Gas welding tools and equipments.

Preparation of Arc welding and Gas welding models: i) Butt joint ii) Lap joint iii) T -joint.

FITTING:

Study of fitting tools and operations.

Preparation offitting models: i) V-fitting ii) Square fitting

SHEET METAL WORK:

Study of sheet metal tools and operations

Preparation of sheet metal models: i) Tray ii) Funnel

PLUMBING WORKS:

Study of pipeline joints and house hold fittings.

Preparation of plumbing models: Basic pipe connections with PVC and GI pipefittings.

CARPENTRY:

Study of wooden joints and tools used in roofs, doors, windows, furniture.

Preparation of carpentry models: i) Lap joint ii) Dovetail joint iii) T-Joint

DEMONSTRATION ON:

ELECTRICAL ENGINNEERING PRACTICE

Study of Electrical components and equipment's

Residential house wiring using switches, fuse, indicator, lamp and energy meter.

ELECTRONICS ENGINNEERING PRACTICE

Study of Electronic components –Resistor, color coding, capacitors etc

Soldering practice – components soldering in simple electric circuit & testing continuity

COMPUTER HARDWARE AND SOFTWARE PRACTICE

Study of PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel, PowerPoint and Publisher.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Prepare simple Lap, Butt and T- joints using arc welding equipments.

CO2: Prepare the rectangular trays and funnels by conducting sheet metal operation.

CO3: Prepare the pipe connections and identify the various components used in plumbing.

CO4: Prepare simple wooden joints using wood working tools.

CO5: Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions

TEXT BOOKS

1. Ranganath. G, & Channankaiah, "Engineering Practices Laboratory Manual" S.S. publishers, 2014.
2. Jeyapoovan.T &, S Gowri "Engineering Practice Lab Manual" Vikas publishing house pvt.ltd, 2014.

REFERENCE BOOKS

1. Kannaiah.P & Narayana.K.L, "Manual on Workshop Practice", Scitech Publications, 2015.
2. Ramesh BabuV, "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai,
3. Revised Edition, 2014.
4. Peter Norton, "Introduction to Computers", 7th Edition, Mc Graw Hill, 2010.
5. Bawa. H.S, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2009.
6. David Anfinson and Ken Quamme, "IT Essentials PC Hardware and Software Companion Guide", CISCO Press, Pearson Education, Third Edition, 2008.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Prepare simple Lap, Butt and T- joints using arc welding equipments.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Prepare the rectangular trays and funnels by conducting sheet metal operation.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Prepare the pipe connections and identify the various components used in plumbing.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Prepare simple wooden joints using wood working tools.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Demonstrate basic electrical, electronic and computer components based on their physical parameters and dimensions		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

118ESE02 BASIC CIVIL, ELECTRICAL, AND ELECTRONICS ENGINEERING L T P C

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To gain knowledge about Civil Engineering Materials.
- To learn about Structural Components of Building.
- To learn the basics of electrical elements.
- To introduce the fundamental concepts of DC and AC circuits.
- To interpret the principle and characteristics of semiconductor devices.

PART-A (CIVIL)

UNIT I CIVIL ENGINEERING MATERIALS 9

Civil Engineering Materials: Bricks, Stones, Sand, Cement, Concrete & Steel sections. M-Sand and their types, Admixtures-Fibers and Fabrics, Superplasticizers - Selection of Materials.

UNIT II COMPONENTS OF BUILDING 9

Component parts of the building -Substructure (Foundation) Types, Bearing capacity, Requirement of Good Foundations. Superstructure: Brick Masonry, Stone Masonry, Lintels, Roofing, Flooring, Plastering Typical cross-section showing the Buildings in a Structure, Standard Legends and Insignia

PART-B (ELECTRICAL & ELECTRONICS)

UNIT III INTRODUCTION TO BASIC ELECTRICAL ELEMENTS 9

Electrical circuit: passive elements - Resistor, Inductor and Capacitor; active elements- Current, Voltage, Power and Energy – Ohm's Law and limitations - Kirchhoff's Laws – relationship between current, voltage and power – Resistors in series, parallel and series -parallel circuits

UNIT IV FUNDAMENTALS OF DC AND AC CIRCUITS 9

DC Circuits: Sources of Electrical Energy - Independent and Dependent Source, Source Conversion - Star –Delta conversion- Mesh and Nodal Analysis. AC Circuits: Generation of sinusoidal - voltage, average - RMS value, form factor and peak factor- Phasor diagrams of R, L, C, combination of R-L, R-C and R-L-C circuit.

UNIT V SEMICONDUCTOR DEVICES AND SWITCHING THEORY 9

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET -Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Know the usage of surveying and properties of construction materials.

CO2: Understand the stress strain of various building and material such as substructure, road transport and bridge.

CO3: Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws.

CO4: Acquire a good understanding of DC and AC circuits.

CO5: Demonstrate the characteristics of semiconductor devices

TEXT BOOKS

1. Ranganath G and Channankaiah, "Basic Engineering Civil & Mechanical", S.S.Publishers, 2014.
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.
3. Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education Private Limited, 2010.
4. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003

REFERENCE BOOKS

1. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering", Cenage Learning India Pvt.Ltd, NewDelhi, 2012.
2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.
3. B.L.Theraja, A.K.Theraja, "A Text Book of Electrical Technology, Volume I ", S.Chand and company Ltd., 2006.
4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9thEdition, Pearson Education / PHI, 2007.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Know the usage of surveying and properties of construction materials.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Understand the stress strain of various building and material such as substructure, road transport and bridge.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Acquire a good understanding of DC and AC circuits.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Demonstrate the characteristics of semiconductor devices	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

118ESE03	BASIC MECHANICAL, ELECTRICAL, AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- The students should familiar with foundry and welding processes.
- The students should familiar with working principle of IC engines and to gain the knowledge about various energy resources, refrigeration and air conditioning systems.
- To learn the basics of electrical elements.
- To introduce the fundamental concepts of DC and AC circuits.
- To interpret the principle and characteristics of semiconductor devices.

PART-A (MECHANICAL)

UNIT I INTRODUCTION TO FOUNDRY AND WELDING 8

Foundry: Introduction - Patterns –materials. Types of pattern and pattern allowances. Molding sand, types and properties, Molding procedure. Welding: Definition and Classification, Gas welding, Oxy Acetylene welding, Types of flames, advantages and disadvantages of gas welding. Resistance welding - Classification, Spot welding and Seam welding. Soldering - Definition and Classification. Brazing – Definition and Classification

UNIT II I C ENGINES, SOURCE OF ENERGY & REFRIGERATION 9

Internal combustion engines, working principle of Petrol and Diesel Engines, four stroke and Two stroke cycles, Comparison of four stroke and two stroke engines.

Sources of energy: Introduction, conventional and non-conventional sources of energy, examples, solar energy. Introduction to refrigeration and air-conditioning, COP, properties of refrigerants and types of refrigerants, working principle of vapour compression & vapour absorption refrigeration system, Layout of typical domestic refrigerator, Window and Split type room Air conditioner.

PART-B (ELECTRICAL AND ELECTRONICS)

UNIT III INTRODUCTION TO BASIC ELECTRICAL ELEMENTS 9

Electrical circuit: passive elements - Resistor, Inductor and Capacitor; active elements- Current, Voltage, Power and Energy – Ohm's Law and limitations - Kirchhoff's Laws – relationship between current, voltage and power – Resistors in series, parallel and series -parallel circuits.

UNIT IV FUNDAMENTALS OF DC AND AC CIRCUITS 9

DC Circuits: Sources of Electrical Energy - Independent and Dependent Source, Source Conversion - Star –Delta conversion- Mesh and Nodal Analysis.

AC Circuits: Generation of sinusoidal - voltage, average - RMS value, form factor and peak factor- Phasor diagrams of R, L, C, combination of R-L, R-C and R-L-C circuits

UNIT V SEMICONDUCTOR DEVICES AND SWITCHING THEORY 9

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET -Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Learn the concept of manufacturing methods encountered in engineering practice such as foundry and welding processes

CO2: Know the working of internal combustion engines and the concept of sources of energy, working principle of refrigeration and air conditioning.

CO3: Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws

CO4: Acquire a good understanding of DC and AC circuits.

CO5 : Demonstrate the characteristics of semiconductor devices

TEXT BOOKS

1. Ranganath G and Channankaiah, "Basic Engineering Civil & Mechanical", S.S.Publishers, 2014.
2. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education Private Limited, 2010.
4. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

REFERENCE BOOKS

1. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering", Cenage Learning India Pvt.Ltd, NewDelhi, 2012.
2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.
3. Venugopal.K and PrabhuRaja.V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2015.
4. B.L.Theraja, A.K.Theraja, "A Text Book of Electrical Technology, Volume I ", S.Chand and company Ltd., 2006.
5. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9thEdition, Pearson Education / PHI, 2007

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learn the concept of manufacturing methods encountered in engineering practice such as foundry and welding processes	2		1		2		2		1		1	2	1	2	2

CO2	Know the working of internal combustion engines and the concept of sources of energy, working principle of refrigeration and air conditioning.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Acquire a good understanding of DC and AC circuits.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Demonstrate the characteristics of semiconductor devices	**2**		**1**		**2**		**2**	**3**	**1**		**1**	**2**	**1**	**2**	**2**

118ESE04 **ELEMENTS OF MECHANICAL ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To gain the knowledge of Various Energy sources, Boilers.
- To explore knowledge of turbine, refrigeration and air-condition systems.
- To explore knowledge internal combustion engines and their working.
- To gain knowledge on the principles on metal forming castings, forging and soldering.
- To gain the knowledge of thread fasteners and power transmission

UNIT I **SOURCE OF ENERGY & BOILERS** **8**

Sources of energy: Introduction, conventional and non-conventional sources of energy, examples, solar energy, hydro power plant. Steam: Steam formation, steam properties- specific volume, enthalpy & internal energy, types of steam (no numerical problems) Boilers: Introduction of boilers, classification, Lancashire boiler, Babcock and Wilcox boiler, list of boiler mountings and accessories and applications (no sketches).

UNIT II **TURBINES & REFRIGERATION** **9**

Turbines: Introduction and classification of steam turbines, working principle of Impulse and Reaction

steam turbines, compounding of impulse steam turbines, Introduction and classification of Gas turbines, open and closed cycle gas turbines, differences, Hydraulic turbines: Introduction and classification, working principle of impulse turbine (Pelton wheel), working principle of reaction turbines (Francis turbine and Kaplan turbine) Refrigeration: Introduction to refrigeration and air-conditioning, COP, properties of refrigerants and types of refrigerants, working principle of vapour compression & vapour absorption refrigerators, working principle of domestic air-conditioner

UNIT III INTERNAL COMBUSTION ENGINES 9

Internal combustion engines: Classification of I.C engines, parts of I. C engines, working principle of 4-stroke (petrol & diesel engines), working principle of 2- stroke (petrol & diesel engines).

UNIT IV FOUNDRY WELDING AND FORGING 9

Foundry: Introduction, Patterns, materials. Types of pattern and pattern allowances. Molding sand, types and properties, Molding procedure. Welding: Definition and Classification – Gas welding – Oxy Acetylene welding, Types of flames, advantages and disadvantages of gas welding. Resistance welding, Classification, Spot welding and Seam welding. Soldering – Definition and Classification. Brazing – Definition and Classification. Forging: Types of Forging – Differences between Hot working and Cold working processes

UNIT V THREAD FASTENERS AND POWER TRANSMISSION 9

THREAD FASTENERS: Elements of Screw thread, External threads, Internal threads, Screw pair- Parallel and Taper- Single and Multi-start threads, Profile and Forms of Screw threads, Bolt- Hexagonal, Square and T-head- Hook bolt, J bolt, Nuts- Hexagonal - Square, Washer- Plain.

POWER TRANSMISSION: Belt Drives- Classification and Applications, Velocity ratio, Creep and Slip, Idler Pulley, Stepped Pulley and Fast & Loose Pulley.

Gear and Gear Trains: Definitions, Classification and Applications, Simple Problems on velocity ratio, gear ratio.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Know about the prime movers such as turbines and IC engines, refrigeration and air-conditioning systems

CO2: Gain the knowledge on working principles of turbine, refrigeration and its type applications

CO3: Become familiar on IC engines, types of IC engines and it's working.

CO4: Become familiar on molding, casting, forging and solidification and their end products.

CO5: Gain the knowledge on forms of screw threads, mechanism of power transfer through belt, rope, chain and gear drives

TEXT BOOKS

1. Ranganath G and Channankaiah, “Basic Engineering Civil & Mechanical”, S.S.Publishers, 2014.
2. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.
3. Gopalakrishna K R, “Elements of Mechanical Engineering”, Subhas Publications, Bangalore, 2008

REFERENCE BOOKS

1. Hajra Choudry, K.P.Roy and Nirjhar Roy "Elements of Mechanical Engineering, Vol.-1 & 2", 7th Edition, Media Promoters, New Delhi, 2012.
2. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering", 1st Edition, Cenage Learning India Pvt.Ltd, NewDelhi, 2012.
3. Khanna O.P, Foundry Technology, Dhanpat Rai Publishing Co. (P) Ltd, 2011.
4. Venugopal.K and PrabhuRaja.V, "Basic Mechanical Engineering", Anuradha Publishers, 2010.
5. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd, 2009.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Know about the prime movers such as turbines and IC engines, refrigeration and air-conditioning systems	2		1		2		2		1		1	2	1	2	2
CO2	Gain the knowledge on working principles of turbine, refrigeration and its type applications	2		1		2		2		1		1	2	1	2	2
CO3	Become familiar on IC engines, types of IC engines and it's working.	2		1		2		2		1		1	2	1	2	2
CO4	Become familiar on molding, casting, forging and solidification and their end products.		1	2	1		1		1	2	2		1		1	1
CO5	Gain the knowledge on forms of screw threads, mechanism of power transfer through belt, rope, chain and gear drives	2		1		2		2	3	1		1	2	1	2	2

Semester II

218ENT01 **Communicative English** **L T P C**
3 0 2 3

OBJECTIVES

At the end of the course, the students should be able to:

- To help learners develop their listening skills which will enable them listen to lecturesand comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To develop the basic reading and writing skills of first year engineering and technology

students.

- To help learners develop grammar and vocabulary of a general kind by developing their reading skills

UNIT I **9**

Listening - conversation - Speaking – introducing oneself - exchanging personal information - Reading – comprehension - Writing - paragraph - Vocabulary Development - synonyms and antonyms - Language Development – consonants & vowels - phonetic transcription.

UNIT II **9**

Listening - telephonic conversation - Speaking – sharing information of a personal kind – greeting - taking leave - Reading – short stories – The Gift of the Magi, A Service of Love and The Last Leaf by O. Henry – Writing – developing hints - Vocabulary Development – everyday vocabulary - Language Development – British and American English - infinitive and gerund.

UNIT III **9**

Listening – class memory quiz - Speaking – impromptu - Reading – magazines – Writing – agenda - proposals - Vocabulary Development - important words used in speaking and writing - Language Development – types of sentences - information and emphasis.

Agenda – Minutes of Meeting – Advertisement – Fliers – Brochures – Faxes – Internet Websites – Intranet Websites – Extranet Websites – Blog writing.

UNIT IV **9**

Listening – interviews of famous persons - Speaking – story narration - Reading – case study – Writing – invitation letter - quotation letter - Vocabulary Development – listening and reading vocabulary - Language Development – cause and effect – purpose and function.

UNIT V **9**

Listening - a scene from a film - Speaking - role play - Reading – jigsaw – Writing – essay writing - Vocabulary Development- business vocabulary - Language Development - degrees of comparison – real English phrases.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Comprehend conversations and talks delivered in English.

CO2: Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.

CO3: Read short stories, magazines, novels and other printed texts of a general kind.

CO4: Write short paragraphs, essays, letters and develop hints in English.

TEXT BOOKS

1. Board of Editors. Using English, A Coursebook for Undergarduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.
3. Uttham Kumar, N. Communicative English (with work book). Sahana Publications, Coimbatore, 2019.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. NewYork: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P.Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books:2013.
4. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book & Workbook). Cambridge University Press, New Delhi: 2005.
6. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge, 2011.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Comprehend conversations and talks delivered in English.	2		1		2		2		1		1	2	1	2	2
CO2	Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.	2		1		2		2	3	1		1	2	1	2	2
CO3	Read short stories, magazines, novels and other printed texts of a general kind.	2		1		2		2		1		1	2	1	2	2
CO4	Write short paragraphs, essays, letters and develop hints in English.		1	2	1		1		1	2	2		1		1	1

218MAT02 ENGINEERING MATHEMATICS-II

L	T	P	C
3	1	0	4

Prerequisite ENGINEERING MATHEMATICS-I

OBJECTIVES

At the end of the course, the students should be able to:

- To understand double and triple integration concepts and apply to study vector calculus comprising of surface and volume integrals along with the classical theorems involving them.
- To learn analytic functions and their properties and also conformal mappings with

few standard examples that have direct applications.

- To grasp the basics of complex integration and application to contour integration which is important for evaluation of certain integrals encountered in engineering problems.
- To introduce the concept of improper integrals through Beta and Gamma functions.

UNIT I **INTEGRAL CALCULUS** **9+3**

Definite and indefinite integrals - Substitution rule – Techniques of integration –Integration by parts – Trigonometric integrals - Trigonometric substitutions - Integration of rational functions by partial fractions – Integration irrational functions.

UNIT II **MULTIPLE INTEGRALS** **9+3**

Double integration – Cartesian and polar co-ordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates –Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

UNIT III **VECTOR CALCULUS** **9+3**

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal, vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (Statement and applications only) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT IV **ANALYTIC FUNCTIONS** **9+3**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (Statement and applications only) – Harmonic and orthogonal properties of analytic function (Statement and applications only) – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and bilinear transformation.

UNIT V **COMPLEX INTEGRATION** **9+3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points –Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding poles on boundaries).

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals and also extending the concept to vector fields.

CO2: Learn the basic concepts of analytic functions and transformations of complex functions.

CO3: Master the integration in complex domain.

CO4: Understand the use of improper integrals' applications in the core subject.

TEXT BOOKS

1. Grewal. B.S., "Higher Engineering Mathematics", 43th Edition, Khanna Publications, Delhi, 2015.

REFERENCE BOOKS

1. James Stewart, “Stewart Calculus”, 8th edition,2015, ISBN: 9781285741550/1285741552.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, tenth edition, Wiley India, 2011.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, “Engineering Mathematics for first year”, S.Chand & Company Ltd., 9th Edition, New Delhi, 2014.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Determine the area and volume in 2-dimension and 3-dimension respectively using multiple integrals and also extending the concept to vector fields.	2		1		2		2		1		1	2	1	2	2
CO2	Learn the basic concepts of analytic functions and transformations of complex functions.		1	2	1		1		1	2	2		1		1	1
CO3	Master the integration in complex domain.		1	2	1		1		1	2	2		1		1	1
CO4	Understand the use of improper integrals’ applications in the core subject.	2		1		2		2		1		1	2	1	2	2

218GET03 ENVIRONMENTAL SCIENCE ANDENGINEERING L T P C
2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world;
  envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.

UNIT I NATURAL RESOURCES 14

Definition, scope and importance of environment – need for public awareness - Forest resources: Use and over- exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and

ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMSANDBIODIVERSITY 8

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes.

UNIT III ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation –consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child

welfare – role of information technology in environment and human health – Case studies.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

CO2: Public awareness of environmental is at infant stage.

CO3: Ignorance and incomplete knowledge has led to misconceptions

CO4: Development and improvement in std. of living has led to serious environmental disasters

TEXT BOOKS

1. Benny Joseph, Environmental Science and Engineering ', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science ', 2nd edition, Pearson Education, 2004.
3. Dr. G. Ranganath, Environmental Science and Engineering, Sahana Publishers, 2018 edition.

REFERENCE BOOKS

1. Dharmendra S. Sengar, Environmental law ', Prentice hall of India PVT LTD, New Delhi, 2007.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.	2		1		2		2		1		1	2	1	2	2
CO2	Public awareness of environmental is at infant stage.		1	2	1		1		1	2	2		1		1	1
CO3	Ignorance and incomplete knowledge has led to misconceptions	2		1		2		2		1		1	2	1	2	2
CO4	Development and improvement in std. of living has led to serious environmental disasters	2		1		2		2		1		1	2	1	2	2

218EMT04	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	4

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the vectorial and scalar representation of forces and moments.
- To understand the static equilibrium of particles and rigid bodies both in two dimensions.
- To understand the concepts of centroids and moment of inertia of composite sections.
- To understand the principle of work and energy.
- To enable the students to comprehend the effect of friction on equilibrium

UNIT I BASICS & STATICS OF PARTICLES 9+3

Introduction-Units and Dimensions-Laws of mechanics - Lame's theorem, Parallelogram and Triangular law of forces, Polygon force, Resolution and Composition of forces, Equilibrium of a particle-Forces in space - Equilibrium of a particle in space-Equivalent systems of forces-Principle of transmissibility-Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Free body diagram-Types of supports and their reactions-Requirements of stable equilibrium-Moments and Couples, Moment of a force about a point and about an axis-Vectorial representation of couples-Varignon's Theorem-Equilibrium of Rigid bodies in two dimensions- Equilibrium of Rigid bodies in three dimensions – Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+3

Determination of Areas and Volumes-First moment of area and the centroid of sections - rectangle, circle, triangle from integration - T section, I section, Angle section, Hollow section by using standard formula, Second and product moments of plane area - Rectangle, triangle, circle from integration-T section, I section, Angle section, Hollow section by using standard formula, Parallel axis theorem and perpendicular axis theorem.

UNIT IV DYNAMICS OF PARTICLES 9+3

Displacement, Velocity and Acceleration, their relationship, Relative motion- Rectilinear motion-Curvilinearmotion, Newton's law-Work Energy Equation of particles-Impulse and Momentum-Impact of elastic bodies.

UNIT V FRICTION 9+3

Frictional force - Laws of Coloumb friction - Simple contact friction - Rolling resistance - Belt friction - Ladderfriction - wedge friction.

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.

CO2: Find solution for problems related to equilibrium of particles.

CO3: Solve the Moment of inertia for different 2-D plane figures.

CO4: Analyze the forces in any structures.

CO5: Solve rigid body subjected to frictional forces.

TEXT BOOKS

1. Ramamrutham S, "Engineering Mechanics (S.I Units)", Dhanpat Rai Publications, 10th Edition, Reprint 2015.
2. Dr. Gujral I S, "Engineering Mechanics", Lakmi Publications, Second Edition, 2011.

REFERENCE BOOKS

1. Bhavikatti S, "Engineering Mechanics", New Age International Publisher, 4th Edition, 2014.
2. Khurmi R S, "Engineering Mechanics", S Chand Publisher, 20th Edition, 2012.
3. Dr. Bansal R K and Sanjay Bansal, "Engineering Mechanics", Lakshmi Publication, 7th Edition, 2011.
4. Rajput R K, "Engineering Mechanics", Dhanpat Rai Publications, 3rd Edition, 2005.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Explain the differential principle applies to solve engineering problems dealing with force, displacement, velocity and acceleration.		1	2	1		1		1	2	2		1		1	1
CO2	: Find solution for problems related to equilibrium of particles.	2		1		2		2	3	1		1	2	1	2	2
CO3	Solve the Moment of inertia for different 2-D plane figures.	2		1		2		2		1		1	2	1	2	2
CO4	Analyze the forces in any structures.	2		1		2		2		1		1	2	1	2	2
CO5	Solve rigid body subjected to frictional forces.		1		2		2		1		1	2	1	2	2	

218PPT05 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

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

UNIT III CONTROL FLOW, FUNCTIONS 9

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

UNIT IV LISTS, TUPLES, DICTIONARIES 9

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

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, date and time, errors and exceptions, handling exceptions, debugging, modules, packages; Illustrative programs: word count, copyfile.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Read, write, execute by hand simple Python programs.

CO3: Structure simple Python programs for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries. CO6: Read and write data from/to files in Python Programs.

TEXT BOOKS

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updatedfor Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

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

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop algorithmic solutions to simple computational problems	2		1		2		2		1		1	2	1	2	2
CO2	Read, write, execute by hand simple Python programs.		1	2	1		1		1	2	2		1		1	1
CO3	Structure simple Python programs for solving problems.		1	2	1		1		1	2	2		1		1	1
CO4	Decompose a Python program into functions.	2		1		2		2		1		1	2	1	2	2
CO5	Represent compound data using Python lists, tuples, dictionaries. CO6: Read and write data from/to files in Python Programs.	2		1		2		2	3	1		1	2	1	2	2

218PHP07 ENGINEERING PHYSICS LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid.

LIST OF EXPERIMENTS

1. (a) Determination of laser parameters – Wavelength.
   (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.

3. Determination of velocity of sound and compressibility of liquid- Ultra sonic interferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material – Uniform bending.

Torsional pendulum- Determination of Rigidity modulus.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.

CO2: Understanding the phenomenon of diffraction, dispersion and interference of light using optical component

CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid

CO4: Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Understanding the phenomenon of diffraction, dispersion and interference of light using optical component		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring the parameters of ultrasound propagating through a liquid	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Understanding the		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

	phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.															

218BSE01 **MATERIAL SCIENCE** **L T P C**
2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To study the basic theory of structure of crystalline materials.
- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in dielectric and nano materials.
- To understand the essential concepts of modern engineering materials.

UNIT I **CRYSTAL PHYSICS** **9**

Introduction and structure of atoms – Crystal structure: The space lattice and Unit Cell - Crystal Systems and Bravais lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure – NaCl, ZnS structures (qualitative).

UNIT II **CONDUCTING MATERIALS** **9**

Conductors - Classical free electron theory of metals - Expression for electrical conductivity - Expression for Thermal conductivity - Wiedemann-Franz law - Lorentz number - Draw backs of classical theory - Quantum theory - Fermi distribution function - Effect of temperature on Fermi distribution function - Density of energy states - carrier concentration in metals.

UNIT III **SEMICONDUCTING MATERIALS** **9**

Intrinsic Semiconductors - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Fermi level - Variation of Fermi level with temperature – Electrical conductivity of intrinsic semiconductors – band gap determination - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors (qualitative) - Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration - Electrical conductivity of extrinsic semiconductors.

UNIT IV **DIELECTRIC MATERIALS AND NANOMATERIALS** **9**

Dielectric materials: Dielectric constant – Dielectric loss - Electrical susceptibility- Electronic, ionic – orientational and space charge polarization – Frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) Nano materials: Synthesis- Plasma arcing- – Chemical vapour deposition – Electro deposition – Ball Milling – Properties of nanoparticles and their applications.

UNIT V **NUCLEAR PHYSICS AND HEAT TRANSMISSION** **9**

Nuclear fission-Nuclear fusion-nuclear reactors-classification-general features-efficiency-coolants moderators thermal reactors. Heat conduction-Expression for thermal conductivity-Amount of heat

flow through a plane wall in one direction-Determine the thermal conductivity –Lee's disc method for bad conductors.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Have the necessary understanding on the functioning of crystalline in solids of materials

CO2: Gain knowledge on classical and quantum electron theories, and energy band structures.

CO3: Acquire knowledge on basics of semiconductor physics and its applications in various devices.

CO4: Get knowledge on dielectric and nano materials and their applications.

CO5: Understand the basics of modern engineering materials

TEXT BOOKS

1. Jasprit Singh, - Semiconductor Devices: Basic Principles, Wiley 2012.
2. Kasap, S.O. - Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
3. Jayaprakash R.N,-Physics for engineers, Dhanam publications, 2018.
4. Kittel, C. - Introduction to Solid State Physics. Wiley, 2005.
5. Theraja B.L - Basic Electronics Solid State, S. Chand & Company Ltd, 2004.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Have the necessary understanding on the functioning of crystalline in solids of materials	**2**		**1**		**2**		**2**	**3**	**1**		**1**	**2**	**1**	**2**	**2**
CO2	Gain knowledge on classical and quantum electron theories, and energy band structures.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Acquire knowledge on basics of semiconductor physics and its applications in various devices.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Get knowledge on dielectric and nano materials and their applications.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Understand the basics of modern engineering materials	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

218BSE02	QUANTUM MECHANICS FOR ENGINEERS	L	T	P	C
		2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To develop in the student awareness of situations in engineering, which need ideas of quantum mechanics.
- To make the student understand the basic language, apparatus and methods of quantum mechanics.
- To enable the student with those aspects of quantum mechanics, which are necessary to begin to work in small structures such as those common in nanotechnology

UNIT I WAVE NATURE OF PARTICLES AND THE SCHRODINGER EQUATION 9

Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

UNIT II MATHEMATICAL PRELIMINARIES FOR QUANTUM MECHANICS 9

Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators, Hermite polynomials, Legendre's equation, spherical harmonics.

UNIT III APPLYING THE SCHRODINGER EQUATION 9

Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials, Scattering from a potential barrier and tunneling; related examples like alpha-decay, field ionization and scanning tunneling microscope
Three-dimensional problems: particle in three dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field, spin Numerical solution stationary-state radial Schrodinger equation for spherically symmetric potentials.

UNIT IV INTRODUCTION TO MOLECULAR BONDING 9

Particle in double delta-function potential, Molecules (hydrogen molecule, valence bond and molecular orbitals picture), singlet/triplet states, chemical bonding, hybridization.

UNIT V INTRODUCTION TO SOLIDS 9

Free electron theory of metals, Fermi level, density of states, Application to white dwarfs and neutron stars, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Numerical solution for energy in one-dimensional periodic lattice by mixing plane waves.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: The student will develop an informed appreciation of the paradigm shift already in evidence in technologies behind modern services and products.

CO2: The student will be prepared to pursue industrial R & D programs in nanotechnologies.

CO3: The student will possess basic physics knowledge to pursue simulation and modelling of systems encountered in nanotechnologies

TEXT BOOKS

1. Quantum Mechanics: An Introduction for Device Physicists and Electrical Engineers, Second Edition, David K Ferry, Institute of Physics Publishing 2001.
2. Fundamental Quantum Mechanics for Engineers, Leon van Dommelen, 15 Jun 2012

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	The student will develop an informed appreciation of the paradigm shift already in evidence in technologies behind modern services and products.	2		1		2		2	3	1		1	2	1	2	2
CO2	The student will be prepared to pursue industrial R & D programs in nanotechnologies.		1	2	1		1		1	2	2		1		1	1
CO3	The student will possess basic physics knowledge to pursue simulation and modelling of systems encountered in nanotechnologies		1	2	1		1		1	2	2		1		1	1

218BSE03 CHEMISTRY FOR TECHNOLOGISTS L T P C
2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To get ample knowledge about gaseous properties.
- To acquire knowledge about the properties of solutions.
- To apply the basic concepts of thermodynamics for engineering stream
- To understand the mechanistic pathway of chemical reactions.
- To impart an adequate knowledge about dyes and drugs

UNIT I THEORY OF GASES AND LIQUIDS 9

Measurable properties of gases, Gas Laws-Boyles law, Charle's law, Graham's law of diffusion,

Avogadro's law, Dalton's law of partial pressure, Absolute scale of temperature, Ideal gas equation. Postulates of Kinetic theory of gases-average-root mean square and most probable velocities-real gases-deviation from ideal behaviour-Compressibility factor-Vander walls equation. Properties of Liquids-Vapour Pressure-Viscosity-surface tension and effect of temperature on various properties.

UNIT II PROPERTIES OF SOLUTION 9

Different methods for expressing concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), vapour pressure of solutions and Raoult's Law - Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties- Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

UNIT III CHEMICAL THERMODYNAMICS 9

Terminologies- System, Surroundings-First law of Thermodynamics-Internal energy and enthalpy of System-Second law of Thermodynamics-entropy of a system-entropy change for an ideal gas- entropy change accompanying change of Phase-Gibbs Helmholtz equation-Clausius –clapeyron equation-Applications-Maxwell relation-Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT IV REACTION MECHANISMS AND INTERMEDIATES 9

Introduction-kinetics, equilibria and energetics of reaction-nucleophilic substitution-addition-elimination-electrophilic substitution in aromatic systems. Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes, nitrenes ylides and enamines.

UNIT V DYES AND DRUGS 9

Classification and properties of drugs. Penicillin sulpha drugs, mode of action, synthesis of sulphanilamide, chloroquine and chloramphenicol. Colour and constitution, chromogen and chromophore. Classification of dyes based on structure and mode of dyeing. Synthesis of dyes. Malachite green, methyl orange, Congo red, phenolphthalein

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Apply gas laws in various real life situations.

CO2: Able to explain the characteristic properties and behaviour of solutions.

CO3: Apply the basic concepts of thermodynamics for engineering stream.

CO4: Familiar in reaction pathways

CO5: Able to understand the chemistry behind dyes and drugs.

TEXT BOOKS

1. Jerry March Organic Reaction Mechanism John Weily Ed, 5 2002.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS

1. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015
2. Puri BR, Sharma LR, Patha nia S, "Principles of Physical Chemistry", 42nd Edition, 2008, Vishal Publishing Co., Jalandhar
3. Morrison RT,
4. Boyd RN, Bhattacharjee SK, “Organic Chemistry”, 7Th Edition, Pearson India, 2011

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Apply gas laws in various real life situations.	2		1		2		2	3	1		1	2	1	2	2
CO2	Able to explain the characteristic properties and behaviour of solutions.		1	2	1		1		1	2	2		1		1	1
CO3	Apply the basic concepts of thermodynamics for engineering stream.		1	2	1		1		1	2	2		1		1	1
CO4	Familiar in reaction pathways	2		1		2		2		1		1	2	1	2	2
CO5	Able to understand the chemistry behind dyes and drugs.	2		1		2		2		1		1	2	1	2	2

218BSE04 ENERGY TO RAGE DEVICES AND FUEL CELLS L T P C
2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles.
- Identify the types of fuel cells and to relate the factors of energy and environment.
- Analyze various energy storage devices and fuel cells.

UNIT I BASICS OF CELLS AND BATTERIES 9

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of practical batteries - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES 9

Primary batteries- zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries - recycling/safe disposal of used cells. Secondary batteries - introduction, cell

reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles.

UNIT III TYPES OF FUEL CELLS 9

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells.

UNIT IV HYDROGEN AS A FUEL 9

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - biomass pyrolysis -gas clean up - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations.

UNIT V ENERGY AND ENVIRONMENT 9

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems. Solar Cells: energy conversion devices, photovoltaic and photo electrochemical cells - photo biochemical conversion cell.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the knowledge of various energy storing devices

CO2: Acquire the knowledge to analyze the working of different types of primary and secondary batteries

CO3: Differentiate the types of fuel cells and recognize the utility of hydrogen as a fuel.

C04: Realize the importance of using green fuel for sustainable development.

TEXT BOOKS

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009.
2. F. Barbir, PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013.

REFERENCE BOOKS

1. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001.
2. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012.
3. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016.
4. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the knowledge of various energy storing devices	2		1		2		2	3	1		1	2	1	2	2

CO2	Acquire the knowledge to analyze the working of different types of primary and secondary batteries		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Differentiate the types of fuel cells and recognize the utility of hydrogen as a fuel.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Realize the importance of using green fuel for sustainable development.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

218PPP08 PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY L T P C

0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Write, test, and debug simple Python programs.

CO2: Implement Python programs with conditionals and loops.

CO3: Develop Python programs step-wise by defining functions and calling them.

CO4: Use Python lists, tuples, dictionaries for representing compound data.

CO5: Read and write data from/to files in Python.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Write, test, and debug simple Python programs.		1		2		2		1		1	2	1	2	2	2
CO2	Implement Python programs with conditionals and loops.	1	2	1		1		1	2	2		1		1	1	1
CO3	Develop Python programs step-wise by defining functions and calling them.	1	2	1		1		1	2	2		1		1	1	1
CO4	Use Python lists, tuples, dictionaries for representing compound data.		1		2		2		1		1	2	1	2	2	2
CO5	Read and write data from/to files in Python.		1		2		2	3	1		1	2	1	2	2	

Semester III

318MAT01 ENGINEERING MATHEMATICS – III

L	T	P	C
3	1	0	4

OBJECTIVES

At the end of the course, the students should be able to:

- To learn various methods to solve the partial differential equations.
- To introduce Fourier series analysis which plays a vital role in many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the Fourier transform techniques used in wide variety of situations.
- To develop z-transform techniques which analyze the discrete time signals

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solutions of first order partial differential equations-Standard Types-Singular solutions-Lagrange's Linear equation- Method of grouping and Method of multipliers-Solution of homogeneous and non-homogenous linear equations of second and higher order with constant coefficients.

UNIT II **FOURIER SERIES** **9+3**

Dirichlet's conditions – General Fourier series – Change of scale - Odd and even functions – Half-range Sine and Cosine series – Parseval's identity applications – Harmonic Analysis.

UNIT III **BOUNDARY VALUE PROBLEMS** **9+3**

Classification of Partial Differential Equations – Method of separation of Variables – Solutions of one-dimensional wave equations and One-dimensional heat equations –Applications using Fourier series solutions in Cartesian coordinates - Steady state solution of two-dimensional heat equation.

UNIT IV **FOURIER TRANSFORMS** **9+3**

Fourier integral theorem – Fourier transform pair - Sine and Cosine transforms – Properties – Fourier Transform of simple functions – Convolution theorem (statement and applications only) – Parseval's identity (statement and applications only).

UNIT V **Z – TRANSFORMS** **9+3**

Z-Transform - Elementary properties and applications – Initial and final value theorems (statement and applications only) - Inverse Z-Transform – Partial fractions method, Residue theorem method and Convolution theorem (statement and applications only) - Solution of difference equations by applying Z-transforms.

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Know the methods to solve partial differential equations occurring in various physical and engineering problems.

CO 2: Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.

CO 3: Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.

CO 4: Apply the Fourier transform techniques in engineering field.

CO 5: Gain the concept of analysis of linear discrete system using Z-transform approach.

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 44th edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition Wiley India, 2016.

REFERENCE BOOKS

1. Andrews L.C and Shivamoggi. B.K., "Integral Transforms for Engineers", SPIE Press Book, 1999
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Co., New Delhi, 1995.
3. T. Veerarajan, "Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Know the methods to solve partial differential equations occurring in various physical and engineering problems.	2		1		2		2		1		1	2	1	2	2
CO2	Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.		1	2	1		1		1	2	2		1		1	1
CO3	Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.		1	2	1		1		1	2	2		1		1	1
CO4	Apply the Fourier transform techniques in engineering field.	2		1		2		2		1		1	2	1	2	2
CO5	Gain the concept of analysis of linear discrete system using Z-transform approach.	2		1		2		2	3	1		1	2	1	2	2

318BTT02 **BIOCHEMISTRY** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To learn the fundamentals of biochemical processes
- To learn the structure and properties of biomolecules and its function
- To gain knowledge of concepts of metabolism
- To gain knowledge of metabolic regulation and intermediate compounds
- To gain knowledge of transportation of protein and degradation

UNITI **INTRODUCTION TO BIOMOLECULES-CARBOHYDRATES** **9**

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, biomolecules. Structure and properties of Carbohydrates (mono, di, oligo& polysaccharides) Proteoglycans, glucosamino glycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans,glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

UNITII STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES 9

Structure and properties of Important Biomolecules.

Lipids: Fatty acids, glycerol, saponification, Iodination, hydrogenation, phospholipids, glycolipids, sphingo lipids, cholesterol, steroids, prostaglandins.

Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary, structure.

Nucleic acids: Purines, pyrimidines, nucleoside, nucleotide, RNA, DNA- Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes

UNITIII CONCEPTS OF METABOLISM AND CARBOHYDRATE METABOLISM 9

Functions of Proteins, Enzymes, Introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt.

UNITIV INTERMEDIARY METABOLISM AND REGULATION 9

Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics-High energy compounds, electron negative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNITV PROTEINTRANSPORTANDDEGRADATION 9

Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

*Upon Completion of this course, students will be able t*o:

CO1: To ensure students have a strong foundation in the structure and reactions of biomolecules.

CO2: To understand metabolic pathways of the major biomolecules and relevance to clinical conditions.

CO3: To correlate biochemical processes with biotechnology applications.

CO4: To understand about metabolic regulation and intermediate compounds.

CO5: To understand about protein secretion, folding, transportation and degradation.

TEXT BOOKS

1. Lehninger Principles of Biochemistry6thEditionbyDavid L.Nelson,MichaelM.Cox 2001
2. Satyanarayana, U. and U. Chakerapani, “Biochemistry” 3rdRev. Edition, Books & Allied (P) Ltd.,2006. 31
3. Rastogi, S.C. “Biochemistry”2ndEdition, TataMcGraw-Hill,2003.
4. Conn, E.E., etal., “OutlinesofBiochemistry”5thEdition, JohnWiley&Sons,1987.

5. Outlines of biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp693.John Wiley and Sons, New York. 1987.

REFERENCE BOOKS

1. Berg, JeremyM.etal. "Biochemsitry",6thEdition, W.H. Freeman&Co.,2006.
2. Murray, R.K., etal "Harper'sIllustratedBiochemistry",27thEdition, McGraw-Hill,2006.
3. Voet,D.andVoet,J.G., "Biochemistry",3rdEdition,JohnWiley&SonsInc.,2004.

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1. http://dl4a.org/uploads/pdf/Biochemistry.pdf
2. http://www.louisbolk.org/downloads/1282.pdf
3. https://awesomechem.files.wordpress.com/2016/10/harpers-illustrated-biochemistry-28th-ed-robert-k-murray-et-al-mcgraw-hill-2009.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To ensure students have a strong foundation in the structure and reactions of biomolecules	2		1		2		2		1		1	2	1	2	2
CO2	To understand metabolic pathways of the major biomolecules and relevance to clinical conditions.		1	2	1		1		1	2	2		1		1	1
CO3	To correlate biochemical processes with biotechnology applications.		1	2	1		1		1	2	2		1		1	1
CO4	To understand about metabolic regulation and intermediate compounds.	2		1		2		2		1		1	2	1	2	2
CO5	To understand about protein secretion, folding, transportation and degradation.	2		1		2		2		1		1	2	1	2	2

318BTT03 **CELL BIOLOGY** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To provide knowledge on the fundamentals of cell biology
- To help students understand the signaling mechanisms
- To understand how organisms' function and the structure and functions of the plasma membrane and the major organelles that occur in prokaryotic and eukaryotic cells.
- To understand how cellular organelles work together to carryout life functions.
- To protect cells to prevent infection and other harmful effects.

UNITI CELL STRUCTURE AND FUNCTION 9

Structure and function of Prokaryotic and Eukaryotic organelles, principles of membrane organization, membraneproteins, cytoskeletal proteins, types of cell division, mitosis & meiosis, extra cellular matrix, cell cycle and molecules that control cell cycle.

UNITII TRANSPORT ACROSS CELL MEMBRANES 9

Passive & active transport, permeases, sodium potassium pump, Ca2+ ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, cotransport symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis, Entry of viruses and toxins into cells

UNITIII RECEPTORS AND MODELS OF EXTRACELLULAR SIGNALLING 9

Cytosolic, nuclear and membrane bound receptors, Types of receptors and mode of action: autocrine, paracrine, endocrine, tyrosine kinases, G Protein receptor.

UNITIV SIGNAL TRANSDUCTION 9

Signal amplification, different models of signal amplifications, cyclic amp, role of inositol phosphates as messengers, biosynthesis of inositol triphosphates, cyclic GMP and G proteins, role in signal transduction, calcium ion flux and its role in cell signaling, current models of signal amplification, MAP kinases, regulation of proteinkinases, serine –threonine kinases, tumor necrosis factor receptor families

UNITV CELL CULTURE 9

Techniques for the propagation of eukaryotic cells. Cell lines, generation of cell lines, maintenance of stock cells, characterization of cells, morphological analysis techniques in cell culture, ex-plant cultures, primary cultures and differentiated cell line. *Cell fractionation and flow cytometry and Localization of proteins in cells– Immunostaining.*

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To develop integral knowledge on cell structure, molecular organization and function of cell organelles.

CO2: To learn the cell is the basic unit of life in the entire living world.

CO3: To Understand the basic knowledge once structure and function as well as on the molecular basis of chromatin organization

CO4: Understand cell at structural and functional level.

CO5: Understand the molecular interaction between cells and signal transduction, secondary

messengers.

TEXT BOOKS

1. Molecular Cell Biology, Darnell J, Lodish H, Baltimore D W.H. Freeman6TH Edition 2005.
2. Cell Biology Kimball T.W., Wesley Publishers, 3rdEdition,*2007.*
3. The Cell Georeffy Cooper, ASM Press,2nd Edition 2007.
4. Molecular Biology of the Cell, James D. Watson, Wilkins, a Wolters Kluwer Business Publishers 8th Edition,2013.

REFERENCE BOOKS

1. Cell Biology De Robertis & De Robertis, ASM Press and Sinauer Associates 4th Edition,2000
2. Cell and Molecular Biology Ajoy paul, Books and Allied (P)Ltd 2007.
3. Cell and Molecular Biology, Gerald Karp, Wiley Publishers,7th Edition,2013.

EBOOKS/WEBLINKS

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2. https://www.nyu.edu/projects/fitch/courses/moleccell/precellevo.pdf
3. http://web.iitd.ac.in/~amittal/SBL101_Essentials_Cell_Biology.pdf
4. https://edisciplinas.usp.br/pluginfile.php/86323/mod_resource/content/1/MolecularBiologyOfTheC ell5th.Ed-pag579+37.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To develop integral knowledge on cell structure, molecular organization and function of cell organelles.	2		1		2		2		1		1	2	1	2	2
CO2	To learn the cell is the basic unit of life in the entire living world.		1	2	1		1		1	2	2		1		1	1
CO3	To Understand the basic knowledge once structure and function as well as on the molecular basis of chromatin organization		1	2	1		1		1	2	2		1		1	1
CO4	Understand cell at structural and functional level.	2		1		2		2		1		1	2	1	2	2
CO5	Understand the molecular interaction between cells and signal transduction, secondary messengers.	2		1		2		2		1		1	2	1	2	2

318BTT04	MICROBIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes
- To enable students, learn the basic structure, growth and metabolism of microorganisms
- To solve the problems in microbial infection and their control
- To enable students to learn the production process and preservation techniques
- To develop skills of the students in the area of industrial and environmental microbiology

UNIT I BASIC TOOLS AND TECHNIQUES 9

History of microbiology, classification and nomenclature of microorganisms, microscopic examination ofmicroorganisms, light and electron microscopy, different staining techniques: gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES-STRUCTURE AND MULTIPLICATION 9

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

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methodsto quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules, biological control of microorganism.

UNIT IV CONTROL OF MICROORGANISMS 9

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

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; *broad spectrum antibiotics*, production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Students attains knowledge on the principles of Microbiology and biochemical aspects of various microbes

CO2: Knowledge on the microorganisms Structure and its different types, growth and metabolism

CO3: The interactions between contaminants, soil, water and microorganisms and its control

CO4: Knowledge on the production process and preservation techniques

CO5: An ability to conduct experiments, as well as to analyze and interpretdata

TEXT BOOKS

1. PrescottL. M., Harley J. P., Klein DA, Microbiology,3rd Edition, Wm. C. Brown Publishers,1996.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.2005
3. Cruger, Wulf and Anneliese Crueger, "Biotechnology: A Text book of Industrial Microbiology", IInd Edition, Panima Publishing,2000.

REFERENCE BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W. C. Brown Publishers,1993.
2. Casida, L. E. "Industrial Microbiology", New Age International(P)Ltd,1968
3. Stanier, RY., *et.al*., General Microbiology, 5th ed. MacmillanPress.2000

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2. https://openstax.org/details/books/microbiology
3. Atlas,RM., Principles of Microbiology, 2nded.,1997,McGraw-Hill
4. http://www.wwnorton.com/college/biology/microbiology2/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Students attains knowledge on the principles of Microbiology and biochemical aspects of various microbes	2		1		2		2		1		1	2	1	2	2
CO2	Knowledge on the microorganisms Structure and its different types, growth and metabolism		1	2	1		1		1	2	2		1		1	1
CO3	The interactions between contaminants, soil, water and microorganisms and its control	2		1		2		2		1		1	2	1	2	2
CO4	Knowledge on the production process and preservation techniques	2		1		2		2		1		1	2	1	2	2
CO5	An ability to conduct experiments, as well as to analyze and interpretdata	2		1		2		2		1		1	2	1	2	2

318BTT05 **INSTRUMENTAL METHODS OF ANALYSIS**

L	T	P	C
2	0	0	2

OBJECTIVES

At the end of the course, the students should be able to:

- To gain knowledge on basics of measurement
- To have a fundamental knowledge about the Light spectrum and Absorption.
- To understand working principles of Fluorescence NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products and surface microscopy
- To gain knowledge about separation of biological products.

UNIT I BASICS OF MEASUREMENT 9

Classification of methods–types of noise-calibration of instrumental methods–electrical components and circuits – signal to noise ratio– signal– noise enhancement.

UNIT II OPTICAL AND THERMAL METHODS 9

General design–sources of radiation–wave lengths electors–sample containers–radiation transducers – types of optical instruments-Calorimeter, Flourimeter, Nephlometry– Fourier transform measurements. Thermo- gravimetric methods – differential thermal analysis–differential scanning calorimetry. Isothermal titration calorimetry.

UNIT III MOLECULAR SPECTROSCOPY 9

Measurement of transmittance and absorbance – Lambert Beer's law – spectrophotometer analysis –qualitative and quantitative absorption measurements - types of spectrometers – UV–visible –IR–Raman spectroscopy, NMR, ESR, SPR, MS–instrumentation – theory.

UNIT IV ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry. Study of surfaces–Scanning probe microscopes– AFM and STM.

UNIT V SEPARATION METHODS 9

Introduction to chromatography – vandeemter equation–Thin Layer Chromatography**)** Paper Chromatography- gas chromatography–stationary phases–detectors–HPLC–pumps–columns–detectors – ion exchange chromatography– size exclusion chromatography– Agarose Electrophroresis, capillary electrophoresis-Adsorption Chromatography.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand and apply the concept of optical and thermal methods

CO2: Understand spectroscopy.

CO3: Understand principle of surface microscopy and its application

CO4: Acquire knowledge on separation techniques used for biological products

CO5: Acquire knowledge on different chromatographic methods for separation of biological products

TEXT BOOKS

1. Instrumental Methods of Analysis; Willard & H.Merrit, Phi, 1997thEdition CBSPublishers.
2. Instrumental Methods of Analysis, D. Skoog, 2000 5thEdition CollegePublishers.
3. Instrumental Methods of Chemical Analysis Galen N. Ewing 5th Edition McGraw Hill International 2006.

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1. Introduction to Instrumental Analysis by Robert D Braun, Pharma Book Syndicate 2005.
2. Instrumental Methods of Chemical Analysis by H Kaur PPM Publishers 1999.
3. Biophysical Chemistry by Upadhyay 4th Edition by Himalaya Publishing House 2007.

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2. https://marianoshraderkels.files.wordpress.com/2017/05/instrumental-methods-of-analysis-oxford- higher-education-by-sivasankar.pdf
3. https://marianoshraderkels.files.wordpress.com/2017/05/instrumental-methods-of-analysis-oxford- higher-education-by-sivasankar.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand and apply the concept of optical and thermal methods		1	2	1		1		1	2	2		1		1	1
CO2	Understand spectroscopy.		1	2	1		1		1	2	2		1		1	1
CO3	Understand principle of surface microscopy and its application	2		1		2		2		1		1	2	1	2	2
CO4	Acquire knowledge on separation techniques used for biological products	2		1		2		2		1		1	2	1	2	2
CO5	Acquire knowledge on different chromatographic methods for separation of biological products	2		1		2		2		1		1	2	1	2	2

318BTT06 **BASIC INDUSTRIAL BIOTECHNOLOGY** **L T P C**
2 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To make the students aware of the overall industrial bioprocesss has to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of commercially important modern bioproducts.
- To understand the production and purification of industrial enzymes,
- To gain knowledge about products of plant, animal and fungal cell cultures.
- To understand the production and purification of therapeutic proteins

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESSES 9

A historical overview of industrial fermentation process, Definition and scope of Industrial Biotechnology, Stock culture, A brief survey of organisms, processes. Growth curve of microorganisms (Bacteria), Process flow sheeting –block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES

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

UNIT III PRODUCTION OF SECONDARY METABOLITES 9

Study of production processes for various classes of secondary metabolites: antibiotics: betalactams (penicillin, cephalosporin), aminoglycosides (streptomycin etc) macrolides (erythromycin), vitamins andsteroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 9

Production of industrial enzymes such as proteases, amylases, lipases, cellulases. Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (PHB), single cell protein.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 9

Production of recombinant proteins and diagnostic applications, production of vaccines. Production of monoclonal antibodies.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand of the steps involved in the production of bioproducts

CO2: Understand the basic biotechnological engineering principles and models to do tasks

CO 3: Understand the Design and deliver useful modern biotechnology products to the society.

CO4: Understand the bulk production of commercially important modern bioproducts.

CO5: Understand the production and purification of Industrial Enzymes and products of plant and animal cell cultures.

TEXT BOOKS

1. Satyanarayana,U. “Biotechnology”Books&Allied(P)Ltd.,2005
2. Kumar, H.D. “A Textbook on Biotechnology” IInd Edition. Affiliated East West Press Pvt.Ltd.,1998.
3. Balasubramanian,D. etal.,“ConceptsinBiotechnology”UniversitiesPressPvt.Ltd.,2004.

4. Presscott, S.C.andCecilG.Dunn,“Industrial Microbiology”,Agrobios(India),2005.
5. Dubey, R.C. “AText book of Biotechnology” S. Chand & Co.Ltd.,2006.

REFERENCE BOOKS

1. Casida, L.E. “Industrial Microbiology”, New Age International(P)Ltd,1968.
2. Cruger, Wulf and Anneliese Crueger, “Biotechnology: A Text book of Industrial Microbiology”, IInd Edition, Panim a Publishing, 2000.
3. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, IInd Edition, Butterworth– Heinemann (an imprint of Elsevier), 1995.

EBOOKS/WEBLINKS

1. http://www.thanut-swu.com/images/BOT101/BiotechnologyBook.pdf
2. http://www.absinitiative.info/fileadmin/media/Knowledge_Center/Pulications/Sectoral_Briefs/Sectoral_Brief
3. _-_Biotech_-_2015.pdf
4. https://www.pdfdrive.com/biology-and-biotechnology-e22686316.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand of the steps involved in the production of bioproducts		1	2	1		1		1	2	2		1		1	1
CO2	Understand the basic biotechnological engineering principles and models to do tasks		1	2	1		1		1	2	2		1		1	1
CO3	Understand the Design and deliver useful modern biotechnology products to the society.	2		1		2		2		1		1	2	1	2	2
CO4	Understand the bulk production of commercially important modern bioproducts.	2		1		2		2		1		1	2	1	2	2
CO5	Understand the production and purification of Industrial Enzymes and products of plant and animal cell cultures.	2		1		2		2		1		1	2	1	2	2

318BTP07	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the principle of qualitative analysis of various biomolecules.
- To understand the concept of quantitative estimation of biomolecules.
- To understand the preparation of standard buffer solution
- To understand the analysis of the body fluids.
- To understand a strong foundation in the structure and reactions of Biomolecules

LIST OF EXPERIMENTS

1. Preparation of buffers and measurement of week acid, base.
2. Qualitative analysis of carbohydrates (monosaccharide's, disaccharides, polysaccharides etc.).
3. Qualitative analysis of proteins and amino acids.
4. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipidsetc.).
5. Quantitative analysis of carbohydrates (Benedict's method etc.)
6. Quantitative estimation of blood glucose (Anthrone Method)
7. Protein estimation by Lowry's method.
8. Protein estimation by Biuret method.
9. Quantitative estimation of amino acids by Ninhydin method.
10. Estimation of DNA by Diphenylamine method.
11. Estimation of RNA by Orcinol method
12. Extraction of lipids and analysis by TLC
13. Enzymatic assay of phosphates.
14. Enzymatic hydrolysis of starch.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Learning the principles behind the qualitative estimation of biomolecules.

CO2: Understanding the principles behind quantitative estimation of biomolecules.

CO3: Understanding the analysis of the same in the body fluids professional career

CO4: Understanding the preparation of standard buffer solution.

CO5: To ensure students have a strong foundation in the structure and reactions of Biomolecules.

TEXT BOOKS

1. Lehninger Principles of Biochemistry 6thEditionbyDavid L.Nelson, Michael M. Cox
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rdRev. Edition, Books & Allied (P) Ltd.,2006. 31
3. Rastogi, S.C. "Biochemis try"2ndEdition, TataMcGraw-Hill,2003.

REFERENCE BOOKS

1. Wilson and Walker "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.

2. Plummer D T"An Introduction to Practical Biochemistry"IIIEdn.,Tata McGrawhill.
3. Voet, D. and Voet, J. G., "Biochemistry",3rd Edition, JohnWiley&SonsInc.,2004

EBOOKS/WEBLINKS

1. http://www.louisbolk.org/downloads/1282.pdf
2. https://awesomechem.files.wordpress.com/2016/10/harpers-illustrated-biochemistry-28th-ed-robert-k-
3. murray-et-al-mcgraw-hill-2009.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learning the principles behind the qualitative estimation of biomolecules.		1	2	1		1		1	2	2		1		1	1
CO2	Understanding the principles behind quantitative estimation of biomolecules.	2		1		2		2		1		1	2	1	2	2
CO3	Understanding the analysis of the same in the body fluids professional career	2		1		2		2		1		1	2	1	2	2
CO4	Understanding the preparation of standard buffer solution.		1	2	1		1		1	2	2		1		1	1
CO5	To ensure students have a strong foundation in the structure and reactions of Biomolecules	2		1		2		2		1		1	2	1	2	2

318BTP08 **CELL BIOLOGY LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- To learn the morphology, identification and propagation of cells
- To understand the basic techniques to work with cells
- To understanding and perform cell staining techniques
- To learn working principles of Microscopy
- To understand isolation of plasmids, nucleus or other organelles and cell division.

LIST OF EXPERIMENTS

1. Sterilization techniques.

2. Identification of plant, animal and their components by microscopy.
3. Isolation of chloroplast
4. Isolation of DNA from cauliflower
5. Determination of cell mobility-Hanging Drop method
6. Tryphan Blue Assay
7. Lactophenol Cotton Blue Staining
8. Osmosis and Tonicity.
9. Simple Staining.
10. Propagation and Maintenance of Cells
11. Staining for different stages of mitosis in Allium Cepa (Onion).

TOTAL 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To learn the basic skills in light microscopy, cell fractionation, and spectroscopy.

CO2: To be able to perform light microscopy techniques, to isolate plastids, nucleus or other organelles and cell division.

CO3: To be able to identify the various stages of mitosis.

CO4: To understand the basic techniques to work with cells

CO5: To understand and perform cell staining techniques

TEXT BOOKS

1. "Laboratory Investigations in Cell and Molecular Biology", Allen Bregman Wiley publishers, 4th Edition, 2001.
2. "General Microbiology" Powar and Daginawala, Himalaya Publishing House, *8th edition* 2012.
3. "Cell Biology: A Laboratory Hand book Volume", JulioE.Celis, Tony Hunter Elsevier Academic Press, 3rd Edition, 2006.

REFERENCE BOOKS

1. "Cell Biology: A Laboratory Handbook: 004", Julio E. Celis, Academic Pr; 2edition, 3rd Edition, 2005.
2. "Laboratory Exercises and Techniques in Cellular Biology", Anthony Contento, WileyPublishers, 1st Edition 2012
3. "Laboratory Methods in Cell Biology" S.Jha AcademicPress, 1st Edition, 2012.

EBOOKS/WEBLINKS

1. https://www.scribd.com/…/Karp-Cell-and-Molecular-Biology-Concepts
2. https://www.nyu.edu/projects/fitch/courses/moleccell/precellevo.pdf
3. http://web.iitd.ac.in/~amittal/SBL101_Essentials_Cell_Biology.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To learn the basic skills in light microscopy, cell		1	2	1		1		1	2	2		1		1	1

	fractionation, and spectroscopy.															
CO2	To be able to perform light microscopy techniques, to isolate plastids, nucleus or other organelles and cell division.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	To be able to identify the various stages of mitosis.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	To understand the basic techniques to work with cells	**2**		**1**		**2**		**2**	**3**	**1**	**3**	**1**	**2**	**1**	**2**	**2**
CO5	To understand and perform cell staining techniques	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

318BTP09 **MICROBIOLOGY LABORATORY** **L T P C**

0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- The course aims to develop the skills of students in different areas of microbiology
- To demonstrate various techniques to learn the morphology, identification and propagation of microbes
- To solve the problems in microbial infection and their control
- To enable students, learn the basic structure, growth and metabolism of microorganisms
- To demonstrate various techniques on effect of physical Factors

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media- Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures-Broth: flask, testtubes; Solid: Pourplates, streak plates, slants, stabs
4. Microscopy– Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/ mould
6. Staining Techniques Simple, Differential-Gram's Staining, spore/capsule staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil–TVC
8. Effect of Disinfectants-Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.

CO2: Know the various aseptic techniques and sterilization methods

CO3: Understand the interactions between contaminants, soil, water and microorganisms and its control.

CO4: Gain knowledge on the microorganism structure and its different types, growth and metabolism

CO5: Develop the Skills to work on several important techniques for the study of microorganisms in the laboratory.

TEXT BOOKS

1. Cappuccino, J.G. and N.Sherman "Microbiology: A Laboratory Manual",4th Edition, Addison-Wesley,1999.
2. Collee, J.G. et al., "Mackie & McCartney Practical Medical Microbiology"4th Edition, Churchill Livingstone,1996.
3. Powarand daginawala, "General microbiology", Himalaya Publishing House,2nded.2011

REFERENCE BOOKS

1. Salle, AJ., Fundamental Principles of Bacteriology,7thed.,1999, Tata-McGrawHill,1998
2. *Dubey, R.C., and Maheswari, D.K. Textbook of Microbiology, S.Chand & Co.2006*
3. *SubbaRao, NS. Soil Microbiology,4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.2018*

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.		1	2	1		1		1	2	2		1		1	1
CO2	Know the various aseptic techniques and sterilization methods	2		1		2		2		1		1	2	1	2	2
CO3	Understand the interactions between contaminants, soil, water and microorganisms and its control.	2		1		2		2		1		1	2	1	2	2

CO4	Gain knowledge on the microorganism structure and its different types, growth and metabolism		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Develop the Skills to work on several important techniques for the study of microorganisms in the laboratory.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

Semester IV

418PST01 PROBABILITY AND STATISTICS L T P C

3 1 0 4

OBJECTIVES

At the end of the course, the students should be able to:

- To impart the knowledge of basic probabilistic theory.

To learn one dimensional discrete and continuous probability distributions occurring in natural phenomena.

To extend the probability theory to two-dimensional random variable and to study the statistical measures.

To introduce the notion of sampling distributions and acquire the knowledge of statistical techniques useful in decision making.

To expose the statistical methods for analysis of variance and control limits.

UNIT I PROBABILITY AND RANDOM VARIABLES 9+3

Axioms of probability - Conditional probability - Total probability – Baye's theorem- Random variables - Probability mass function - Probability density function - Properties - Moments - Moment generating functions and their properties.

UNIT II PROBABILITY DISTRIBUTIONS 9+3

Binomial, Poisson, Geometric, Uniform, Exponential, and Normal distributions and their properties - Functions of a random variable-simple applications.

UNIT III TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Central limit theorem (Statement and applications only for independent and identically distributed random variables).

UNIT IV TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT V DESIGN OF EXPERIMENTS 9+3

Analysis of variance – Completely Randomized Design (CRD) (one way classification) – Randomized Block Design (RBD) (two way classification) - Latin Square Design (LSD) – Factorial

Designs- 2^2 factorial designs- Control charts for measurements - $\overline{X}$ chart, R-chart, *p* - chart and *np* – chart.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To impart the knowledge of basic probabilistic theory.

CO2: To learn one dimensional discrete and continuous probability distributions occurring in natural phenomena.

CO3: To extend the probability theory to two-dimensional random variable and to study the statistical measures.

CO4: To introduce the notion of sampling distributions and acquire the knowledge of statistical techniques useful in decision making.

CO5: To expose the statistical methods for analysis of variance and control limits.

TEXT BOOKS

1. Miller and Freund., "Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, 2012.
2. Veerarajan.T., "Probability, Statistics and Random Processes", Tata McGraw-Hill publishing company Limited, New Delhi, 2014

REFERENCE BOOKS

1. Spiegel, M.R, Schiller, J and Alu Srinivasan, R, "Schaum's Outlines Probability and Statistics", Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2010.
2. Gupta.S.C., & Kapoor,V.K., "Fundamentals of mathematical statistics", 11th edition, Sultan Chand & Sons publishers, New Delhi, 2013.
3. Ibe, O.C.,"Fundamentals of Applied Probability and Random Processes", Elsevier, U.P., 1st Indian Reprint, 2007.
4. Kandasamy. P, Thilagavathy, K., & Gunavathi. K., "Probability, Statistics and Queueing Theory"., S. Chand & Company Ltd., New Delhi, 2014.
5. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill edition, New Delhi, 2014.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To impart the knowledge of basic probabilistic theory.		1	2	1		1		1	2	2		1		1	1
CO2	To learn one dimensional discrete and continuous probability distributions occurring in natural phenomena.	2		1		2		2		1		1	2	1	2	2
CO3	To extend the probability	2		1		2		2		1		1	2	1	2	2

	theory to two-dimensional random variable and to study the statistical measures.															
CO4	To introduce the notion of sampling distributions and acquire the knowledge of statistical techniques useful in decision making.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	To expose the statistical methods for analysis of variance and control limits.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

418BTT02 **MOLECULAR BIOLOGY** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- Study the structural and functional organization of nucleic acids
- Learn molecular tools for studying activity of genes
- Learn the structure and properties of biomolecules and their functions
- Understand the genetics of prokaryotes and eukaryotes
- Acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of cells.

UNIT I **CHEMISTRY OF NUCLEIC ACIDS** **9**

Overview of Central dogma. Organization of prokaryotic and eukaryotic genome. Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of DNA and RNA elements, biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: DNA supercoiling. Reversible
denaturation and hyperchromic effect.

UNIT II **DNA REPLICATION & REPAIR** **9**

DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, D-loop and rolling circle mode of replication. DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III **TRANSCRIPTION** **9**

Structure and function of mRNA, rRNA and tRNA. Structural aspects of gene. RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing and RNAediting.

UNIT IV **TRANSLATION** **9**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble

hypothesis and its importance, Prokaryotic and eukaryotic ribosome. Steps in translation: Initiation, Elongation andt ermination of protein synthesis prokaryotic and eukaryotic. Post translational modifications and their significance.

UNIT V **REGULATION OF GENE EXPRESSION** **9**

Hierarchical levels of gene regulation, Prokaryotic gene regulation –*lac* and *trp* operon, Regulation Of gene expression with reference to λ phage life cycle.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Ensure Have the basic knowledge of structure and biochemistry of nucleic acids and proteins and discriminate between them

CO2: Understand the principles o of DNA replication, transcription and translation and explain how they relate to each other

CO3: Correlate Biochemical processes with molecular biology applications

CO4: Understand metabolic regulation and intermediate compounds

CO5: Understand gene organization and mechanisms of control of the gene and expression in various organisms

TEXT BOOKS

1. Friefelder, David. "Molecular Biology." Narosa Publications,1999
2. Weaver, Robert F. "Molecular Biology" IIndEdition, Tata McGraw-Hill,2003.
3. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IVth Edition,JohnWiley,2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" IIndEdition, Panima Publishing, 1993.
5. Phundan Singh, "Principles of Genetics", Kalyani Publishers,2012.

REFERENCE BOOKS

1. Dr. P. K. Gupta, "A Text Book of Cell & Molecular Biology" 4th Revised Edition, Rastogi Publications, 2015.
2. Robert Brooker, "Genetics: Analysis and Principles"5thEdition, Publishing Pennsylvania Plaza publisher,2014,
3. Dr. P. S. Vermaand V K Agarwal, "Genetics", S. Chandpublishing,2010.

EBOOKS/WEBLINKS

1. https://pothi.com/pothi/book/ebook-kaushlendratripathi-introduction-molecular-biology
2. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology
3. http://www.digitalbookindex.org/_search/search010biolmoleculercellbiologya.asp

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Ensure Have the basic knowledge of structure	2		1		2		2		1		1	2	1	2	2

	and biochemistry of nucleic acids and proteins and discriminate between them															
CO2	Understand the principles o of DNA replication, transcription and translation and explain how they relate to each other	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Correlate Biochemical processes with molecular biology applications		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Understand metabolic regulation and intermediate compounds		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Understand gene organization and mechanisms of control of the gene and expression in various organisms	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

418BTT03 STOICHIOMETRIC AND PROCESS CALCULATIONS

L	**T**	**P**	**C**
3	**1**	**0**	**4**

Prerequisite Engineering Mathematics II

OBJECTIVES

At the end of the course, the students should be able to:

- To learn the basic principles of process calculations
- To understand the calculations of mass flow rate in different processes employed in bio-chemical industries
- To predict the energy consumption and energy efficiency in chemical processing industries
- To develop skills in the area of chemical engineering with emphasis on fluid mechanics
- To study the techniques and skills underlying fluid flow measurement.

UNIT I BASIC PRINCIPLES OF MATERIAL BALANCES AND ENERGY BALANCES 9+3

Importance of material balance and energy balance in process industry Dimensions, Units, Conversion factors and their uses; applied mathematics for experimental curve fitting; Numerical differentiation; Numerical Integration

UNIT II MATERIAL BALANCES 9+3

Basic concepts involved in material balance calculations - Overall and component balances; material balances without chemical reaction; material balances with chemical reactions *stoichiometric equation*, stoichiometric coefficient, *stoichiometric ratio, stoichiometric proportion*; degrees of freedom; recycle ratio calculations, purge ratio calculations; humidity calculations

UNIT III **ENERGY BALANCES** **9+3**

Overall and component balances; Calculation of heat capacity, specific heat capacity; partial pressure-calculations; Laten theats – calculations, energy balances - calculations, *Heat of mixing*, Sensible heat calculations; vapour pressure - calculations

UNIT IV **FLUID MECHANICS** **9+3**

Fluid–properties–*Fluid flow phenomena*–compressible, incompressible fluids, Newtonian And Non-Newtonian Fluids, Fluid statics for compressible & incompressible fluids applications in chemicall engineering, Fluid pressure drop calculations. Pressure measuring devices

UNIT V **FLOW THROUGH PACKINGS AND FLUIDIZATION** **9+3**

Flow Measurement Orifice Meter, Venturimeter, Pitottube; Flow in packed columns, flow in fluidization columns, settling phenomena- sedimentation, centrifugal pumps, centripetal pumps and *Reciprocating pumps*–characteristics, working and its applications

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Solve problems related to units and conversions and fit the given data using different methodologies

CO2: Solve problems related to material balance concepts & design reactors for biochemical processes

CO3: Solve problems related to energy balance concepts & design reactors for biochemical processes

CO4: Apply their knowledge in describing the physical properties of fluid and calculating the pressure distribution for incompressible fluids and

CO5: Design a system, component, or process to meet desired needs within realistic constraints such as economic, manufacturability, and sustainability.

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P. Harriot "UnitOperationsofChemicalEngineering",6th Edition, McGrawHill,2014.
2. Bhatt, B.I.and S.M. Vora "Stoichiometry (SI Units)",3rd Edition, TataMcGraw-Hill,2014.
3. K.A. Gavhane,"Introduction to process calculations" ,22nd Edition,NiraliPrakashan2012.
4. Narayanan, K.V. and Lakshmi Kutty "StoichiometryandProcessCalculations",2nd Edition, PHI, 2006.
5. Geankoplis, C. J. "Transport Processes and SeparationprocessPrinciples",7th Edition, PHI,2012.

REFERENCE BOOKS

1. Himmelblau, D. M. "BasicprinciplesandcalculationsinChemicalEngineering",8th Edition, PHI, 2013.
2. Foust,A .S. etal.," Principles of Unit Operations", 2nd Edition, John Wiley& Sons, 2014.
3. Coulson, J. M. and et al. "Coulson&Richardson'sChemicalEngineering",7th Edition, Vol. I&II, Butterworth–Heinman (an imprint of Elsevier),2011.
4. Robert W. Fox, Alan T. McDonald & Philip J. Pritchard "Introduction to Fluid Mechanics"

6th Edition, John Wiley & Sons 2003.

EBOOKS/WEBLINKS

1. http://www.pdfdrive.com/basic-principles-and-calculations-in-chemical-engineering-e185247644.html
2. http://www.pdfdrive.com/coulson-and richardsons-chemical-engineering-fourth edition-volume-3a- chemical-and-biochemical-reactors-and-reaction-engineering-e158316586.html
3. http://www.pdfdrive.com/stoichiometry-and-process-calculations-e187417539.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Solve problems related to units and conversions and fit the given data using different methodologies	2		1		2		2		1		1	2	1	2	2
CO2	Solve problems related to material balance concepts & design reactors for biochemical processes		1	2	1		1		1	2	2		1		1	1
CO3	Solve problems related to energy balance concepts & design reactors for biochemical processes		1	2	1		1		1	2	2		1		1	1
CO4	Apply their knowledge in describing the physical properties of fluid and calculating the pressure distribution for incompressible fluids and	2		1		2		2		1		1	2	1	2	2
CO5	Design a system, component, or process to meet desired needs within realistic constraints such as economic, manufacturability, and sustainability.	2		1		2		2		1		1	2	1	2	2

418BTT04 FUNDAMENTALS OF UNIT OPERATIONS L T P C
3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To understand about dimensional analysis and empirical methods governing the transport of momentum(fluid flow) in chemical and biotechnology engineering systems

- To analyze the scale-up of equipments for the production of biochemical products
- To assimilate the basic concepts of solid-liquid separation gained in earlier courses
- To predict various modes of heat transfer and exchange operations in transportation of fluids
- To understand the techniques of unit operations involved in designing a heat transfer in bioprocess equipment applications.

UNIT I MIXING AND AGITATION 9

Dimensional analysis-Rayleigh and Buckingham's method; principles of agitation, impellers, flow patterns: power consumption and power correlation in Newtonian liquids. Blending and mixing, agitator selection andscale up.

UNIT II BASICS OF FILTRATION & CENTRIFUGATION 9

Unit operations for solid-liquid separation - Filtration-Theory of filtration and equations; constant pressure, constant volume, constant rate filtration, discontinuous filter, continuous vacuum filter: rotary drum filters, Centrifugation-settling of solids, centrifuges, scale-up of centrifugation, centrifugal Filtration.

UNIT III CONDUCTION HEAT TRANSFER 9

Heat transfer phenomena-thermodynamics & heat transfer; Modes of heat transfer, Fourier's law of heat conduction, thermal conductivity; steady state conduction; Resistance concept- compound resistances in series, extended surfaces; unsteady state conduction; combined conduction and convection; 2dimensionalconduction.

UNIT IV CONVECTION HEAT TRANSFER 9

Convection-Forced and natural convection, Dimensional analysis, Dimensiona'numbers, Convection heat transfer coefficient, heat flux, individual heat transfer coefficients, overall heat transfer coefficients and fouling factors, application of dimensional analysis for convection, condensation phenomena, Film and dropwise condensation overtubes; heat transfer through boiling

UNIT V HEAT EXCHANGERS 9

Heat exchange equipment; counter current and parallel-current flows, LMTD correction factor, heat exchangers: single- pass1-1exchanger,1-2parallel-counterflowexchanger,2-4 exchanger, multipass exchanger, enthalpy balances, and condensers-shell-tube condensers

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand about the transport of momentum (fluid flow) in chemical engineering systems

CO2: Improve their of knowledge in techniques of agitation, mixing of liquids, filtration operations and sedimentation separation

CO3: Understand modes of heat transferring techniques during extraction, distillation, evaporation

CO4: Evaluate effects of process variables while scaling up the bioprocess equipment and

CO5: Comprehend the important mechanical aspects while designing bioprocess equipment.

TEXT BOOKS

1. McCabeW.L., Smith J.C. Unit Operations in Chemical Engineering.7th Edition.Mc graw hill 2014.
2. Dutta B.K, "Heat: Principles & applications", PHI publication 2000.
3. Gavahne.K.A., Unit Operations-I Fluid flow & mechanical separations, Niraliprakasan,2011.

4. Gavahne.K.A., Unit Operations-II Heat & Mass Transfer, Niraliprakasan, 25th edition, 2012.

REFERENCE BOOKS

1. Geankoplis C.J. Transport Processes and Unit Operations.4th edition, Prentice Hall India. 2003.
2. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M.,"Coulson &Richardson's Chemical Engineering",6th Edition,Vol.I & II,Butterworth–Heinman (an imprint of Elsevier), 2004.
3. Donald Q.Kern, "*Process Heat Transfer*",Tata Mc Graw Hill Book Co., NewDelhi,1997.
4. Foust, A.S."Principles of Unit Operations",2nd Edition, John Wiley&Sons,1999.

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1. https://www.pdfdrive.com/heat-and-mass-transfer-by-kothadaraman-e29924786.html
2. https://www.pdfdrive.com/fundamentals-of-heat-and-mass-transfer-6e-e14571835.html
3. https://www.pdfdrive.com/fluid-mechanics-heat-transfer-and-mass-transfer-chemical-engineering- practice-e157347975.html
4. https://www.pdfdrive.com/heat-and-mass-transfer-by-rk-rajput-e50661606.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand about the transport of momentum (fluid flow) in chemical engineering systems	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Improve their of knowledge in techniques of agitation, mixing of liquids, filtration operations and sedimentation separation		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Understand modes of heat transferring techniques during extraction, distillation, evaporation	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Evaluate effects of process variables while scaling up the bioprocess equipment and	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Comprehend the important mechanical aspects while designing bioprocess equipment.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

418BTT05	ENZYME TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisite Biochemistry

OBJECTIVES

At the end of the course, the students should be able to:

- To provide knowledge and application of working principles and their mechanism of action onenzymes
- To learn theoretical and practical aspects of kinetics
- To improve knowledge in the area of immobilization technique
- To learn enzyme reactions and their characteristics along with the production and purification process.
- To understand about the principles of Biosensors.

UNIT I **INTRODUCTION TO ENZYMES** **9**

Nomenclature & Classification of enzymes. Mechanisms of enzyme action- Lock and key and induced fit model; concept to active site, *catalysis, activator and inhibitors*, specificity of enzyme action; Enzyme units; *coenzymes, isoenzymes*

UNIT II **KINETICS OF ENZYMES** **9**

Kinetics of single substrate reactions; Michelis–Menten equations, signification of Michelis – Menten equations, the lineweaver-burk plot, Eadie-hofstee and hanes plots: turn over number; types of inhibition–Competitive, uncompetitive and non-competitive inhibition; Allosteric regulation of enzymes; Monod, wymanmodel; pH and temperature effect on enzymes; Deactivation kinetics.

UNIT III **ENZYME IMMOBILIZATION** **9**

Physical and chemical techniques for enzyme immobilization–adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - Examples, advantages and disadvantages of enzyme immobilization, Applications of immobilized enzyme systems.

UNIT IV **PURIFICATION AND CHARACTERIZATION OF ENZYMES** **9**

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

UNIT V **APPLICATION OF ENZYME BIOSENSORS IN INDUSTRY** **9**

Enzyme biosensors; Definition and Main component of biosensor, Advantages and disadvantages of enzyme biosensors, Example of an Enzyme Biosensor-Electro chemical Biosensor, Blood Glucose Biosensor, Applications of biosensors in industry, Animal husbandry and health care and environment.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop knowledge on enzymes and enzyme reactions which is the key step towards understanding various concepts in biotechnology;

CO2: Analyze theoretical and practical aspects of kinetics provide the importance towards

interpreting the results;

CO3: Apply the process for commercial production of enzymes;

CO4: Implement ideas on processing, production and purification of enzymes on an industrial scale

CO5: Design and novel biosensor products with better quality and wide commercial application.

TEXT BOOKS

1. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker, Inc.2006
2. James M. Lee, "Biochemical Engineering", PHI, USA.2001
3. Nicholas C. Price and Lewis Stevens, "Fundamentals of Enzymology", Oxford university press 1999
4. Trevor Palmer "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry" Horwood,

REFERENCE BOOKS

1. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.2001
2. Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub.2003
3. Faber K, Biotransformations in Organic Chemistry, IV edition, Springer
4. Roger Harrisonetal., "Bioseparation science and Engineering", Oxford UniversityPress,2003.

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1. https://nptel.ac.in/courses/102102033/
2. https://ndl.iitkgp.ac.in/
3. https://www.pdfdrive.com/microbial-enzyme-technology-in-food-applications-e185805089.htm
4. https://www.pdfdrive.com/biosensors-and-biodetection-methods-and-protocols-volume-2 electrochemical-bioelectronic-piezoelectric-cellular-and-molecular-biosensors-e181167582.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop knowledge on enzymes and enzyme reactions which is the key step towards understanding various concepts in biotechnology;		1	2	1		1		1	2	2		1		1	1
CO2	Analyze theoretical and practical aspects of kinetics provide the importance towards interpreting the results;	2		1		2		2		1		1	2	1	2	2
CO3	Apply the process for commercial production of enzymes;	2		1		2		2	3	1		1	2	1	2	2

CO4	Implement ideas on processing, production and purification of enzymes on an industrial scale	2		1		2		2		1		1	2	1	2	2
CO5	Design and novel biosensor products with better quality and wide commercial application.		1	2	1		1		1	2	2		1		1	1

418BTT06 ENVIRONMENTAL BIOTECHNOLOGY L T P C

3 0 0 3

Prerequisite Environmental Science & Engineering

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the fundamentals of biotechnological concepts;
- To develop the skills in the area of environmental biotechnology and its pre-requisite(s)for PG studies in Biotechnology;
- To know the conversion of waste into energy using microorganisms;
- To understand about the eco-friendly bioproducts from renewable sources and
- To improve the skills in the area of waste water treatment technology.

UNIT I BIOGEOCHEMICAL ROLE OF SOIL MICROORGANISMS 9

Microbial flora of soil–Interactions among soil microorganisms–Nitrogen cycle–Carbon cycle– Sulfur cycle– Phosphorous cycle.

UNIT II BIODEGRADATION 9

Aerobic degradation of recalcitrant organic compounds by microorganisms– Growth associated degradation of aliphatic–Diversity of aromatic compounds–Co- metabolic degradation of organo pollutants – Degradative capacities of fungi. Anaerobic degradation of organic compounds – Degradation of hydrocarbons–Alkylcompounds–ketones–Aromaticcompounds–Halogenated organics–Sulfonates–Nitro organics.

UNIT III BIOREMEDIATION TECHNOLOGIES 9

Remediation technologies–Bioventing–Biosparging and bioslurping–Phytoremediation–Bio Desulphurization of coal and oil–Microbial transformation of heavy metals–Bioleaching, bioaccumulation – Biosorption and bio precipitation of heavy metals.

UNIT IV ECO-FRIENDLY BIOPRODUCTS FROM RENEWABLE SOURCES 9

Fundamentals of composting process–Composting technologies–Composting systems–Compost quality–Biofertilizers–Biopesticides–Scientific aspects and prospects of biofuel production– Bioethanol–Bio hydrogen and biodiesel– *Biogas plant digester*.

UNIT V BIOLOGICAL TREATMENT OF WASTEWATER 9

Physical and chemical characteristics of waste water–Biological processes for waste water treatment- Activated sludge process–Trickling filter–Rotating biological contactors–Fluidized bedreactor– Upflow anaerobic sludge blanket reactor (UASB)–High-rate anaerobic waste water

treatment.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop and improve in standard of living;

CO2: Understand the dynamic process integrated themes related to biodiversity;

CO3: Envision the surrounding environment its function with technology;

CO4: Understand the structure and biochemical aspects of various microbes and

CO5: Acquire knowledge about the renewable forms of energy and its features of biomass and its utilization

TEXT BOOKS

1. Jordening, H. J .and Winter, J., "Environmental Biotechnology: Concepts and Application", Wiley- VCH Verlag,2005.
2. Evans, G. M. and Furlong, J. C., "Environmental Biotechnology: Theory and Application", John Wiley and Sons,
3. 2003.
4. Bhattacharya, B. C. and Banerjee, R., "Environmental Biotechnology", Oxford University Press, 2007.
5. Rajagopalan,R, 'Environmental Studies-From Crisisto Cure', Oxford University Press, 2005.
6. G.Tyler Miller and Scott E. Spoolman,"Environmental Science", Cengage Learning India PVT, Ltd., Delhi, 2014.

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1. Pelczar, M.J., Chan, E. C. S. and Krieg, N.R., "Microbiology", TataMcGraw-Hill,2005.
2. Rittmann, B. E. and McCarty, P. L., "Environmental Biotechnology: Principles and Applications", McGraw-Hill, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India Pvt., Ltd., New Delhi, 2007.
4. Erach Bharucha, "Text book of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad,2015.

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1. http://www.pdfdrive.com/environmental-biotechnology-principles-and-applications-e157042082.html
2. http://www.pdfdrive.com/environmental-science-e12033451.html
3. http://www.pdfdrive.com/environmental-biotechnology-theory-and-application-e7353867.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop and improve in standard of living;	2		1		2		2		1		1	2	1	2	2
CO2	Understand the dynamic		1	2	1		1		1	2	2	3	1		1	1

	process integrated themes related to biodiversity;															
CO3	Envision the surrounding environment its function with technology;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Understand the structure and biochemical aspects of various microbes and	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Acquire knowledge about the renewable forms of energy and its features of biomass and its utilization.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

418BTP07 **MOLECULAR BIOLOGY LABORATORY** **L T P C**

0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- Gain knowledge on the basis of measurements and instruments used in Molecular Biology;
- Provide hands-on experience in performing basic molecularbiology techniques;
- Understand the theory behind each technique and to describe common applications of each methodology in biological research;
- Gain knowledge about separation of biological products;
- Take up specialized projects in Molecular biology which is a pre-requisite for research work.

LIST OF EXPERIMENTS

1. Preparation of reagents, handling equipments and lab safety in molecular biology labs;
2. Quantification of DNA using UV spectrophotometer;
3. Estimation of melting point (tm) of DNA;
4. Determination of molecular weight of DNA by Agarose gel electrophoresis;
5. Determination of protein profile by SDSPAGE;
6. Isolation of genomic DNA-Plant Cells;
7. Isolation of genomic DNA-Yeast Cells;
8. Isolation of DNA from whole blood;
9. Isolation of bacterial plasmid DNA;
10. Restriction enzyme digestion.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Demonstrate knowledge and understanding of the principles under pinning important techniques in molecular biology;

CO 2: Present advanced knowledge in the specialized fields of Molecular Biology;

CO 3: Demonstrate knowledge and understanding of applications of these techniques;

CO 4: Demonstrate the ability to carry out laboratory experiments and interpret the results;

CO5: Understand and be aware of hazardous chemicals and safety precautions in case of an emergency.

TEXT BOOKS

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor,2006.
2. David Freifelder,"MolecularBiology",4th revised Jones & Bartlett Publisher.2005.
3. Dr.P.K.Gupta, "Molecular Biology and Genetic Engineering";2nd Reprint. Rastogi Publications, 2011.

REFERENCE BOOKS

1. Michael P. Weiner "Genetic Variation: A Laboratory Manual" *Rain Dance Technologies,2007.*
2. Robert Schleif "Genetics and Molecular Biology" 2nd Edition. The Johns Hopkins University Press.1993.
3. Carson, Susan, "MolecularBiologyTechniques"3rdEdition, Elsevier.2012.

EBOOKS/WEBLINKS

1. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya
2. https://www.researchgate.net/publication/226072152_Basic_Techniques_in_Molecular_Biology
3. http://genome.tugraz.at/MolecularBiology/WS11_Chapter09_.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Demonstrate knowledge and understanding of the principles under pinning important techniques in molecular biology;	2		1		2		2		1		1	2	1	2	2
CO2	Present advanced knowledge in the specialized fields of Molecular Biology;		1	2	1		1		1	2	2		1		1	1
CO3	Demonstrate knowledge and understanding of applications of these techniques;	2		1		2		2		1		1	2	1	2	2
CO4	Demonstrate the ability to carry out laboratory experiments and interpret the results;		1	2	1		1		1	2	2		1		1	1
CO5	Understand and be aware of hazardous chemicals and safety precautions in case of an emergency.		1	2	1		1		1	2	2		1		1	1

418BTP08	INSTRUMENTAL METHODS OF ANALYSIS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- To gain knowledge on the basis of measurements and instruments;
- To have a practical hands-on experience on absorption spectroscopic methods;
- To gain knowledge about separation of biological products;
- To acquire experience in the purification by performing chromatography and
- To validate and analyze using spectrometric and microscopic techniques.

LIST OF EXPERIMENTS

1. Ultra violet and visible spectrometry instrumentation
2. Determination of maximum wavelength of KMnO4
3. Determination of maximum wavelength for copper sulphate
4. Finding the maximum wavelength of Fe3(1,10 phenanthroline) using UV spectrometry
5. Absorption spectrum of plant pigments
6. UVspectra of nucleic acids
7. Estimation of SO4-by Nephelometer
8. Estimation of Al3+by flourimetry
9. Estimation of trace elements by flame photometry
10. Separation and Identification of amino acids using paper chromatography
11. Separation and Identification of amino acids using TLC
12. Chromatography analysis using gel chromatography

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand calibration of instruments;

CO2: Acquire knowledge on separation techniques used for biological products;

CO3: Understand and apply optical methods;

CO4: Acquire knowledge on different chromatographic methods for separation of biological product

CO5: Acquire knowledge of purification by chromatography.

TEXT BOOKS

1. Textbook of Qualitative Inorganic Analysis, AIVogal, ELBSedition1987.
2. A Biologist guide to principles and techniques of practical biochemistry keith Wilson, Kenneth H Gouicing 3rd edition ELBS Series.
3. Hobert H Willard D.L. Merrit J.R.J. A Dean instrumental methods Analysis, CBS Publishers Distributors1992.
4. Electrochemical Methods by Bard Faulkner 2nd Edition Wiley Publishers 2006.
5. Biophysical Chemistry by Upadhyay 4th Edition by Himalaya Publishing House2007.

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1. Instrumental Methods of Analysis. D. Skoog, 2000 5th Edition College Publishers.
2. Instrumental Methods of Chemical Analysis Galen N. Ewing 5th Edition McGraw Hill International 2006.
3. Introduction to Instrumental Analysis by Robert D Braun, Pharma Book Syndicate 2005.
4. Instrumental Methods of ChemicalAnalysisbyHKaurPPMPublishers1999.

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1. http://www.pdfdrive.com/instrumental-analysis-by-skoog-holler-crouch-2007-brookscole-e79362564.html
2. http://www.pdfdrive.com/chemical-analysis-modern-instrumentation-methods-and-techniques- e19446473.html
3. http://www.pdfdrive.com/vogels-qualitative-inorganic-analysis-5th-ed-e46819938.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand calibration of instruments;	2		1		2		2		1		1	2	1	2	2
CO2	Acquire knowledge on separation techniques used for biological products;	2		1		2		2		1		1	2	1	2	2
CO3	Understand and apply optical methods;	2		1		2		2		1		1	2	1	2	2
CO4	Acquire knowledge on different chromatographic methods for separation of biological product		1	2	1		1		1	2	2		1		1	1
CO5	Acquire knowledge of purification by chromatography.	2		1		2		2		1		1	2	1	2	2

418BTP09 ENZYME TECHNOLOGY LABORATORY

L	T	P	C
0	0	2	1

Prerequisite Biochemistry

OBJECTIVES

At the end of the course, the students should be able to:

- To study about various parameters affecting the natural properties of enzymes.
- To provide hands on experience in enzyme production and purification techniques.
- Provide hands-on experience in performing enzyme production and purification techniques.
- To understand the students on enzyme characterization and immobilization methods.

- Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the students to take up specialized project in enzyme production and purification will
- Be a pre-requisite for research work.

LIST OF EXPERIMENTS

1. Production of microbial enzymes
2. Partial purification of enzymes
3. Partial digestion of protein using enzyme-amylase, invertase, papain, pepsin
4. Effect of pH on enzyme activity.
5. Effect of temperature on enzyme activity
6. Effect of substrate concentration on enzyme activity
7. Determination of stability of enzyme activity.
8. Quantitative analysis of enzyme-amylase, invertase, papain, pepsin
9. Estimation of Vmax and Km.
10. Assaying of alkaline phosphatase activity
11. Enzyme immobilization–Gel entrapment
12. Immobilization of yeast cells as biocatalyst for the production of ethanol from sugar.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Demonstrate the activity of enzyme with various factors

CO 2: Learnt the various process of enzyme immobilization

CO3: Awareness about various kinetic studies on enzymes

CO4: Demonstrate the ability to carry out laboratory experiments and interpret the results.

CO5: Explain about Enzyme kinetics and characterization and how to use them for practical applications

TEXT BOOKS

1. Practical Enzymology,2nd Edition, By Hans Biss wange, Wiley-VCH Verlag GmbH & Co. KGaA, 2012.
2. Practical Biochemistry for Colleges by E. J. Wood,1st Edition, Elsevier,1989.
3. Enzymes in Industry: Production and Applications: W. Gerhartz, VCH Publishers, New York, 1990

REFERENCE BOOKS

1. Enzyme Technology by M.F. Chaplin and C. Bucke, Cambridge University Press, Cambridge,1990.
2. Bailey and Ollis, “Biochemical Engineering Fundamentals”, McGraw Hill (2nd Ed.),1986.
3. Shuler and Kargi, “Bioprocess Engineering “, Prentice Hall, 1992.

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1. https://www.pdfdrive.com/enzyme-kinetics-and-mechanism-part-d-developments-in-enzyme- dynamics-e157727403.html
2. https://www.pdfdrive.com/enzyme-technologies-for-pharmaceutical-and-

biotechnological- applications-e184251789.html

3. https://www.pdfdrive.com/enzyme-engineering-methods-and-protocols-e164853179.html
4. https://www.pdfdrive.com/enzyme-studies-e164429917.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Demonstrate the activity of enzyme with various factors	2		1		2		2		1		1	2	1	2	2
CO2	Learnt the various process of enzyme immobilization		1	2	1		1		1	2	2		1		1	1
CO3	Awareness about various kinetic studies on enzymes		1	2	1		1		1	2	2		1		1	1
CO4	Demonstrate the ability to carry out laboratory experiments and interpret the results.	2		1		2		2		1		1	2	1	2	2
CO5	Explain about Enzyme kinetics and characterization and how to use them for practical applications	2		1		2		2		1		1	2	1	2	2

Semester V

518BTT01 **BIOINFORMATICS** **L T P C**

3 0 0 3

Prerequisite Basics of computing and C programming

OBJECTIVES

At the end of the course, the students should be able to:

- To develop inter disciplinary skills in the applications of computers in biotechnology.
- To navigate through internet-based biological databases and genomic browsers
- To let the students, know there cent evolution in biological science.
- To develop the student knowledge about the programming
- To gain work about the statistical tools

UNIT I **INTRODUCTION** **9**

Introduction to Bioinformatics – applications, Operating systems- types, Elementary UNIX commands, TCP/IP, Telnet, FTP, Protocols, Hardwares, Network topology, Search engines.

UNIT II **BIOLOGICAL DATABASES** **9**

Introduction to databases – Data life cycle biological databases; Primary nucleotide databases

(EMBL, Gene Bank and DDBJ); Primary protein databases (SwissProt, TrEMBL and PIR, Secondary protein databases (PROSITE, BLOCKS and Profiles); Structural databases – SCOP and CATH.
Sequence retrieval from database

UNIT III PATTERN MATCHING AND DYNAMIC PROGRAMMING 9

Introduction to pair wise sequence alignment – local vs. global; Dynamic programming – Needleman – Wunsch algorithm & Smith –Waterman algorithm; Dot matrix analysis; substitution matrices, BLAST
–FASTA—Statistical methods–Hidden Mark of models.

UNIT IV PHYLOGENY 9

Introduction to multiple sequence alignment, Introduction; mutations; mutations as a measure of time; Phylogenetic analysis Distance matrix methods, character-based methods. Molecular clock theory, Bootstrapping.

UNIT V ADVANCED TOPICS IN BIOINFORMATICS 9

Introduction to Systems Biology and Synthetic Biology, Microarray analysis – types and applications, Bioinformatics approaches for drug discovery.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop bioinformatics tools with programming skills.
CO2: Apply computational based solutions for biological perspectives.
CO3: Pursue higher education in this field.
CO4: Practice life-long learning of applied biological science.
CO5: Developed the student knowledge about the programming

TEXT BOOKS

1. Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013
2. Dan Gusfield, "Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology" Cambridge University Press,1997.
3. Durbin, R., Eddy, S., Krogh, A., and Mitchison, G., "Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids" Cambridge, UK: CambridgeUniversityPress,1998.
4. Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
5. Bergeron. B. Bioinformatics Computing,2ndEdition, Prentice Hall of India Learning Pvt (Ltd), India, (2009).

REFERENCE BOOKS

1. Attwood, T.K and Parry Smith.D.J. Introduction to Bioinformatics, 1stEdition, Pearson Education Asia, India, (2002).
2. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall,2006.
3. Andreas D.Baxevanis, B.F. Francis Ouellette: Bioinformatics: A Practical Guide to the Analysis of Genes and
4. Proteins, Volume 39, John Wiley, 1998

5. Baldi, P. and Brunak, S., "Bioinformatics: The Machine Learning Approach" 2nd
6. Edition, MIT Press,2001.
7. J.Pevsner, Bioinformatics and Functional Genomics,2nd Edn.,Wiley-Blackwell,2009.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop bioinformatics tools with programming skills.	2		1		2		2		1		1	2	1	2	2
CO2	Apply computational based solutions for biological perspectives.		1	2	1		1		1	2	2		1		1	1
CO3	Pursue higher education in this field.	2		1		2		2		1		1	2	1	2	2
CO4	Practice life-long learning of applied biological science.		1	2	1		1		1	2	2		1		1	1
CO5	Developed the student knowledge about the programming	2		1		2		2		1		1	2	1	2	2

518BTT02 GENETIC ENGINEERING

L	T	P	C
3	0	0	3

Prerequisite Molecular Biology

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the principle of nucleic acid isolation.
- To understand the principles of PCR and their uses in genetic engineering.
- To gain a thorough knowledge about nucleic acid hybridization.
- To learn history of DNA sequencing and current methods and gene synthesis
- To gain the techniques related to the DNA technology

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Introduction of recombinant DNA into host cells, manipulation of DNA – Restriction and modification enzymes, Design of linkers and adaptors; Characteristics of cloning and vectors; prokaryotic and eukaryotic host systems.

UNIT II POLYMERASE CHAIN REACTION TECHNIQUES 9

Principle of polymerase chain reaction (PCR)-Components of PCR reaction and optimization of PCR -Gene specific primer and degenerate primer–Inverse PCR, Hot-start PCR, Loop mediated PCR-, Reverse transcription PCR and Real time PCR.

UNIT III PROTEIN TECHNIQUES 9

Electrophoresis of protein–native and denaturing conditions, capillary and gel electrophoresis, 2D gel

electrophoresis, Enzyme-linked immunosorbent assay, yeast hybrid system–one hybrid system–two hybrid system, phage display.

UNIT IV CONSTRUCTION OF RECOMBIANT LIBRARIES 9

Construction of cDNA and genomic DNA Libraries. Screening of Libraries with DNA probes and Anti- sera. Blot analysis-Southern, Northern & Western blot; dot and Slot blot. Immunological techniques. DNA methylation, DNA hybridization-DNA Sequencing.

UNIT V TRANSGENIC TECHNOLOGY 9

Principles of Transgene Technology. Scope of Transgenetic Technology. Gene tagging (T-DNA tagging andTransposon tagging) in gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies-Targeted gene replacement, Chromosome engineering.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the basics of biotechnology

CO2: Understand the value of and the processes involved with the polymerase chain Reaction (PCR).

CO3: Understand the concept of recombinant DNA technology or genetic engineering

CO4: Analyze a research problem and step-by-step instructions for

Conducting experiments or testing hypothesis

CO5: Explain the general principles of generating Transgenic plants, animals and genetically modified organisms.

TEXT BOOKS

1. Klug, Cummings and Spencer. “Concepts of Genetics” published Pearson,2016.
2. Daniel L.Hartl, Maryellen Ruvolo.“Genetics: Analysis of Genes and Genomes”8th Edition, Published Laxmi (Pvt.Ltd). 2011.
3. T. A. Brown, Gene cloning and DNA Analysis An Introduction, Wiley Blackwell publications,2010

REFERENCE BOOKS

1. Gardner, Simmons and Snustad. “Principles of Genetics” 8th Edition, Published, Wiley.2006
2. Benjamin A. Pierce. “Genetics: A Conceptual Approach” 4th Edition, Published, WH Freeman & Co. 2010.
3. Scott F. Gilbert and Susan R. Singer. “Developmental Biology (Developmental Biology Developmental Biology)” 9th Edition, Published, Sinauer Associates,2010.
4. Robert J. Brooke, “Genetics: Analysis and Principles”4th Edition, McGraw-Hill Higher Education,2012.
5. Smita Rastogi and Neelam Pathak. “Genetic Engineering (Oxford Higher Education)”1st Edition, Oxford University Press,2009.

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	Understand the basics of biotechnology	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Understand the value of and the processes involved with the polymerase chain Reaction (PCR).	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Understand the concept of recombinant DNA technology or genetic engineering	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Analyze a research problem and step-by-step instructions for Conducting experiments or testing hypothesis		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Explain the general principles of generating Transgenic plants, animals and genetically modified organisms.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

518BTT03 **BIOPROCESS ENGINEERING-I** **L T P C**

3 0 0 3

Prerequisite **Microbiology, Basic Industrial Biotechnology**

OBJECTIVES

At the end of the course, the students should be able to:

- To study the historical development of bioprocess technology, design of fermenter andtypes of fermentation process
- To gain knowledge about formulation, optimization of medium and principles of sterilization
- To inculcate the stoichiometry and energetic ofcell growth and product formation
- To evaluate the kinetic sand mechanism of microbial growth
- To gain the overview about the kinetics

UNIT I **OVERVIEW OFFERMENTATION PROCESSES** **9**

Introduction to bioprocessing: Historical development of Bioprocess technologies, General requirements of fermentation processes, Basic design and construction of fermenters and ancillaries, Main parameters to be monitored and controlled in fermentation processes. Solid-state fermentation and its applications.

UNIT II **RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS** **9**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, Medium Formulation: Types of media – media design and usage of various commercial media for industrial fermentations,

medium optimization.

UNIT III STERILIZATION KINETICS 8

Thermal death kinetics of microorganisms, Batch and continuous heat sterilization of liquid media, Filter sterilization of liquid media, Air sterilization and design of sterilization equipment.

UNIT IV METABOLICS TOICHIOMETRY AND ENERGETICS 10

Stoichiometry of cell growth and product formation: Elemental balances, degree sof reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients. Energetic analysis of microbial growth and product formation: Oxygen consumption and heat evolution in aerobic cultures, Thermodynamic efficiency of growth.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCTFORMATION 10

Phases of Cell growth in batch cultures, Simple unstructured kinetic models for microbial growth, growth of filamentous organisms, product formation kinetics–Leudeking -Piretmodels, substrate and product Inhibition on cell growth and product formation.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Develop skills of the students in the area of bioprocess technology with emphasis an bioprocess principles

CO2: Discuss and distinguish the medium requirements and optimization method s

CO3: Explain the sterilization kinetics of medium and equipments

CO4: Learn about fermentation processes, metabolic stoichiometry, energetic, kinetics of microbial growth etc

CO5: Understand the kinetics of microbial growth that plays a vital role in the fermentation process

TEXT BOOKS

1. Pauline. M. Doran, "Bioprocess Engineering Principles", Academic press, 2012.
2. Stanbury. P. F, Whitaker. A and Hall. S. J, “Principles of Fermentation Technology”, 2nd Edition, Butterworth–Heinemann, 1995.

REFERENCE BOOKS

1. Najafpour.G.D, “Biochemical Engineering and Biotechnology”,Elsevier,2007.
2. Shuler.M. LandKargi.F, “Bioprocess Engineering: BasicConcepts”2ndEdition, Pearson,2002.
3. Bailey. J. E and Ollis. D. F, “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw-Hill,2010.
4. Blanch.H.Wand Clark. D.S, “Biochemical Engineering”. Marcel &Dekker, Inc.,2007.
5. Rao.D. G, “Introduction to Biochemical engineering” , 2ndEdition,McGraw-Hill, 2010.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop skills of the students in the area of bioprocess technology		1	2	1		1		1	2	2		1		1	1

	with emphasis an bioprocess principles															
CO2	Discuss and distinguish the medium requirements and optimization method		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Explain the sterilization kinetics of medium and equipments	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Learn about fermentation processes, metabolic stoichiometry, energetic, kinetics of microbial growth etc	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Understand the kinetics of microbial growth that plays a vital role in the fermentation process	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

518BTT04 **FUNDAMENTALS OF MASS TRANSFER** **L T P C**

3 0 0 3

Prerequisite Fundamentals of Unit Operations

OBJECTIVES

At the end of the course, the students should be able to:

- Explain the basic principles of mass transfer operations and other separation processes with examples.
- Impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer of components from one phase to other phases.
- Focus on absorption and distillation operations and the process design aspects of the same operations.
- Understand extraction and leaching operations and their applications in bioprocessing industry.
- Understand adsorption and drying operations and the process design aspects of the same operations.

UNIT I **DIFFUSION AND MASS TRANSFER** **9+3**

Diffusion: Molecular diffusion, Fick's law of diffusion, steady state molecular diffusion in gases and liquid one component transferring to a non diffusing component and equimolar diffusivity estimation, Interphase Mass Transfer; Mass Transfer coefficients, Concept of overall mass transfer coefficient for liquids and gases, diffusivity measurement and prediction.

UNIT II **GAS LIQUID OPERATIONS** **9+3**

Principles of gas absorption; Single component absorption in single and multistage operation; selection criteria for solvents, material balance, minimum gas-liquid ratio, Design principles of packed absorbers-HETP, HTU and NTU concepts, Industrial absorbers.

UNIT III VAPOUR LIQUID OPERATIONS 9+3

V-L Equilibria, P-x-y and T-x-y diagrams, relative volatility, Raoult's law; Ideal behavior of fluids, types of Distillation-Simple, Steam and Flash Distillation; Continuous distillation; Design calculations-McCabe– Thiele method, Concept of minimum, total and optimum reflux ratio, deviations from ideality-Extractive distillation and Azeotropic distillation.

UNIT IV EXTRACTION OPERATIONS 9+3

Liquid- liquid extraction: distribution coefficient, ternary systems and triangular diagrams, solvent selection criteria for extraction, single stage and multistage extraction – immiscible system, extraction equipments. Solid- liquid equilibria, Leaching Principles, constant under flow staged processes- Single stage leaching, multistage counter current leaching, Leaching equipments– Batch and continuous types.

UNITV SOLID FLUID OPERATIONS 9+3

Types of adsorption, Nature of adsorbents, Langmuir and Freundlich isotherm, calculation of staged processes, adsorption equipments – Batch and fixed bed adsorption; Drying - Mechanism, Drying curves-Time of Drying calculation; Batch and continuous drying equipments.

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Define the basic principles of mass transfer operations and the measurement of diffusivity, mass transfer coefficient;

CO2: Understand the importance of mass transfer phenomena in the design of process equipment in distillation operations;

CO3: Understand the HETP, NTU and HTU concepts of various gas absorption packed tower columns;

CO 4: Understand the design aspects of extraction and various leaching equipments and

CO5: Understand the importance of adsorption and drying processes and their industrial applications.

TEXT BOOKS

Geankoplis C J. "Transport process and separation process principles", 4th edition, Prentice Hall ofIndia.2003

Anantharaman N. and Meera Sheriffa Begum K.M. "Mass Transfer - Theory and Practice", New Delhi:PHI Learning Private Limited. 2011

TreybalR.E. Mass Transfer Operations.3rd edition. McGraw-Hill, 1981.

REFERENCE BOOKS

1. Warren L. McCabe, Julian C. Smith, Peter Harriot. "Unit Operations of Chemical Engineering",7th edition, NewDelhi: McGraw Hill. 2012
2. Ghosal, S.K., Sanyal S.K.& Datta S. "Introduction to Chemical Engineering", New Delhi: Tata McGraw Hill. 2006

3. Benitez J, Principles and modern applications of Mass Transfer Operation, Wiley,2009.
4. Coulson and Richardson, "*Chemical Engineering"*. Vol I & II, New Delhi: Asian Books Pvt Ltd,1998.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Define the basic principles of mass transfer operations and the measurement of diffusivity, mass transfer coefficient;		1	2	1		1		1	2	2		1		1	1
CO2	Understand the importance of mass transfer phenomena in the design of process equipment in distillation operations;	2		1		2		2		1		1	2	1	2	2
CO3	Understand the HETP, NTU and HTU concepts of various gas absorption packed tower columns;	2		1		2		2		1		1	2	1	2	2
CO4	Understand the design aspects of extraction and various leaching equipments and		1	2	1		1		1	2	2		1		1	1
CO5	Understand the importance of adsorption and drying processes and their industrial applications.		1	2	1		1		1	2	2		1		1	1

518BTT05 CHEMICAL THERMODYNAMICS & BIOTHERMODYNAMICS L T P C
3 0 0 3

Prerequisite Stoichiometry and process calculations

OBJECTIVES

At the end of the course, the students should be able to:

- To study about the ideal and non-ideal behavior properties of fluids
- To understand about the determination of solution on thermodynamic properties
- To deal thermodynamic properties of fluids on its equilibrium in phase change

- To deal thermodynamic properties of fluids on its chemical reaction under equilibrium condition
- To analyze the energy in process on behavior with its properties

UNIT I THERMODYNAMIC PROPERTIES OF FLUIDS 9

Basics concepts in thermodynamics, Volumetric properties of fluids exhibiting non ideal behavior; Residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Gibbs Helmhotz Equation, Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS 9

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

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; Bubble point, Dew point Calculation, liquid-liquid equilibria and solid-solid equilibria.

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES 9

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction, Carnot Cycle, Bio thermodynamics.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1 Knowledge on ideal and non-ideal behavior in thermodynamics on properties of fluids

CO2: Knowledge on solutions thermodynamics to determine the properties in the processes.

CO3: Description of properties criteria in order to maintain the phase change co existing equilibrium

CO4: Description of properties criteria in order to maintain the chemical reactions co existing Equilibrium

CO:5 Knowledge on energy utilization and to interpret thermodynamic properties data in the bio processing operations.

TEXT BOOKS

1. Narayanan K.V. A Text Book of Chemical Engineering Thermodynamics. Prentice Hall India, Eighth Edition 2013.
2. Smith J.M., Van Ness H.C., Abbot M.M. Chemical Engineering Thermodynamics.6th Edition. McGraw-Hill,2005

REFERENCE BOOKS

1. Sandler S.I. Chemical and Engineering Thermodynamics. John Wiley,3rd edition 1998.
2. B.G. Kyle, "Chemical process thermodynamics",2nd Edn., Prectice Hall of India Pvt. Ltd., New Delhi 2000.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge on ideal and non-ideal behavior in thermodynamics on properties of fluids	2		1	3	2		2		1		1	2	1	2	2
CO2	Knowledge on solutions thermodynamics to determine the properties in the processes.	2		1		2		2		1		1	2	1	2	2
CO3	Description of properties criteria in order to maintain the phase change co existing equilibrium	2		1		2		2		1		1	2	1	2	2
CO4	Description of properties criteria in order to maintain the chemical reactions co existing Equilibrium		1	2	1		1		1	2	2		1		1	1
CO5	Knowledge on energy utilization and to interpret thermodynamic properties data in the bio processing operations.	2		1		2		2		1		1	2	1	2	2

518BTP07 **GENETIC ENGINEERING LAB**

L	T	P	C
0	0	2	1

Prerequisite MICROBIOLOGY, CELL BIOLOGY, MOLECULAR BIOLOGY

OBJECTIVES

At the end of the course, the students should be able to:

- To illustrate creative use of modern tools and techniques for manipulation and analysis of gene sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.
- To understand research methodologies employing genetic engineering techniques.
- To understand the principles of PCR and their uses in genetic engineering.

- To understand the principles of blotting techniques

LIST OF EXPERIMENTS

1. Isolation of plasmid DNA
2. Restriction enzyme digestion
3. Purification of digested DNA – GelElution
4. Preparation of competent cells
5. Transformation and screening in *E. coli*
6. β-galactosidase assay
7. DNA cloning
8. PCR
9. DNA fingerprinting
10. SDS-PAGE
11. Western blotting
12. Southern blotting

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

Technical know-how on versatile techniques in recombinant DNA technology.

CO1: An ability to design and conduct experiments, as well as to analyze and interpret data

CO2. Apply of genetic engineering techniques in basic and applied experimental biology.

CO3: Develop proficiency in designing and conducting experiments involving genetic manipulation.

CO4: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CO5: An ability to learned about the various blotting techniques

TEXT BOOKS

1. Isil Aksan Kurnaz, "Techniques in Genetic Engineering" Published, CRC Press,2015
2. David Micklos "Genome science a practical and conceptual introduction to molecular genetic analysis in eukaryotes"1st Edition, Published, Cold Spring.2013
3. Rolf H.J. Schlegel, "Rye: Genetics, Breeding, and Cultivation" Published, CRCPress.2013
4. TA Brown "Introduction to Genetics: A Molecular Approach" Published, Garl and Science.2011.
5. Setlow, Jane K. "Genetic Engineering-Principles and Methods" Published, Plenum.2003

REFERENCE BOOKS

1. Isil Aksan Kurnaz, "Techniques in Genetic Engineering" Published, CRC Press.2015.
2. DR. P.S. VERMA and V K Agarwal. "Genetic Engineering" Published, S. Chand Publishing.2009.
3. Utpal Roy and Vishal Saxena. "A Handbook of Genetic Engineering" 47th, Edition, Published, Kalyani.2007.
4. Vennisonand S John. "Laboratory Manual for Genetic Engineering" published, Prentice HallIndia Learning Private Limited. 2009.
5. C. C. Giriand Archana Giri."Plant Biotechnology: Practical Manual" Published, IK International Publishing House Pvt. Ltd. 2007

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	An ability to design and conduct experiments, as well as to analyze and interpret data		1	2	1		1	3	1	2	2		1		1	1
CO2	Apply of genetic engineering techniques in basic and applied experimental biology.		1	2	1		1		1	2	2		1		1	1
CO3	Develop proficiency in designing and conducting experiments involving genetic manipulation	2		1		2		2		1		1	2	1	2	2
CO4	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	2		1		2		2		1		1	2	1	2	2
CO5	An ability to learned about the various blotting techniques	2		1		2		2		1		1	2	1	2	2

518BTP08 **BIOPROCESS ENGINEERING LAB I** **L T P C**
0 0 2 1

Prerequisite **Bioprocess principles**

OBJECTIVES

At the end of the course, the students should be able to:

- To develop basic experimental skills for preparing medium and sterilization.
- To provide practical understanding of effect on parameters on cell growth
- To provide training on upstream processes technology
- To provide knowledge on preparation and utilization offer mentor
- To provide knowledge on production primary and secondary metabolite.

LIST OF EXPERIMENTS

1. Preparation of bioreactor, utilizes for bioreactor
2. Medium preparation and sterilization

3. Effect of temperature on cell growth
4. Effect of pH on cell growth
5. Monod kinetics
6. Growth of bacteria-Estimation of biomass, calculations of specific growth rate, yield coefficient
7. Growth of Yeast-Estimation of biomass, calculations of specific growth rate, yield coefficient
8. Effect of substrate inhibition on cell growth
9. Production of primary metabolites
10. Production of secondary metabolites
11. Medium optimization-Plackett burman design
12. Medium optimization-Response surface methodology
13. Single cell protein (SCP) production by continuous culture

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO:1 Knowledge on preparation of medium and sterilization in upstream processes

CO:2 Knowledgeon optimization of cell growth

CO:3 Exposureto upstream processes and preparation before the fermentation

CO:4Knowledgeon preparation and utility of bioreactor

CO:5Knowledge on production of metabolites in lab scale fermenter

TEXT BOOKS

1. S. Kulandaivelu and S.Janarthanan,"Practical Manual on Fermentation Technology" IK International publishling house, New Delhi,2012
2. Palvannan T, Shanmugam S, Satish Kumar T,"Laboratory Manual On Biochemistry, Bioprocess & Microbiology",Scitech Publications (India) Pvt Lt,2006

REFERENCE BOOKS

1. Sarfaraz K. Niazi, Justin L. Brown, "Fundamentals of Modern Bioprocessing" CRC Press, 2015
2. Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications,1998.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge on preparation of medium and sterilization in upstream processes		**1**	**2**	**1**		**1**	**3**	**1**	**2**	**2**		**1**		**1**	**1**
CO2	Knowledgeon optimization of cell growth		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Exposureto upstream processes and preparation before the fermentation	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

CO4	Knowledgeon preparation and utility of bioreactor	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Knowledge on production of metabolites in lab scale fermenter	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

518BTP09 **CHEMICAL ENGINEERING LABORTY FOR BIOTECHNOLOGISTS** **L T P C**
0 0 0 2

OBJECTIVES

At the end of the course, the students should be able to:

- To provide basic understanding of chemical engineering principles and operations
- Course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters
- To provide basic understanding of chemical engineering operations
- To gain knowledge related to distillation
- To provide the overview about the heat exchanger

LIST OF EXPERIMENTS

1. Flow measurement–a) Orifice meter b) Venturi meter
2. Pressure drop in flow through packed column
3. Pressure drop in pipes
4. Filtration–Vacuum leaf filter
5. Filtration–Plate and Frame filter press
6. Heat transfer characteristics in heat exchanger
7. Horizontal Condenser
8. Simple distillation
9. Steam distillation
10. HETP in packed column
11. Liquid-liquid equilibria in extraction
12. Adsorption equilibrium
13. Drying Characteristics in Tray Dryer

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Ability to apply the skill of unit process of chemical engineering and biotechnology.

CO2: Ability to analyse the principles of chemical engineering and its application on biological perspectives.

CO3: Design and working principles of fluid moving machinery and transport phenomenon.

CO4: Gained knowledge related to distillation

CO5: Learned the overview about the heat exchanger

TEXT BOOKS

1. GeankoplisC.J. Transport Processes and Unit Operations. 4rd Edition, Prentice Hall India,2003.
2. McCabe W.L.,Smith J.C. Unit Operations In Chemical Engineering.7th Edition Mcgraw hill,2014..
3. Dutta.B.K, Principles of Mass Transfer Separation processes, Prentice Hall India, 2000

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Ability to apply the skill of unit process of chemical engineering and biotechnology.	2		1		2		2		1		1	2	1	2	2
CO2	Ability to analyse the principles of chemical engineering and its application on biological perspectives.	2		1		2		2		1		1	2	1	2	2
CO3	Design and working principles of fluid moving machinery and transport phenomenon.		1	2	1		1		1	2	2		1		1	1
CO4	Gained knowledge related to distillation	2		1		2		2		1		1	2	1	2	2
CO5	Learned the overview about the heat exchanger	2		1		2		2		1		1	2	1	2	2

Semester VI

		L	T	P	C
618BTT01	**PROTEIN ENGINEERING**	**3**	**0**	**0**	**3**

Prerequisite Biochemistry

OBJECTIVES

At the end of the course, the students should be able to:

- Identify the importance of protein Biomolecules.
- Realize the structure-function relationships in proteins
- Understand protein structure-function relationship
- Gain the knowledge of tertiary structure of protein
- Ability to know the concept of various protein structure

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 9

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modifications (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN ARCHITECTURE 9

Primary structure: peptide mapping, peptide sequencing - automated Edman method and mass spectroscopy High- throughput protein sequencing setup, Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT III STRUCTURE-FUNCTION RELATIONSHIP 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in home domain, Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center,Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate- assisted catalysis other commercial applications. Computer exercise on the above aspects

UNITIV TERTIARY STRUCTURE 9

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3Dstructures. Quaternary structure: Modular nature, formation of complexes, Computer exercise on the above aspects

UNIT V PROTEOMICS 9

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it, protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above Aspects

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: To analyze the various interactions in protein makeup.

CO2: To be familiar with different levels of protein structure.

CO3: To know the role of functional proteins in various field of study.

CO4: To practice the latest applications of protein science in their research.

CO5: Student learned the concept of various protein structure

TEXT BOOKS

1. Branden C. and ToozeJ., "IntroductiontoProteinStructured"2ndEdition, Garland Publishing,1999.
2. CreightonT.E. "Proteins" 2nd Edition.W.H. Freeman,1993

3. Liebler, “Introduction to Proteomics” HumanaPress,2002

REFERENCE BOOKS

1. Voet D. and Voet G., “Biochemistry”.3rd Edition.John Wiley and Sons,2008
2. Haggerty, Lauren M. “Protein Structure: Protein Science and Engineering”. Nova Science Publications,2011.
3. Williamson, Mike “How Proteins Work”. Garland Science,2012

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	To analyze the various interactions in protein makeup.		1	2	1		1		1	2	2		1		1	1
CO2	To be familiar with different levels of protein structure.		1	2	1		1		1	2	2		1		1	1
CO3	To know the role of functional proteins in various field of study.	2		1		2		2		1		1	2	1	2	2
CO4	To practice the latest applications of protein science in their research.	2		1		2		2	3	1		1	2	1	2	2
CO5	Student learned the concept of various protein structure	2		1		2		2		1		1	2	1	2	2

618BTT02 CHEMICAL REACTION ENGINEERING L T P C
3 1 0 4

Prerequisite Stoichiometric and process calculations

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTIONENGINEERING 9+3

Introduction to Chemical kinetics; rate equation, rate constant, elementary and non- elementary reactions; concentration and temperature dependence; development of rate equations for different homogeneous reactions, Search for reaction mechanism; Interpretation of batch reactor data-Integral and differential method of analysis (constant volume batch reactor).

UNIT II IDEAL FLOW AND NON-IDEAL FLOW 9+3

Basics of non-ideal flow; RTD function and measurement, RTD in plug flow and mixed flow reactor, relation among E, F and C curve, conversion in non-ideal flow, non-ideal flow models-tank in series and dispersion models; reactor performance with non-ideal flow.

UNIT III IDEAL REACTORS 9+3

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors - batch, plug flow and mixed flow reactors; space time and space velocity; multiple reactor systems; multiple Reactions

UNIT IV GAS-SOLID AND GAS-LIQUID REACTIONS 9+3

Resistances and rate equations; heterogeneous catalysis; reactions steps; selection of a model, unreacted core models for spherical particles - progressive conversion model and shrinking core model, determination of rate controlling step.

UNIT V FIXED BED AND FLUID BED REACTORS 9+3

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Write the rate equation for most of the chemical reaction.

CO2: Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

CO3: Design reactors for heterogeneous reactions and optimize operating conditions.

CO4: Student develop knowledge for design of ideal reactors and RTD studies

CO5: Student gained knowledge in heterogeneous reactions and reactor types.

TEXT BOOKS

1. Levenspiel O. Chemical Reaction Engineering. 3rd Edition.JohnWiley.1999
2. Fogler H.S. Elements of ChemicalReactionEngineering.PrenticeHallIndia.2002
3. Mark E. Davis and Robert J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill Higher Education; 1stedition 2002

REFERENCE BOOKS

1. Missen R.W., Mims C.A., Saville B. A. Introduction to Chemical Reaction Engineering and Kinetics. JohnWiley.1999
2. Dawande, S.D., "Principles of Reaction Engineering",Ist Edition, Central Techno Publications,2001.
3. Richardson, J. F. and Peacock, D. G., "Coulson Richardson -Chemical Engineering", Vol.III,IIIrd
4. Edition, Butterworth-Heinemann-Elsevier,2006

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Write the rate equation for most of the chemical reaction.		1	2	1		1		1	2	2		1		1	1
CO2	Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and	2		1		2		2		1		1	2	1	2	2

	solve chemical engineering problems.															
CO3	Design reactors for heterogeneous reactions and optimize operating conditions.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Student develop knowledge for design of ideal reactors and RTD studies		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Student gained knowledge in heterogeneous reactions and reactor types.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

618BTT03 **BIOPROCESS ENGINEERING-II** **L T P C**
3 1 0 4

Prerequisite Bioprocess Engineering–I and Fundamentals of Mass Transfer

OBJECTIVES

At the end of the course, the students should be able to:

- To impart the basics of different operational modes of bioreactors
- To develop knowledge for design aspects of bioreactor scaleup for various systems
- To acquire knowledge in reactor consideration for enzyme systems, modelingand simulation of bioprocess.
- To develop knowledge in recombinant cultivation systems.
- To develop bioengineering skills for the production of biochemical productusing integrated biochemical processes.

UNIT I **OPERATIONAL MODES OF BIOREACTORS** **9+3**

Ideal reactors and its characteristics, Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in w a s t e water treatment, two stage cultivation, packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors.

UNIT II **BIOREACTOR SCALE–UP** **9+3**

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

UNIT III **BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS** **9+3**

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors.

UNIT IV **MODELLING AND SIMULATION OF BIOPROCESSES** **9+3**

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

UNIT V RECOMBINANT CELL CULTIVATION 9+3

Different host vector system for recombinant cell cultivation strategies and advantages. E. coli, yeast Pichiapastoris/Saccharomyces cereviseae, Animal cell cultivation, Plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system

TOTAL HOURS 45+15 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Analyze various operational modes of bioreactor systems

CO2: Capability to design bioreactor system for various industrial applications.

CO3: Apply modeling and simulation of bioprocesses and thereby reduce cost and to enhance the quality of products and systems.

CO4: Demonstrate recombinant techniques and cultivation of various plant, animal and insect systems for industrial applications.

CO5: Integrate research lab and Industry; identify problems and seek practical solutions for large scale of Biotechnology industries.

TEXT BOOKS

1. James E. Bailey& David F. Ollis, “Biochemical Engineering Fundamentals”, McGraw-Hill2000
2. Anton Moser, “Bioprocess Technology”, Kinetics and Reactors”, Springer Verlag.1999
3. Shuler and Kargi, “Bioprocess Engineering”, PrenticeHall,1992
4. Pauline Doran, “Bioprocess Engineering Principles”, Academicpress,2nd edition,2013

REFERENCE BOOKS

1. James M. Lee, “Biochemical Engineering”, PHI, USA2002
2. Pauline Doran, “Bioprocess Engineering Calculation”, Blackwell Scientific Publications 1998
3. Harvey W. Blanch, Douglas S. Clark, “Biochemical Engineering”, Marcel Decker Inc 2001
4. Atkinson, Hand book of Bioreactors, Harvey W. Blanch, Douglas S. Clark, Biochemical 59 Engineering, Marcel Decker Inc 2008

EBOOKS/WEBLINKS

1. https://www.pdfdrive.com/bioprocess-engineering-kinetics-biosystems-sustainability-and-reactor-design- e187875542.html
2. https://www.pdfdrive.com/pauline-m-doran-bioprocess-engineering-principles-e58066628.html
3. https://www.pdfdrive.com/bioprocess-engineering-basic-concepts-by-shuler-and-kargi-e184284346.html

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	Analyze various operational modes of bioreactor systems	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Capability to design bioreactor system for various industrial applications.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Apply modeling and simulation of bioprocesses and thereby reduce cost and to enhance the quality of products and systems.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Demonstrate recombinant techniques and cultivation of various plant, animal and insect systems for industrial applications.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Integrate research lab and Industry; identify problems and seek practical solutions for large scale of Biotechnology industries.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

618BTT04 HEALTH & PHARMACEUTICALBIOTECHNOLOGY L T P C

3 0 0 3

Prerequisite Biochemistry

OBJECTIVES

At the end of the course, the students should be able to:

- To have the basic knowledge of pharmacology
- To gain knowledge in various dosage forms and biopharmaceutics
- To be able to understand in pharmacokinetics and drug discovery
- Dosage forms and applications
- To gain the knowledge about the various biopharmaceuticals

UNIT I INTRODUCTION TO PHARMACOLOGY 9

Historical outlines of drugs, classifications of drugs, physico-chemical properties of drugs, Routes of administration of drugs, drug metabolism, controlled release drug delivery system, drug stability, Sources: plant, marine and microorganisms

UNIT II DRUG DISCOVERY 9

Introduction, basic clinical evolution of new drugs, bioavailability of drugs, quantitative and qualitative assay of drugs by biological testing, packing techniques like compression of tablets, wet & dry granulation, direct compression, tablet presses and coating

UNIT III PHARMACOKINETICS AND BIOTRANSFORMATION 9

Pharmacokinetics: Introduction, absorption, distribution, elimination and metabolism of drugs, site of action, Phase I and Phase II reactions, prodrugs, adverse drug effects, Role of Enzymes in drug metabolism

UNIT IV PHARMACEUTICAL DOSAGE FORMS AND APPLICATIONS 9

Oral solid dosage forms, compressed tablets, types, pills, solutions, syrups, juices, nasal solutions, emulsions, lotions and extracts. Applications of various drugs in human body and site of action

UNIT V BIOPHARMACEUTICALS 9

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, common drugs which are abused, antibiotics, human insulin, interferon, somatostalim, somatotropin – its preservation and analytical methods

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Drugs, drugs action, drug metabolism

CO2: Various dosage forms of Biopharmaceuticals

CO3: The recent evolution in pharmaceutical biotechnology

CO4: Evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market.

CO5: Gained the knowledge about the various biopharmaceuticals

TEXT BOOKS

1. Remington, "The science and practice of pharmacy", Lippincott Williams and Wilkins, 20th edition,2001
2. Gareth Thomas, "Medicinal Chemistry an Introduction", John Wiley, NewDelhi,2000
3. RamI. Mahato, Ajit S. Narang, "Pharmaceutical Dosage Forms and Drug Delivery",2nd Edition CRC Press, 2011
4. Mohsen A. Hedaya "Basic Pharmacokinetics", 2nd Edition, Routledge,2012

REFERENCE BOOKS

1. Katzung, B. G. "Basic and Clinical Pharmacology", Prentice Hall of India, New Delhi.,1995
2. Tripathi, K. D. "Essentials of Medical Pharmacology", Jaypee Brothers Medical Publishers(P)Ltd, 6thedition, John Wiley, New Delhi, 2000

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Drugs, drugs action, drug metabolism		1	2	1		1		1	2	2		1		1	1

CO2	Various dosage forms of Biopharmaceuticals	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	The recent evolution in pharmaceutical biotechnology	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Gained the knowledge about the various biopharmaceuticals		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

618BTT05 **IMMUNOLOGY** **L T P C**
3 0 0 3

Prerequisite Cell Biology

OBJECTIVES

At the end of the course, the students should be able to:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To understand the basic principles of immunology and recent advancements in the field of adaptive immunity
- To explain various techniques of monoclonal and antibody engineering
- To understand the activation of complements, receptors and negative immune regulation.

UNIT I **INTRODUCTION** **9**

Cells and tissues of immune system; hematopoiesis; innate and acquired immunity; types of immune responses; antigens: chemical and molecular nature; haptens; adjuvants, Immunization and vaccines, immune techniques

UNIT II **HUMORAL RESPONSE** **9**

Development, maturation, activation and differentiation of B cells: *Theory of clonal selection*; Structure and functions of antibodies: Genes and generation of diversity; Hybridoma technology for productionof monoclonal antibodies-Antibody engineering, Kinetics of antibody response

UNIT III **CELLULAR RESPONSE** **9**

Development, maturation, activation and differentiation of T cells; and CMI (Cell mediate immunity), TCR; Clonal energy; Antigen presenting cells: Macrophage, Langerhan's cells and B cells- Antigen processing and presentation; Classes of MHC; MHC/HLA genetic loci; HLA alleles and diseases

UNIT IV **IMMUNITYTOINFECTION AND HYPERSENSITIVITY REACTIONS** **9**

Inflammation, Immune response to infections: bacteria, viruses, fungi and parasites; Cytokines;

Complement systems; Different types of Hyper sensitivity and their roles

UNIT V IMMUNOLOGY OF TRANSPLANTATION, AUTOIMMUNITY AND TUMOR 9

Transplantation: types of graft; mechanism of graft rejection; HVG and GVH rejection; immunological strategies to prevent graft rejection; *Autoimmunity, Autoimmune disorders and their diagnosis,* Tumorimmunity

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Awareness of immune system structure and functions

CO2: Awareness of immunity to various pathogens

CO3: Awareness of cellular and molecular aspects of lymphocyte activation, homeostasis differentiation, and memory.

CO4: Awareness of molecular basis of complex, cellular processes involved in inflammation and immunity, in state of healthy and diseased conditions

CO5: Awareness of tumor allergy and hypersensitivity reactions

TEXT BOOKS

1. Ashim K. Chakravarthy, "Immunology", TataMcGraw-Hill,2010
2. Richard A Goldsby, Thomas J Kindt, Barbara A Osborne and Janis Kuby. "Immunology" 5th Edition, W. H. Freeman & Co., 2005
3. Benjamin E.and Leskowitz S. Immunology A Short Course, Wiley Liss NY,2010
4. William E.Paul "FundamentalImmunology",7thedition,Library of congress cataloguingin publications,2013
5. Danny Altmann "Immunology",12thedition, British Society of Immunology,2017

REFERENCE BOOKS

1. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essential Immunology,13thEdition, Wiley –Blackwell, 2016.
2. Janeway, Travers, Walport and Shlomichik, (2001), "Immunobiology", GarlandPubl.,2011
3. IanR.Tizard." Immunology-An Introduction" 4thEdition.Thomson Publ.,2013
4. Andrew H. Lichtman, ShivPilla, Abul K. Abbas, Cellular & Molecular Immunology, 7thedition, south Asia Publication, 2011
5. Dr. S. K. Gupta, "Essentials of Immunology", 2nd edition, AryaPublications,2010

EBOOKS/WEBLINKS

1. https://www.pdfdrive.com/kuby-immunology-7th-edition-2013-e44842271.html
2. https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html
3. https://www.pdfdrive.com/roitts-essential-immunology-e58124862.html

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	Awareness of immune system structure and functions	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Awareness of immunity to various pathogens	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Awareness of cellular and molecular aspects of lymphocyte activation, homeostasis differentiation, and memory.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Awareness of molecular basis of complex, cellular processes involved in inflammation and immunity, in state of healthy and diseased conditions		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Awareness of tumor allergy and hypersensitivity reactions		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

618BTP07 **BIOPROCESS ENGINEERING LAB II** **L T P C**

0 0 2 1

Prerequisite Bioprocess Engineering lab–I

OBJECTIVES

At the end of the course, the students should be able to:

- To impart practical knowledge in sterilization and preparation of bioreactor
- To develop practical knowledge of bioreactor operations in lab scale
- To develop knowledge in mass transfer rate in bioreactor
- To understand the control and measurement of various parameters in bioreactor
- To learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry

LIST OF EXPERIMENTS

1. Batch sterilization kinetics
2. Batch cultivation with exhaust gas analysis
3. Operation of pH control and dissolved oxygen measurement
4. Estimation of KLa - Dynamic gassing out method
5. Estimation of KLa - Sulphite oxidation method

6. Estimation of KLa - Power correlation method
7. Fed batch cultivation kinetics
8. Algal cultivation
9. Residence time distribution-CSTR
10. Residence time distribution-PFR
11. Estimation of overall Heat transfer coefficient
12. Estimation of mixing time in reactor

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Analyze various operational modes of bioreactor systems

CO2: Capable of handle bioreactor system for various industrial applications.

CO3: Design and conduct experiments on bioprocess engineering problems

CO4: Design and control the operating parameters of various types of bioreactors

CO5: Demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

TEXT BOOKS

1. James E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill2000
2. Anton Moser, "Bioprocess Technology", Kinetics and Reactors", Springer Verlag.1999

REFERENCE BOOKS

1. James M. Lee, "Biochemical Engineering", PHI, USA2002.
2. Pauline Doran, "Bioprocess Engineering Calculation", Blackwell Scientific Publications1998.

EBOOKS/WEBLINKS

1. https://www.pdfdrive.com/bioprocess-engineering-kinetics-biosystems-sustainability-and-reactor-design- e187875542.html
2. https://www.pdfdrive.com/pauline-m-doran-bioprocess-engineering-principles-e58066628.html
3. https://www.pdfdrive.com/bioprocess-engineering-basic-concepts-by-shuler-and kargi-e184284346.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Analyze various operational modes of bioreactor systems	2		1		2		2		1	3	1	2	1	2	2
CO2	Capable of handle bioreactor system for various industrial applications.	2		1		2		2		1		1	2	1	2	2

CO3	Design and conduct experiments on bioprocess engineering problems		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Design and control the operating parameters of various types of bioreactors	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

618BTP08 **HEALTH AND PHARMACEUTICAL BIOTECHNOLOGY LAB** **L T P C**
0 0 2 1

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the techniques, procedures, and equipment's related to drug preparation, compounding and quality assurance;
- To understand the basic calculations of the quantity of medication to be compounded or dispensed
- To understand the basic information regarding the appropriate use of equipment and apparatus required to administer medications
- To learn evaluation and interpretation of health science literature efficientlyand accurately for pharmaceutical care, research and education
- To recognize errors in prescribing and demonstrate the proper procedure to resolve such errors as they occur.

LIST OF EXPERIMENTS

1. Study of Flowsheets and symbols of pharmaceutical engineering;
2. Determination of the Partition Coefficient of Citric Acid (drug) between aqueous phase and non- aqueous phase;
3. Determination of the effect of pH on Partition Coefficient of Citric Acid (drug) between aqueous phase and non-aqueous phase;
4. Preparation of O/W emulsion;
5. Preparation of aspirin;
6. Determine the particle size distribution of a powder-sieving method;
7. Preparation of aqueous solutions and syrups;

8. Preparation of non-aqueous solutions, like spirits, tinctures;
9. Preparation of semisolid dosage forms: ointment bases;
10. Preparation of low-viscosity topical medicine

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understanding the recent trends in pharmaceutical biotechnology

CO2: Understanding the techniques, procedures, and equipments related to Drug preparation, compounding and quality assurance

CO3: Understanding the basic Calculations of the quantity of medication to be compounded or dispensed

CO4: Evaluate and interpret health science literature efficiently and accurately for pharmaceutical care, research and education

CO5: Understanding Pharmaceutical parameters for current and future biotechnology related products in the market.

TEXT BOOKS

1. Remington, "The science and practice of pharmacy", Lippincott Williams and Wilkins, 20thedition,2001
2. CVS Subrahmanyam, J. Thimmasettee, V. Kussumdevi and Sarasijia suresh, "Laboratory manual of pharmaceutical Engineering., 2nd ed.,2011.

REFERENCE BOOKS

1. Katzung, B. G. "Basic and Clinical Pharmacology", Prentice Hall of India, New Delhi.,1995
2. Tripathi, K. D. "Essentials of Medical Pharmacology", Jaypee Brothers Medical Publish ltd, 6th edition, John Wiley, New Delhi,2000

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understanding the recent trends in pharmaceutical biotechnology		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Understanding the techniques, procedures, and equipments related to Drug preparation, compounding and quality assurance	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Understanding the basic Calculations of the quantity of medication to be compounded	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

	or dispensed															
CO4	Evaluate and interpret health science literature efficiently and accurately for pharmaceutical care, research and education	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Understanding Pharmaceutical parameters for current and future biotechnology related products in the market.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

618BTP09 **IMMUNOLOGY LAB** **L T P C**
0 0 2 1

Prerequisite Cell Biology lab

OBJECTIVES

At the end of the course, the students should be able to:

- To state the principle of the routine immunologic procedures performed in the clinical laboratory
- To describe the immunologic responses involved in preventingand combating infections.
- To undergo laboratory training in different immunological and immune technological techniques.
- To understand the molecular specificity of antibodies for specific antigens
- To simulate the spread of an infectious disease and determine etiology

LIST OF EXPERIMENTS

1. Handling of animals, immunization and raising antisera
2. Identification of Blood cells
3. Differential count of white blood cells
4. Blood grouping (ABO & Rh factor)
5. Widal Test (Slide &Tube Test)
6. Isolation of monocytes from blood
7. Identification of T cells by Tcell rossetting using sheep RBC.
8. Isolation of peripheral blood mononuclear cells
9. Ouchterlony double immune diffusion technique (ODD)
10. Radial immune diffusion (RID) *(mancin imethod)*
11. Immuno electrophoresis
12. Enzyme Linked Immunosorbent Assay
13. Western Blotting

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Awareness of basic and state-of-the-art experimental methods and technologies

CO2: Awareness to develop an ability to summarize, integrate and organize information a nd relate it to disease outcomes

CO3: Awareness to evaluate the potential for current research and new discoveries to improve our understanding of immunology and its relevance to human health and to our society.

CO4: Awareness to use medical case reports, identify "disease defects" and define molecular or cellular targets for therapeutic intervention:

CO5: Awareness to understand basic mechanisms and preventive Therapeutic measures

TEXT BOOKS

1. AshimK. Chakravarthy, "Immunology", TataMcGraw-Hill,2010
2. Richard A Goldsby, Thomas JKindt, Barbara A Osborne and Janis Kuby. "Immunology" 5th Edition, W.H. Freeman & Co.,2005
3. Benjamin E .and Leskowitz S. "Immunology A short Course", Wiley Liss NY,2010
4. Mark Peakman and Leonie Taams, "Clinical & Experimental Immunology", 12thedition,British Society for Immunology, 2017.
5. FrankC. Hay, Olwyn M. R. West wood "Practical Immunology",4thEditionWileyBlackwell Publications,2010

REFERENCE BOOKS

1. Talwar, G.P and Gupta, S.K. A Handbook of practical and immunology", CBS Publishers&Distributors.2004
2. Janeway, Travers, Walport and Shlomichik, "Immunobiology", GarlandPubl.,2011
3. Ian R. Tizard." Immunology-An Introduction.4thEdition". Thomson Publ.,2013
4. J Ochei and A. Kolhatlkar "Medical Laboratory Science Theory and Practice" by PPM Publishers1999
5. Barbara Detrick, Robert G. Hamilton, John L. Schmitz "Manual of Molecular and Clinical Laboratory Immunology",8theditionASMPress,2016

EBOOKS/WEBLINKS

1. https://www.pdfdrive.com/manual-of-molecular-and-clinical-laboratory-immunology-e185420621.html
2. https://www.pdfdrive.com/clinical-laboratory-immunology-e33514338.html
3. https://www.pdfdrive.com/handbook-of-laboratory-animal-science-volume-i-third-edition-essential-principles-and-practices-e162094241.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Awareness of basic and state-of-the-art experimental methods	2		1		2		2		1		1	2	1	2	2

	and technologies															
CO2	Awareness to develop an ability to summarize, integrate and organize information a nd relate it to disease outcomes		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Awareness to evaluate the potential for current research and new discoveries to improve our understanding of immunology and its relevance to human health and to our society.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Awareness to use medical case reports, identify "disease defects" and define molecular or cellular targets for therapeutic intervention:	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Awareness to understand basic mechanisms and preventive Therapeutic measures	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

618BTP10 ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB

L	**T**	**P**	**C**
0	**0**	**2**	**1**

Prerequisite Instrumental Methods of Analysis Lab

OBJECTIVES

At the end of the course, the students should be able to:

- Develop skills and techniques used in modern biotechnology.
- Learn the techniques of chromatography
- Gain knowledge related to the hybridization techniques
- Ability to develop the techniques of fermenter types
- Develop skills about the types of centrifugations

LIST OF EXPERIMENTS

1. Various types of Centrifugations
2. Running of a pilot fermenter
3. 2D gel Electrophoresis
4. ELISA
5. DNA Hybridization
6. Isoelectric Focusing
7. Electroporation
8. High Performance Liquid Chromatography
9. Thin Layer Chromatography
10. Vermicomposting
11. COD Analyzer

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Knowledge on practical skills in analytical techniques and instrumentation of biotechnology

CO2: Analytical skills to do project

CO3: Learn various separation techniques involved in biotechnology industries

CO4: Student develop the techniques knowledge of fermenter types

CO5: Developed skills about the types of centrifugations

TEXT BOOKS

1. Keith Wilson and John Walker, Practical Biochemistry– Principles and techniques, Cambridge University Press, U.K;5th Edition, 2003
2. Frank C. Hay, Olwyn M.R. Westwood, quot; Practical Immunology; Blackwell Science; 4th edition (January28,2002)

REFERENCE BOOKS

1. Rapley and Walker, Molecular Biomethods Handbook, Humana Press, Totowa, NewYork,2003

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge on practical skills in analytical techniques and instrumentation of biotechnology	2		1		2		2		1		1	2	1	2	2
CO2	Analytical skills to do project		1	2	1		1		1	2	2		1		1	1
CO3	Learn various separation techniques involved in biotechnology industries	2		1		2		2		1		1	2	1	2	2

CO4	Student develop the techniques knowledge of fermenter types	2		1		2		2		1		1	2	1	2	2
CO5	Developed skills about the types of centrifugations		1	2	1		1		1	2	2		1		1	1

Semester 7

718BTT01 DOWNSTREAM PROCESSING L T P C

3 0 0 3

Prerequisite Fundamentals of Unit Operation, Instrumental Methods of Analysis

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the methods too btain pure proteins, enzymes and in general about product development R&D
- Gain knowledge and hands on experience with on Downstream processes
- Understand the concepts in purification of bio molecules
- Gain knowledge in drying and crystallization
- Learned the work about the finishing operation

UNIT I DOWNSTREAM PROCESSING 9

Introduction to downstream processing, principles characteristics of biomolecules and bioprocesses.

Cell disruption for product release- mechanical, enzymatic and chemical methods. Pretreatment ofproducts.

UNIT II PHYSICAL METHODS OF SEPERATION 9

Unit operations for solid-liquid separation: filtration- Batch and continuous filtration, Microfiltration:centrifugation- Types of centrifuges and sedimentation

UNIT III ISOLATION OF PRODUCTS 9

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, supercritical extraction membrane

separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 9

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, sizeexclusion, hydrophobic interaction, bio affinity and pseudo affinity chromatographic techniques, HPLC

UNIT V FINAL PRODUCT FORMULATION AND FINISHINGOPERATIONS 9

Crystallization – Basic Concept, Crystal size distributions, Batch Crystallization, Recrystallization. Drying – Basic concept, Drying Equipments, Conduction drying, Adiabatic Drying, lyophilisation of final product

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Define the fundamentals of downstream processing for product recovery

CO2: Understand the requirements of successful operations of downstream processing

CO3: Describe the process of downstream equipments and explain the techniques in multifactorial manufacturing

CO4: Understood the knowledge in finishing operation in DSP C

CO5: Gained the knowledge about the purification process

TEXT BOOKS

1. P.A. Belter, E.L. Cussler and Wei-Houhu – Bioseparations – Downstream Processing For
2. Biotechnology, Wiley Interscience Pub. (2002).
3. R.O. Jenkins, (Ed.) – Product Recovery in Bioprocess Technology – Biotechnology By OpenLearning Series, Butterworth-Heinemann (1998).

REFERENCE BOOKS

1. E L V Harris and S. Angal, Protein Purification Methods, Ed. IRL Press at Oxford University Press, 2004.
2. J. E. Bailey and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd Edition, Mc-Graw Hill, Inc., 2001.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Define the fundamentals of downstream processing for product recovery		1	2	1		1		1	2	2		1		1	1
CO2	Understand the requirements of successful operations of downstream	2		1		2		2		1		1	2	1	2	2
CO3	Describe the process of downstream equipments and explain the techniques in multifactorial manufacturing	2		1		2		2	3	1		1	2	1	2	2
CO4	Understood the knowledge in finishing operation in DSP C	2		1		2		2		1		1	2	1	2	2
CO5	Gained the knowledge about the purification process		1	2	1		1		1	2	2		1		1	1

718BTT02	PLANT BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisite Molecular Biology

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the principles, practices and application of plant tissue culture and transformation in science, agriculture and industry;
- To acquaint themselves with experimental design and analysis of plant biotechnology experiments;
- To get hands-on experience and training in representative plant tissue culture and genetic engineering techniques;
- To understand the basics of agrobacterium and applications of plantbiotechnology;
- To learn different gene transfer techniques;

UNIT I INTRODUCTION TO PLANT BIOTECHNOLOGY: AN OVERVIEW 9

History of plant biotechnology, Scope and significance of Plant Biotechnology, Plant Tissue Culture as a technique to produce novel plants and hybrids, different types of tissue culture medium and their constituents, plant growth hormones

UNIT II PLANT CELL AND TISSUE CULTURE 9

Concept of cellular totipotency, Types of cell culture: culture of single cells, cell and organ differentiation. Stages of micropropagation. Choice of plant species for micropropagation, production of virus free plants: protoplast isolation, micropropagation work in India

UNIT III GENE TRANSFER TO NUCLEAR GENOME 9

Time line for utilization of gene transfer technology (event). Target cells for transformation: vector for gene transfer technology. Ti and Ri plasmids of Agrobacterium. Gene transfer methods: Agro-infection and gene transfer, physical delivery method, Viruses mediated gene transfer, status and expression of transferred genes

UNIT IV PLANT BIOTECHNOLOGY FOR AGRICULTURAL PRACTICES 9

Biopesticides and Bioinsecticides, Integrated pest management. A total system or ecological approach ofIPM. Present status and future needs for making biopesticides and IPR popular. Biofertilizers and integrated nutrients management, Molecular Pharming

UNIT V PLANT BIOTECHNOLOGY FOR THE ENVIRONMENT 9

Environment, bioenergy and biofuels, bioremediation, types of biodiversity and their applications, plant

biotechnology: reasons of concern for loss of biodiversity, plant biotechnology and climate change

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Acquainted with principles, technical requirements, scientific and commercial applications in Plant Biotechnology;

CO2: Understand and support methodologies in plant tissue/cell culture to plant improvement, as

well as DNA handling with PCR-based detection diagnostic tools;

CO3: Motivated to set goals towards pursuing graduate school and higher-level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries;

CO4: Knowledge about plant tissue culture and transgenic plants;

CO5: Gained knowledge use it for the development of therapeutic products;

TEXT BOOKS

1. Slater A, NW Scott, MR Fowler. Plant Biotechnology, 2nd ed. Oxford University Press, 2008
2. Chawla, H.S, Introduction to Plant Biotechnology, 2nd edition, 2007
3. Hopkins, W. G and Huner, N. P. A. Introduction to Plant Physiology. 3rd ed. John Wiley & Sons Inc. New York, 2004
4. Balasubramanian, Bryce, Dharmalingam, Green, Kunthalajayaraman. Concepts in Biotechnology, revised edition. Universities Press, 2007
5. Karvita B Ahluwalia. Genetics. New Age international Pvt. Ltd. Publishers. New Delhi. 2002

REFERENCE BOOKS

1. Bhojwani and Bhatnagar. Embryology of Angiosperms, Vikar Publishing House Pvt. Ltd, New Delhi. 1981
2. Sharpiro. Mobil Genetic Elements, Academic press, New York. 1983
3. Gamburg, O.L., and Philips G.C. Plant Tissue & Organ Culture: Fundamental Methods. Narosa Publishing House, 2005
4. Grierson D. and Covey, S.N. Plant Molecular Biology, 2nd Edition, Blackie,1988 Heldt, Hans-Walter, Plant Biochemistry & Molecular Biology, 1st Edition Oxford University Press,1997

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/102103016
2. https://archive.nptel.ac.in/courses/102/106/102106080/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Acquainted with principles, technical requirements, scientific and commercial applications in Plant Biotechnology;		1	2	1		1		1	2	2		1		1	1
CO2	Understand and support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic	2		1		2		2		1		1	2	1	2	2

	tools															
CO3	Motivated to set goals towards pursuing graduate school and higher-level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries;	2		1		2		2	3	1		1	2	1	2	2
CO4	Knowledge about plant tissue culture and transgenic plants;	2		1		2		2		1		1	2	1	2	2
CO5	Gained knowledge use it for the development of therapeutic products;		1	2	1		1		1	2	2		1		1	1

718BTT03 ANIMAL BIOTECHNOLOGY L T P C

3 0 0 3

Prerequisite Genetic Engineering

OBJECTIVES

At the end of the course, the students should be able to:

- Explain the fundamentals of animal cell culture, details of the diseases and therapy
- Offer the knowledge about micromanipulation and transgenic animals
- Know about transgenic animals
- Learn about large scale production of animal cell cultures
- Ability to earn about the therapeutic use

UNIT I ANIMAL CELL CULTURE 9

Introduction to basic tissue culture techniques; Natural media, Nutritional requirement of media; chemically defined and serum free media; commonly used cell lines & their origin, various types of cultures- suspension cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; animal cell cultures and their applications, their maintenance and preservation; organ cultures. Measurement of cell viability,contact inhibition.

UNIT II ANIMAL DISEASES, DIAGNOSIS AND THEIR THERAPY 9

Bacterial and viral diseases in animals; diagnosis of animal diseases using monoclonal antibodies, molecular diagnostic techniques-like PCR, in-situ hybridization; northern and southern blotting, RFLP. Animal diseases; Treatment of animal diseases through recombinant cytokines, monoclonal antibodies, vaccines and their applications in animal infections, High technology vaccines and gene therapy.

UNIT III MICROMANIPULATION OF EMBRYO 9

Introduction to micromanipulation technology; Methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods, Biopharming– Transgenic animal technology, application to production and therapeutics (mice, sheep, cattle), equipment used in micromanipulation; artificial insemination and embryo transfer

UNIT IV TRANSGENIC ANIMALS 9

Concepts of transgenic animal technology; stem cell cultures in the production of transgenic animals. Cellular reprogramming, DNA micro injection, lipofection, production of dolly, embryonic stem cells, retro viral methodof gene insertion, calcium phosphate DNA uptake method. Knockout mice and mice model for human genetic disorders.

UNIT V SCALING UP OF ANIMAL CELL CULTURES 9

Tissue culture as a screening system, cytotoxicity and diagnostic tests, mass production of important biological molecules, harvesting of products, applications of cell culture technology in production of human andanimal viral vaccines, Bio-reactors used for animal cell culture

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand animal cell culture, animal diseases and their diagnosis

CO2: Gain the knowledge of therapy for animal infections

CO3: Know the concepts of micro manipulation technology and transgenic animal technology

CO4: The concepts of transgenic animals

CO5: Bulk production of animal cell cultures

TEXT BOOKS

Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002

Ramadass P, Meera Rani S. Text Book of Animal Biotechnology. Akshara Printers,1997

Freshney R.I. Cultures of Animal cells: A manual of Basic Techniques and specialized applications, 6thEdition, John Wiley and Sons, 2010.

Glick, B.R. and Pasternack, J.J. and Pattern ,C. Molecular Biotechnology, 4th Edition ASM Press, 2003

REFERENCE BOOKS

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press, 2000
2. Johnson A and Holland.A, Animal Biotechnology and ethics, Chapmara& Hall Madras 1998
3. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition, R.Ian Freshney,September2010,Wiley-Blackwellpublications

EBooks/Weblinks

NPTEL :: Biotechnology - Animal Physiology

Animal Biotechnology(B.pdf (gurukpo.com)

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand animal cell	2		1		2		2		1		1	2	1	2	2

	culture, animal diseases and their diagnosis															
CO2	Gain the knowledge of therapy for animal infections		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Know the concepts of micro manipulation technology and transgenic animal technology		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	The concepts of transgenic animals	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Bulk production of animal cell cultures		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

718BTT04 GENOMICS AND PROTEOMICS L T P C

3 0 0 3

Prerequisite Genetic Engineering

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the gene cloning methods, tools and techniques involved in genome analysis and genomics.
- Explain the heterologous expression of cloned genes in different hosts, production of recombinant proteins and PCR techniques.
- Identify the importance of protein biomolecules and the structure-function relationships in proteins.
- Explain comparative genomics and proteomics.
- Know about the functional organization of the genome and proteome

UNIT I ORGANIZATION OF GENOMES 9

Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene prediction rules and software's; Genome databases; Sequence complexity- Introns, Exons, Intron-Exon boundary; Genome diversity: Bacteria, Archae and eukaryotes.

UNIT II MAPPING GENOMES 9

Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping and Sequence tagged site mapping, pooling strategies, WGS (Whole Genome Sequencing)

UNIT III FUNCTIONAL GENOMICS 9

Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing Understanding a genome sequence: locating the genes in a genome sequence, structure Global expression profiling – Introduction, traditional

approaches to expression profiling, Analysis of RNA expression, applications of genome analysis and genomics.

UNIT IV PROTEOME INFORMATICS 9

2D Electrophoresis - Spot visualization and picking - Database for 2D gel - Tryptic digestion of protein -Peptide finger printing-Data analysis: Mass spectrometry; ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detectors - Ramachandran plot - Post-translational modifications of proteins - Limitation of proteomics.

UNIT V APPLICATIONS OF GENOMICS AND PROTEOMICS 9

Genomic medicine - Synthetic biology and bioengineering - Conservation genomics - Interaction proteomics - Protein networks - Expression proteomics – Biomarkers – Proteogenomics.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Clone commercially important genes and recombinant proteins.

CO2: Understand of gene and genome sequencing techniques.

CO3: Understand of microarrays, Analysis of Gene expression and proteomics.

CO4: Analyze the various interactions in protein makeup and different levels of protein structure.

CO5: Apply the latest applications of protein science in their research.

TEXT BOOKS

1. Primrose, S.B., and R.M. Twyman, “Principles of gene manipulation and Genomics”, Blackwell Publishing, MA. USA, 2006.
2. Twayman.R.M, “Principles of Proteomics” (Advanced text series), Taylor and Francis, 1st edition,2004.

REFERENCE BOOKS

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York
2. Starkey, M. and Elaswarapu, R. 2010. Genomics: Essential methods. 1st Edition, John Wiley and Sons, New Jersey, USA
3. Campbell, A.M. and Heyer, L.J., “Discovering Genomics, Proteomics and Bioinformatics”, 2 nd Edition, Benjamin Cummings, 2007.
4. Dunham, I., “Genome Mapping and sequencing”, Horizon Scientific, 2003
5. Read, T.D., Nelson, K.E., Fraser, C.M., “Microbial Genomes”, Humana Press, Inc., USA, 2004.
6. Daniel C. Liebler “Introduction to Proteomics” Humana Press, Inc USA 2002.

EBooks/Weblinks

1. https://onlinecourses.nptel.ac.in/noc21_bt25/preview
2. https://nptel.ac.in/courses/102103017

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Clone commercially important genes and	2		1		2		2		1		1	2	1	2	2

	recombinant proteins.															
CO2	Understand of gene and genome sequencing techniques.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Understand of microarrays, Analysis of Gene expression and proteomics.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Analyze the various interactions in protein makeup and different levels of protein structure.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Apply the latest applications of protein science in their research.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

718BTP07 DOWNSTREAM PROCESSING LABORATORY L T P C

0 0 2 1

Prerequisite Bioprocess Engineering lab–I and Bioprocess Engineering lab -II

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the nature of the end product, its concentration, stability and degree of purification required
- Design processes for the recovery and subsequent purification of targetbiological products
- Gain practical knowledge in the concept of extraction
- Understand the concept in chromatographic techniques
- Understand the techniques of separation process

LIST OF EXPERIMENTS

1. Solid liquid separation – Centrifugation
2. Precipitation – Ammonium sulphite precipitation
3. Aqueous two-phase extraction of biologicals
4. Cell disruption techniques – Ultrasonication
5. Cell disruption techniques –Batch and continuous
6. Ultra-filtration separation
7. High resolution purification – Affinity chromatography
8. High resolution purification – Size exclusion chromatography
9. High resolution purification – Ion exchange chromatography
10. Product polishing – Spray drying

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Acquired knowledge for the separation of whole cells and other insoluble ingradients from the culture broth.

CO2: Learned various techniques like extraction, precipitation, membrane separation for concentrating biological products

CO3: Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses

CO4: Understand the concept in chromatographic techniques

CO5: Understand the techniques of separation process

TEXT BOOKS

1. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).
2. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).

REFERENCE BOOKS

1. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods and Applications, VCH Pub. 1989.

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Acquired knowledge for the separation of whole cells and other insoluble ingradients from the culture broth.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Learned various techniques like extraction, precipitation, membrane separation for concentrating biological products		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Learned the basic principles and techniques of chromatography to purify the biological products and formulate the products for different end uses		**1**	**2**	**1**	**3**	**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Understand the concept in chromatographic techniques	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

CO5	Understand the techniques of separation process	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

718BTP08 **PLANT BIOTECHNOLOGY LAB** **L T P C**
0 0 2 1

Prerequisite **Molecular Biology**

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the principles, practices and application of plant tissue culture and transformation in science, agriculture and industry;
- To get acquainted students with experimental design and analysis of plant biotechnology experiments;
- To get hands-on experience and training in representative plant tissue culture and genetic engineering techniques;
- To understand the basics of agrobacterium and applications of plant biotechnology;
- To learn different gene transfer techniques;

LIST OF EXPERIMENTS

1. Introduction to plant tissue culture
2. Preparation of Tissue culture medium (Murashige and Skoog)
3. Effect of plant growth regulator of various explants for callus induction and cell suspension culture
4. In vitro seeds germination
5. Micropropagation of *Moringaolifera orconcanensis* plant by leaf disc culture
6. Organogenesis and somatic embryogenesis
7. Artificial seed preparation
8. Shoot tip and nodal sector culture
9. Callus culture
10. Meristem Culture for Virus-Free Plants
11. Agrobacterium tumefaciens-mediated plant transformation
12. Cell Suspension culture

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the theoretical background in plant sciences needed for plant biotechnology

CO2: Working knowledge of laboratory techniques used in plant biotechnology;

CO3: Knowledge about capacity to undertake research in plant biotechnology;

CO4: Support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic tools;

CO5: Motivated to set goals towards pursuing graduate school and higher-level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries;

TEXT BOOKS

1. J. Reinert and M.M. Yeoman, “Plant Cell and Tissue Culture” Springer-Verlag Berlin Heidelberg. 1982
2. Keith Lindsey, “Plant Tissue Culture Manual”, Springer Netherlands, 1997

REFERENCE BOOKS

1. Hirenkumar Sherathiya, “Practical Manual for Plant Tissue Culture: Basic Techniques of PlantTissue Culture and Molecular Biology” 2013
2. L.G. Nickell, “Plant Growth Regulators”, Springer-Verlag Berlin Heidelberg, 1982

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the theoretical background in plant sciences needed for plant biotechnology	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Working knowledge of laboratory techniques used in plant biotechnology;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Knowledge about capacity to undertake research in plant biotechnology;	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR-based detection diagnostic tools;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Motivated to set goals towards pursuing graduate school and higher-level positions, such as lab manager and key scientist in plant biotechnological research institutes and industries;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

718BTP09	ENTREPRENEURSHIP DEVELOPMENT LAB	L	T	P	C
		0	0	2	1

OBJECTIVES

At the end of the course, the students should be able to:

- Help skill the youth and create awareness in the society
- Impart knowledge about Indian economy and various livelihood options among youth to make better life choices
- Facilitate experiential learning on starting up any micro-enterprises as asource of livelihood
- Startup business models by applying various entrepreneurial skills
- Learn about the development process

LIST OF EXPERIMENTS

1. Introduction: Concept of entrepreneurship, Fundamentals of Marketing, Entrepreneurial Development: Training, Institution in aid of entrepreneur, Power and importance of Positioning of a company name and product.
2. Study of Start-up: Setting of a small industry, location of an enterprise, steps to start small industry, Incentive & subsidies for industry, Problems of entrepreneurship, The Art of Negotiation, Workable marketing and the strength of distribution. Opportunities and lessons in international marketing
3. Study of Problem and Solution of Entrepreneurship: Risks and benefits, Steps involved in commercialization of a biotechnological product, Case studies.
4. Production and marketing of Bio fertilizer
5. Production and commercialization of mosquito fern
6. Designing of wastewater treatment plant and analyzing of Risk and benefit in commercialization of the plant
7. Steps involved in setting up of a small industry for the production of artificial food sweeteners and marketing
8. Study of opportunities in setting up of a small-scale vegetable processing plant
9. Case study on problems of entrepreneurship in bio gas production
10. Workable marketing and the strength of distribution in biotechnology equipment service.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Learn about the concept of saving and spending, planning and budgeting, enterprises and financial-non financial institutions

CO 2: Positively position themselves in their developmental environment.

CO 3: Enhance their employability and entrepreneurial skills and gain knowledge on positive career choices

CO 4: Plan start up business models by applying various entrepreneurial skills.

CO5: Learned about the development process

TEXT BOOKS

1. Dynamics of Entrepreneurial development & management; Vasant Desai, Himalay. Publications,2010
2. Entrepreneurship reflection & investigation; M.S. Bisht& R.C. Mishra, Chugh Publication.2005
3. Entrepreneurship development in India; Samiuddin, Mittal Publication.2015

REFERENCE BOOKS

1. Innovation, Product Development and Commercialization: Case Studies and Key Practices for Market.
2. Science Business: The Promise, the Reality, and the Future of Biotech by Gary P. Pisano Harvard Business School Press: 2006
3. Putting Biotechnology to Work: Bioprocess Engineering Commission on Life Sciences, The National Academy Press,1992

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/110/107/110107094/
2. https://onlinecourses.nptel.ac.in/noc20_mg35/preview
3. https://lecturenotes.in/s/1997-bioentrepreneurship/videos

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learn about the concept of saving and spending, planning and budgeting, enterprises and financial-non financial institutions	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO2	Positively position themselves in their developmental environment.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Enhance their employability and entrepreneurial skills and gain knowledge on positive career choices	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Plan start up business models by applying various entrepreneurial skills.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Learned about the development process	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

718BTE01 CLINICAL RESEARCH AND DATABASE MANAGEMENT L T P C

3 0 0 3

Prerequisite Probability and statistics, Health and Pharmaceutical Biotechnology

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the roles and responsibilities of the clinical research teams
- To review the CRDM Start-up activities/documentation
- Learn about the research work
- Understand the concept of the trial out sources

UNIT I ETHICAL GUIDELINES 9

Ethical Guidelines for Biomedical Research on Human guidelines – student of specific principles for clinical evaluation – Human Genome project - DNA banking – prenatal diagnosis – principles in transplantation. regulatory affairs - GCP/ICH guidelines

UNIT II APPLICATIONS OF STATISTICS AND PROBABILITY 9

Application of Biostatics in clinical Trial Management: Correlation-simple linear regression–multiple regressions–T-test-F-test–Chisquaretest-ANOVA–OnewayANOVA.Biostatistics and database Management system.

UNIT III CONTRACT RESEARCHES 9

Contract research – delivery model – CR Business environment – CR Information research – Contract research – Regulatory affairs of Contract research – Clinical trials environment

UNIT IV CILNICAL TRIALS OUT SOURCING 9

Clinical trials – protocol approval – Informed consent – responsibility of sponsor – investigator – ethics committee – types of clinical trials – structure & contents of clinical report. Data blinding & Randomization – Data Management – trial subjects recruiting; DRA (Drug regulatory affairs)-Process and Management of drug regulatory affairs in clinical trials.

UNIT V OUTSOURCING TRENDS-CASE STUDY OF MEDICAL CODING 9

Introduction of medical coding and billing – Role of International classification of diseases book in medical coding- CPT (Current Procedure Terminology codes)- HIPAA (Health information portability and accounting act) - HCPCS (Healthcare Common Procedure Coding System)- CPC (Certified Professional Coder)–Medical billing and medical transcription- Medical coding job marketing Business Process Outsourcing (BPO`s) companies-starting own business sectors of medical coding and billing.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Knowledge on handling human and animal trials subjected to regulations

CO2: Knowledge of biostatistics subjected to validation on drug development

CO3: Develop ability to describe clinical research documentation and protocol

CO4: Learned about the research work

CO5: Understand the concept of the trial out sources

TEXT BOOKS

1. ICMR, "Ethical guidelines for biological research on human subjects", Indian council of Medical Research Press, New Delhi,2000.
2. International Classification of Diseases (ICD)- 10-CM, Code Book diagnoses code set to assist in ICD- 10 training and code clarification, Tata MC Graw Hill, New York, USA, 2012.
3. Knut Schoeder, "The 10 minutes Clinical Assessment", Wiley Black well, Singapore, 2010

REFERENCE BOOKS

1. The drug and cosmetic rule. Schedule Y., "Requirements and guidelines for permission to import and/or manufacture of new drugs for sale or to undertake clinical trials". Government of India, New Delhi,1945.
2. Machin, D. and Fayers, P., "Randomized clinical trials –Design, Practice and Reporting", Wiley Blackwell, Singapore,2010.

EBOOKS/WEBLINKS

1. https://onlinecourses.nptel.ac.in/noc21_ge14/preview
2. https://www.classcentral.com/course/datamanagement-540

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge on handling human and animal trials subjected to regulations		1	2	1		1		1	2	2		1		1	1
CO2	Knowledge of biostatistics subjected to validation on drug development		1	2	1		1		1	2	2		1		1	1
CO3	Develop ability to describe clinical research documentation and protocol	2		1		2		2		1		1	2	1	2	2
CO4	Learned about the research work	2		1		2		2	3	1		1	2	1	2	2
CO5	Understand the concept of the trial out sources	2		1		2		2		1		1	2	1	2	2

718BTE02 TRANSPORT PHENOMENA IN BIOPROCESS

L	T	P	C
3	0	0	3

Prerequisite Fluid mechanics

OBJECTIVES

At the end of the course, the students should be able to:

- Enable the students to understand different types of fluids, their flow characteristics and different mathematical models applied to actual situations.

- Mechanism of fluids in motion under different conditions.
- Gain the knowledge in equations of change and their applications
- Understand the concept in transport in turbulent and boundary layer flow
- Gain the knowledge in equations of flow pattern

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION 9

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods. Phenomenological laws of

transport properties Newtonian and non-Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

UNIT II ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW 9

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving

reaction and forced convection.

UNIT III EQUATIONS OF CHANGE AND THEIR APPLICATIONS 9

Conservation laws and equations of change; Development of equations of continuity motion and energyin single multi components systems in rectangular co-ordinates and the forms in curvilinear co- ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors;

applications in scale-up.

UNIT IV TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 9

Turbulent phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow

Over flat surface.

UNIT V ANALOGIES BETWEEN TRANSPORT PROCESSES 9

Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the concept in transport in turbulent and boundary layer flow

CO2: Gain the knowledge in equations of flow pattern

CO3: Gain the knowledge in equations of change and their applications

CO4: Understand the concept in transport in turbulent and boundary layer flow

CO 5: Gain the knowledge in equations of flow pattern

TEXT BOOKS

1. R.B. Bird, W.E. Stewart and E.W. Lightfoot, "Transport Phenomena", John Wiley, II Edition 2006.
2. Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena A Unified Approach ", Brodkey Publishing 2003.

REFERENCE BOOKS

1. L.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGrawHill, New York, 1972.
2. R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.
3. J.R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", V Edn. John Wiley, New York, 2007.

E BOOKS/ WEB LINKS

1. https://onlinecourses.nptel.ac.in/noc20_ch06/preview
2. https://onlinecourses.nptel.ac.in/noc20_bt30/preview

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the concept in transport in turbulent and boundary layer flow		1	2	1		1		1	2	2		1		1	1
CO2	Gain the knowledge in equations of flow pattern	2		1		2		2		1		1	2	1	2	2
CO3	Gain the knowledge in equations of change and their applications	2		1		2		2		1		1	2	1	2	2
CO4	Understand the concept in transport in turbulent and boundary layer flow		1	2	1		1		1	2	2		1		1	1
CO5	Gain the knowledge in equations of flow pattern		1	2	1		1		1	2	2		1		1	1

718BTE03 **BIOSIMILAR TECHNOLOGY** **L T P C**

3 0 0 3

Prerequisite **Molecular Biology, Immunology**

OBJECTIVES

At the end of the course, the students should be able to:

- To understand about the design and development of different kinds of biologics, biomimetics, and biosimilars;

- To learn about their different biotechnological applications;
- To acquire knowledge about the regulatory framework of Biosimilars;
- To understand about the bioequivalence studies;
- To gain knowledge of various characterization methods;

UNIT I INTRODUCTION TO BIOPHARMA 9

Generics in Biopharma, definition of biologics, biosimilars, super biologics, differences between chemical genetics and biosimilars, the developmental and regulatory challenges in biosimilar development, prerequisites for biosimilar development, biosimilar market potential

UNIT II TYPES OF BIOSIMILAR DRUGS 9

Peptides, proteins, antibodies, enzymes, vaccines, nucleic acid-based therapies (DNA, RNA, etc), Cellbased therapies (including stem cells)

UNIT III CHARACTERIZATION METHODS 9

Aggregation- precipitation, floccule strength, precipitate ageing & kinetics, adsorption of proteins & peptides on surfaces, effect of temperature on protein structure, hydration & thermal stability of proteins

- solid powders, suspension on non-aqueous solvents, reversed micelles, aqueous solution of polyols, analytical and spectrophotometric characterization of proteins, protein sequencing and structure
determination

UNIT IV BIOEQUIVALENCE STUDIES 9

Immunogenicity & allergenicity of biosimilars; factors affecting immunogenicity - structural, post-translational modifications, formulations, impurities, manufacturing and formulation methods for biosimilars; types of bioequivalences (average, population, individual), experimental designs & statistical considerations for bioequivalence studies (non-replicated designs – General Linear Model, Replicated
crossover designs), introduction to “ORANGE BOOK” & “PURPLE BOOK”

UNIT V CASE STUDIES 9

Indian companies working in this space & their product pipeline (Biocon, Intas, Dr Reddy’s, Reliance, Bharat Biotech, Lupin, Cipla, Shanta, etc); products - Erythropoietin, growth hormone, granulocyte
stimulating factors, interferons, streptokinase, monoclonal antibodies

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: a perspective of the complexity to establish bio similarity of therapeutic proteins and biologics;

CO2: knowledge on novel biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields;

CO3: understand current topical and newly emerging aspects of pharmaceutical biotechnology;

CO4: understanding of the legal steps involved in bringing a new drug to the market;

CO5: acquainted with the current regulatory acts and safety norms of the modern pharmaceutical industries;

TEXT BOOKS

1. Laszlo Endrenyi, Paul Declerck and Shein-Chung Chow, Biosimilar Drug Development, Drugs andPharmaceutical Sciences, Vol 216, CRC Press
2. Cheng Liu and K. John Morrow Jr., Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley, Dec 2016
3. Crommelin Dwan J.A., Robert D. Sindelar and Bernd Meibohm, "Pharmaceutical Biotechnology: Fundamentals and application", Springer, 4th Edition, 2013
4. James Swarbrick, "Encyclopedia of Pharmaceutical Technology", CRC Press, 4 th Edition, 2013
5. Shein-Chung Chow, "Biosimilars: Design and Analysis of Follow-on Biologics", CRC Press, 3 rd Edition, 2013

REFERENCE BOOKS

1. Gary Walsh, "Pharmaceutical Biotechnology-Concepts and Application", John Wiley and Sons Publishers, 1st Edition, 2007
2. Shayne Cox Gad, "Pharmaceutical Manufacturing Handbook: Production and Processes", Wiley, 2nd Edition, 2011
3. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley, 2000
4. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" IVth Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009
5. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl, 1995

E BOOKS/ WEB LINKS

1. https://www.kidney.org/sites/default/files/02-10-6762_HBE_Biosimilars_Booklet_v2.pdf
2. https://archive.nptel.ac.in/courses/102/105/102105058/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	a perspective of the complexity to establish bio similarity of therapeutic proteins and biologics	2		1		2		2		1		1	2	1	2	2
CO2	knowledge on novel biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields;	2		1		2		2	3	1		1	2	1	2	2
CO3	understand current topical and newly emerging aspects of	2		1		2		2		1		1	2	1	2	2

	pharmaceutical biotechnology;															
CO4	understanding of the legal steps involved in bringing a new drug to the market;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	acquainted with the current regulatory acts and safety norms of the modern pharmaceutical industries;		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

718BTE04 **RATIONAL DRUG DISCOVERY** **L T P C**
3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- Drug design
- Peptide libraries
- High through put screening
- Validation processes
- Drug Discovery

UNIT I **FUNDAMENTALS ON RATIONAL DRUG DESIGN** **8**

Various approaches in drug discovery process – conventional versus rational, drug targets, lead identification; Principles of ligand chemistry – lead optimization, pharmacophores, bio-isosteres, principles of ligand chemistry such as configuration, conformation, chirality, isosteric replacement; Parameters of ligand design such as Physiochemical, geometric, conformational, topological, partitional, steric, stereochemical and electronic properties of drug molecules.

UNIT II **IN-SILICO AND SIMULATION METHODOLOGIES IN DRUG DISCOVERY** **10**

Introduction to molecular docking, denovo pharmacophore elucidation drug design for structurally well- defined receptor targets from case studies; Principles of macromolecule-ligand docking, AUTODOCK; Molecular dynamic simulations, relative energy, energy minimization methods, ligand binding free energy calculations, intermolecular interactions, forces related to drug binding, force-field calculation including solvation, role of solubility in drug binding and pKa, Poisson-Boltzmann Surface Area
(PBSA), AMBER, GROMOS and GROMACS

UNIT III **COMBINATORIAL AND SYNTHETIC PEPTIDE LIBRARIES** **10**

Combinatorial Chemistry in drug development, Biopolymers as natural libraries, Selection and

evolution of expression genetic libraries, Combinatorial assembly of antibody genes, Molecular solutions to Combinatorial problems, Solid-Phase peptide synthesis, Peptide on pins, Other iterative disconvolution strategies, Examples of Split/Couple/Mix Peptide Libraries, Positional Scanning, Polystyrenes, Grafted supports, coupling strategies, linkers, Supported Solution and Phase Synthesis, analytical methods for solid-phase

UNIT IV HIGH THROUGHPUT SCREENING HTS IN DRUG DISCOVERY 9

Classification of HTS: Protein based biochemical screens, methods of analytical biochemistry used in HTS (photometry, purification, electrophoresis, kinetic assay, radioisotopes, immunoassay HTS FACS based assays). Assay design for HTS and statistical treatment of the results for decision

UNIT V GENETIC BASED TOOLS IN DRUG DISCOVERY PROCESS 8

Basic of gene silencing, transgenic worms in drug screening; designing siRNAs, Types of RNAi Screens – Loss of Function screens (LOF), Synthetic Lethal screen, Mini-clonogenic RNAi screen; optimizing, and implementing high-throughput siRNA genomic screening for the discovery of survival genes andnovel drug targets, siRNA HTS Screening for identification of targeted pathways in biological systems

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Learn various conventional Methods of drug discovery

CO2: Learn various now methods of drug discovery

CO3: Compare the convantional and now methods

CO4: Apply these methods in academics

CO5: Advanced methods employed in new drug discovery process that will help them in for Academics and industry research

TEXT BOOKS

1. Block J.H. and Beale, J.M., 'Wilson & Gisvolds Text Book of Organic Medicinal and Pharmaceutical Chemistry', 11th Edition, Lippincott Williams &Wilkins, 2004
2. Fassina, G. "Combinatorial Chemistry and Technologies: Methods and Applications", 2ndEdition,CRC Press, 2005

REFERENCE BOOKS

1. Janzen W. P. "High Throughput Screening: Methods and Protocols". Humana Press. 2002
2. Leach, AR, "Molecular Modeling & Drug Design", 2ndEdition, John Willy, 2000

EBOOKS/ WEB LINKS

1. https://nptel.ac.in/courses/102106070
2. https://archive.nptel.ac.in/courses/102/106/102106070/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learn various conventional Methods of	2		1		2		2		1		1	2	1	2	2

	drug discovery															
CO2	Learn various now methods of drug discovery	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Compare the convantional and now methods		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Apply these methods in academics	**2**		**1**	**3**	**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Advanced methods employed in new drug discovery process that will help them in for Academics and industry research		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**

718BTE05 BIOTERRORISM AND NATIONAL SECURITY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

Prerequisite Microbiology, Genetic Engineering, Molecular biology

OBJECTIVES

At the end of the course, the students should be able to:

- learn about the familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively
- Explores how the meaning of national security has shifted and expanded over time
- Identify the jurisprudentially, and policy-wise
- Understand the concept of national security with a wide-range of domestic legal and policy issues, from civil rights and immigration, to private law, business, and environmental and economic issues
- Learn about the national security

UNIT I TERRORISM AND BIOTERRORISM 9

Definition-Traditional Terrorists-New Terrorists-Nuclear, chemical, and radiological weapons-The psychology of Bioterrorism-Historical perspective

UNIT II MICROBES AND IMMUNE SYSTEM 9

Primary classes of Microbes-bacteria, virus, and other Agents-Immune system interaction between microbes and the immune system

UNIT III BIOTERRORISM WEAPONS AND TECHNIQUES 9

Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox and Tularemia and VHF.

UNIT IV PREVENTION AND CONTROL OF BIOTERRORISM 9

Surveillance and detection- Detection equipment and sensors –Diagnosis-Treatment Vaccinations-

Supplies-Effectiveness-Liability-Public Resistance-Response-First Responders-Infectious Control-Hospital-Prevention- Protection-Decontamination Notification-Role of Law Enforcement-Economic impact.

UNIT V BIOTERRORISM MANAGEMENT 9

Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-

Information Management-Government control and industry Support-Microbial forensics

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the threats to national security, methods to tackle them

CO2: Understand law enforcement & the role of health agencies to handle them

CO3: Understand the concept of civil rights and immigration, to private law, business, and environmental and economic issues

CO4: Understand the concept of national security which also interpolates with a wide-range of domestic legal and policy issues

CO5: Learned about the national security

TEXT BOOKS

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press ,1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

REFERENCE BOOKS

1. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.

EBOOKS/ WEB LINKS

1. http://www.centerforhealthsecurity.org/ourwork/pubs_archive/pubspdfs/2012/sloan_book/Preparing%20for%20Bioterrorism_Gigi%20Kwik%20Gronvall_December%202012.pdf
2. http://www.rand.org/pubs/testimonies/CT348.html
3. http://www.gpo.gov/fdsys/pkg/BILLS-107hr3162enr/pdf/BILLS107hr3162enr.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the threats to national security, methods to tackle them		1	2	1		1		1	2	2		1		1	1

CO2	Understand law enforcement & the role of health agencies to handle them		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO3	Understand the concept of civil rights and immigration, to private law, business, and environmental and economic issues	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	Understand the concept of national security which also interpolates with a wide-range of domestic legal and policy issues	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Learned about the national security	**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**		

718BTE06 **FUNDAMENTALS OF NANOBIOTECHNOLOGY** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- learn about basis of nanomaterial science
- learn various nanomaterials used in Biotechnology
- learn various Techniques and Characterization Techniques
- learn about the various characterization techniques
- learn the factors influencing the concept of nanotechnology

UNIT I **INTRODUCTION TO NANOTECHNOLOGY** **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials nano particles quantum dots, nanowires ultra-thin films- multilayered materials. Length of Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (Qualitative only).

UNIT II **GENERAL METHODS OF PREPARATION** **10**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapor phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III **NANOMATERIALS** **10**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT) methods of synthesis arc growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships? applications) Nanometal

oxides-ZnO, TiO_2, MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

UNIT IV **CHARACTERIZATION TECHNIQUES** **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V **APPLICATIONS OF NANOBIOTECHNOLOGY** **8**

Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline

silver for bacterial inhibition.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand Nanotechnology the science of Nanomaterials

CO2: Understand how to prepare of Nanomaterials

CO3: Will develop knowledge in Nanobiotechnology

CO4: learn various Techniques and Characterization Techniques

CO5: learn about the various characterization techniques

TEXT BOOKS

1. Edelstein A.S. and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Propertiesand Applications", Instituteof Physics Publishing, Bristol and Philadelphia, USA 1996
2. John Dinardo. N, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge,Wiley-VCH, 2000.

REFERENCE BOOKS

1. Timp. G, "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modelingand Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	Understand Nanotechnology the science of Nanomaterials		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO2	Understand how to prepare of Nanomaterials	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Will develop knowledge in Nanobiotechnology	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO4	learn various Techniques and Characterization Techniques	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	learn about the various characterization techniques	**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**		

718BTE07 **CANCER BIOLOGY** **L T P C**

3 0 0 3

Prerequisite Genetic Engineering, Molecular biology

OBJECTIVES

At the end of the course, the students should be able to:

- Learn about pathogenesis of cancer;
- Understand fundamentals of cancer;
- Identify cancer through tools developed by biotechnology research & moleculessynthesized for cancer therapy;
- Understand preventive measures for cancer
- Learn about the cancer therapy

UNIT I **FUNDAMENTALS OF CANCER BIOLOGY** **9**

Introduction of cancer biology and cancer genetics, intra and extra cellular control of cell division, programmed cell death(apoptosis), intrinsic and extrinsic pathways of cell death, necrosis, malignancies, metastasis, apoptosis in relation with cancer, Regulation of cell cycle, tumor suppressor genes, different forms of cancers, diet and cancer.

UNIT II **PRINCIPLES OF CARCINOGENESIS** **9**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, Detection using biochemical assays, tumor markers, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis

UNIT III **PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER** **9**

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto-oncogene activity. Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, and three step theory of invasion, proteinases and tumor cell invasion.

UNIT IV **SIGNALLING AND METABOLIC PATHWAYS IN CANCER** **9**

Pathways that contribute to the altered cancer cell metabolism, Warburg effect. Tumor Angiogenesis, Cancer Stem Cells, Cell signaling pathways- Jak-STAT signaling, Notch signaling and Ras Signaling pathways in cancer.

UNIT V NEW MOLECULES FOR CANCER THERAPY 9

Different forms of therapy, chemotherapy, radiation therapy, Immunotherapy, CAR-T therapy, advances in cancer detection, Anticancer Drugs- Classes of Anticancer Drugs, Drug Metabolism and Toxicity, Targeted Therapy in Cancer, Gene therapy.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand cancer and causes of cancer.

CO2: Learn about cancer detection techniques.

CO3: Learn about identification and detection of oncogene

CO4: Learn about the new molecules used to treat cancer

CO5: Learn about the cancer therapy

TEXT BOOKS

1. Primrose, S.B., and R.M. Twyman, "Principles of gene manipulation and Genomics", Blackwell Publishing, MA. USA, 2006.
2. Twayman. R. M, "Principles of Proteomics" (Advanced text series), Taylor and Francis, 1st edition, 2004.
3. Weinberg, R.A. "The Biology of Cancer" Garland Science, 2007
4. McDonald, F et al., "Molecular Biology of Cancer" 2nd Edition. Taylor & Francis, 2004

REFERENCE BOOKS

1. Brown T. A., Genomes 3. Garland Science Publishing, New York,2007
2. Campbell, A.M. and Heyer, L.J., "Discovering Genomics, Proteomics and Bioinformatics", 2 nd Edition, Benjamin Cummings, 2007.
3. Dunham, I., "Genome Mapping and sequencing", Horizon Scientific, 2003
4. Read, T.D., Nelson, K.E., Fraser, C.M., "Microbial Genomes", Humana Press, Inc., USA, 2004.
5. Daniel C. Liebler "Introduction to Proteomics" Humana Press, 2002.

EBOOKS/ WEBLINKS:

1. https://nptel.ac.in/content/storage2/courses/104103068/pdf/M4.pdf
2. https://nptel.ac.in/courses/102/106/102106025/
3. https://nptel.ac.in/content/storage2/courses/102103041/pdf/mod4.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand cancer and causes of cancer.	2		1		2		2	3	1		1	2	1	2	2
CO2	Learn about cancer detection techniques.	2		1		2		2		1		1	2	1	2	2

CO3	Learn about identification and detection of oncogene		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	Learn about the new molecules used to treat cancer		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO5	Learn about the cancer therapy	**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**		

718BTE08 **DISASTER MANAGEMENT** **L T P C**

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster RiskReduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity
- To enhance the knowledge related to disaster management

UNIT I **INTRODUCTION TO DISASTERS** **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II **APPROACHES TO DISASTER RISK REDUCTION (DRR)** **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III **INTER-RELATIONSHIP BETWEEN DISASTERS AND** **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV **DEVELOPMENTDISASTER RISK MANAGEMENT IN INDIA** **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and

legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Differentiate the types of disasters, causes and their impact on environment and society.

CO2: Assess vulnerability and various methods of risk reduction measures as well as mitigation.

CO3: Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

CO4: developed rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

CO5: enhanced the knowledge related to disaster management

TEXT BOOKS

1. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.
2. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
3. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
4. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.

REFERENCE BOOKS

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

E BOOKS/ WEBLINKS

1. https://nptel.ac.in/courses/105104183
2. https://onlinecourses.nptel.ac.in/noc22_ar05/preview

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Differentiate the types of disasters, causes and their impact on environment and society.	2		1		2		2		1		1	2	1	2	2

CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.		**1**	**2**	**1**		**1**		**1**	**2**	**2**		**1**		**1**	**1**
CO4	developed rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	enhanced the knowledge related to disaster management	**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**		

718BTE09 PROCESS EQUIPMENT ANDPLANT DESIGN L T P C

3 0 0 3

Prerequisite Fundamentals of Unit Operations and Fundamentals of Mass Transfer

OBJECTIVES

At the end of the course, the students should be able to:

- To develop key concepts and techniques to design a heat exchangers and evaporator in a process plant;
- To develop key concepts and techniques to design an extractor, distillation and absorption tower in a process plant;
- To train the students to utilize these key concepts to make design and operating decisions;
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes;
- To provide the students with the design and scaleup of bioreactors;

UNIT I HEAT EXCHANGERS, CONDENSERS, EVAPORATORS 9

Single and multi-process exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi-effect evaporators, forced

circulation evaporators

UNIT II STORAGE VESSEL FOR VOLATILE AND NONVOLATILEFLUIDS, PRESSURE VESSEL STRUCTURE **9**

Design of the following equipments as per ASME, ISI codes, drawing according to scale; Monoblock and multiplayer vessels, combustion details and supporting structure

UNIT III EXTRACTOR, DISTILLATION AND ABSORPTION TOWER **9**

Materials of construction for bioprocess plants, Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

UNIT IV PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES **9**

Various types of pumps, Principles of working, construction, usages, advantages and disadvantages; various types of seals, effectiveness, usages; pneumatic seals; gate, globe and butterfly valves, their material of construction; pneumatically controlled Valves

UNIT V PIPING, PLANT LAY OUT AND DESIGN **9**

Various types of Piping, materials of construction, their usage; Pipe lay out; Modern PlantDesign and case studies

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: understand the working principles of heat exchangers, condensers and evaporators and develop a datasheet;

CO2: acquire basic knowledge to draw and design of storage vessel and pressure vessel as per ASME and ISI codes;

CO3: understand the construction and assembly drawing of extraction towers, distillation towers and absorption towers;

CO4: learn working principles, constructions, usage of various pump, seals, valves and pipes;

CO5: apply modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems;

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P. Harriott “Unit Operations of Chemical Engineering”, VIth Edition, McGraw-Hill, 2001
2. Brownbell I.E., Young E.H. “Chemical Plant Design” 1985
3. Mann, U., “Principles of Chemical Reactors Analysis & Design: New tools for Industrial ChemicalReactor Operations”, Willey–VCH, 2009
4. Mansi, E.M.T.EL., Bryce, C.F.A., Demain, A.L. and Allman, A.R., “Fermentation Microbiology and Biotechnology”, 3rd edition Taylor and Francis, 2012
5. Towler, G. and Sinnott, R., “Chemical Engineering Design: Principles, Practice, Economics of Plantand Process Design”, 2nd edition, Butterworth – Heinemann ltd., Elsevier, 2012

REFERENCE BOOKS

1. Kern D.Q. “Heat Transfer”. McGraw Hill, 1985
2. Impre, J.F.M.V., Vanrolleghem, P.A. and Iserentant, D.M., “Advanced Instrumentation, Data Interpretation and Control of Biotechnological Processes”, Kluwer Academic Publishers, 2010

3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc
4. James M. Lee, Biochemical Engineering, PHI, USA
5. Bailey, J.A. and Ollis, D. F., Fundamentals of Biochemical Engineering", McGraw Hill – 1986

E BOOKS/ WEBLINKS

1. https://onlinecourses.nptel.ac.in/noc21_ch52/preview
2. https://archive.nptel.ac.in/courses/103/105/103105210/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	understand the working principles of heat exchangers, condensers and evaporators and develop a datasheet;		1	2	1		1		1	2	2		1		1	1
CO2	acquire basic knowledge to draw and design of storage vessel and pressure vessel as per ASME and ISI codes;	2		1		2		2		1		1	2	1	2	2
CO3	understand the construction and assembly drawing of extraction towers, distillation towers and absorption towers;	2		1		2		2		1		1	2	1	2	2
CO4	learn working principles, constructions, usage of various pump, seals, valves and pipes;	2		1		2		2		1		1	2	1	2	2
CO5	apply modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems;	1		2		2		1		1	2	1	2	2		

718BTE010 PRINCIPLES OF FOOD PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To understand the constituents and additives present in food;
- To gain knowledge about the microorganisms, which spoil food and food borne diseases;
- To know different techniques used for the preservation of food for maintaining the quality;
- To understand microbial activity at different temperatures;
- To understand total quality management;

UNIT I **FOOD AND ENERGY** **9**

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role
and functional properties in food, contribution to textural characteristics

UNIT II **FOOD ADDITIVES** **9**

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids

UNIT III **FOOD MICROBIOLOGY AND FOOD BORNE DISEASES** **9**

Bacteria, yeasts sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein. Classification –food infections–bacterial and other types; food in toxications and poisonings–bacterial and non-bacterial; food spoilage–factors responsible for
Spoilage

UNIT IV **FOOD PRESERVATION** **9**

Principles involved in the use of sterilization, pasteurization and blanching, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods*, Edible coatings – Control of pH and water activity*

UNIT V **FOOD QUALITY MANAGEMENT** **9**

Evaluation of food quality: appearance, textural, flavor factors, consumer safety, organization dealing with inspection, *Analysis of heavy metal, fungal toxins, pesticide and herbicide contamination in food* food safety standards: WHO, GMP

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Different constituents present in food and microorganisms involved in the processing of food;
C02: Principles and different preservations techniques of food;
CO3: Unit operations in modern food processing and impact of the process on food quality
CO4: Different techniques used in analysis of food additives;
CO5: Good Manufacturing Practices for maintaining food quality;

TEXT BOOKS

1. T.P. Coultate – Food – The Chemistry of its Components, 4 Edition. Royal Society, London, 2002
2. B. Sivasanker – Food Processing and Preservation, 6 Edition, Prentice-Hall of India Pvt.

Ltd.New Delhi, 2009
3. Sri Lakshmi B , Food Science, New Age International Publishers , India, 2007
4. Zeuthen P. and Bogh-Sorensen, L., "Food Preservation Techniques", 1st Edition, CRC Press, 2003
5. Pometto A, Shetty K, Paliyath G and Levin R. E., "Food Biotechnology", 2nd Edition , CRC press, 2005

REFERENCE BOOKS

1. W.C. Frazier and D.C. Westhoff – Food Microbiology, 4th Edition, Tata McGraw-Hill Book Company Ltd., New Delhi, India, 2008
2. James.M. Jay – Modern Food Microbiology, 4th Edition CBS Publishing Company Ltd., New Delhi, India 2005
3. Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert Levin, Food Biotechnology, 2nd Edition, CRC Press,2006
4. Adams M., Adams M. R. and Robert Nout M. J., Fermentation and food safety", Springer, 2001
5. Fellows, P.J., "Food Processing Technology: Principles and Practice", 3rd Edition, CRC Press, 2009

E BOOKS/ WEBLINKS

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=795
2. https://archive.nptel.ac.in/courses/126/105/126105011/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Different constituents present in food and microorganisms involved in the processing of food;	2		1		2		2		1		1	2	1	2	2
CO2	Principles and different preservations techniques of food;	2		1		2		2		1		1	2	1	2	2
CO3	Unit operations in modern food processing and impact of the process on food quality		1	2	1		1		1	2	2		1		1	1
CO4	Different techniques used in analysis of food additives;		1	2	1		1		1	2	2		1		1	1
CO5	Good Manufacturing Practices for maintaining	1		2		2		1		1	2	1	2	2		

	food quality;															

818BTT01 BIOETHICS, IPR AND ENTREPRENEURSHIP L T P C

3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To create awareness about IPR and Engineering ethics
- To follow professional ethics and practices in their careers
- To create awareness and responsibilities about the environment and society
- To enhance ethical knowledge
- To gain knowledge related to the ethical issue related to biotechnology

UNIT I HISTORY OF BIOETHICS 9

Bioethics as a discipline – philosophical reflections on experimenting with human subjects - active and passive euthanasia; culture assumption in the history of Bioethics– medical ethicsin India and America.

UNIT II METHODS OF ETHICAL ANALYSIS 9

Ethical reasoning- philosophical, clinical and cultural dimensions; challenge of ethical relativism; methods of philosophical theories and principles- Equality and its implications; methods of casuistry andmethods of narrative approaches

UNIT III ETHICS IN BIOTECHNOLOGY 9

Ethics committee (hospital) – Inner working of an ethics committee; ethics consultation – skills, roles and training; Biosafety regulation-national and international guidelines; rDNA guidelines-guidelines for rDNAresearch activities, mechanism of implementation of biosafety guidelines

UNIT IV PATENTING, IPR AND APPLICATIONS 9

Introduction to Intellectual property rights, types: patents, copy right, trade mark, trade secret,geographical indications, importance of IPR, Patenting and non-patenting life, TRIPS

UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9

The Significance of the Biotechnology Entrepreneur; The Integration of Two Distinctly Different Disciplines; Biotechnology Entrepreneurship Versus General Entrepreneurship; Entrepreneurship and Intrapreneurship; Essential Biotechnology Entrepreneurial Characteristics; Four Backgrounds of Biotechnology Entrepreneurs

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO: 1 Touches on fundamental values, such as human dignity and the genetic integrity of humanity.

CO:2 Serve basic human needs such as human health, food and a safe environment,

CO:3 Raise human rights issues such as access to health and benefits from scientific progress

CO: 4 Concerns over equitable access to the fruits of new technologies, the consent of those involved in research, and protection of the environment.

CO:5 Obtaining a clear information on the entrepreneurship and understand their economic values

TEXT BOOKS

1. Bioethics , second edition , Nancy S.Jecker , Albert R.Jonsen,RobertA,Pearlman.Jones and BartlettPublishers,2003.
2. Singh K, " Intellectual Property Rights on Biotechnology", BCIL, New Delhi,2001.
3. M.K. Sateesh, "Bioethics and Biosafety", I.K. International Publishing House pvt. Ltd, 2008.

REFERENCE BOOKS

1. Entrepreneurship Development – Poornima. M. Charantimath – Small Business Enterprises – PearsonEducation – 2006
2. Sasson A, "Biotechnologies and Development", UNESCO Publications, 1998
3. Sasson A, "Biotechnologies in Developing countries present and future", UNESCO Publishers, 1993

E BOOKS/ WEBLINKS

1. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech by Craig Shimasaki

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Touches on fundamental values, such as human dignity and the genetic integrity of humanity.	2		1		2		2		1		1	2	1	2	2
CO2	Serve basic human needs such as human health, food and a safe environment,	2		1		2		2		1		1	2	1	2	2
CO3	Raise human rights issues such as access to health and benefits from scientific progress		1	2	1		1		1	2	2		1		1	1
CO4	Concerns over equitable access to the fruits of new technologies, the consent of those involved in research, and protection of the environment.	2		1		2		2	3	1		1	2	1	2	2
CO5	Obtaining a clear information on the entrepreneurship and understand their economic	1		2		2		1		1	2	1	2	2		

	values															

Semester 8

818BTE01	**TISSUE ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

At the end of the course, the students should be able to:

To make the student gain knowledge in Stem cell basics.

To learn growing of ES cells in lab

To Understand the Basic Concept Behind Tissue Engineering Focusing on Biomaterials and Its Applications

To Learn the Fundamentals of Tissue Engineering and Tissue Repairing and Differentiation of stem cells and Application of stem cells

To Acquire Knowledge on Clinical Applications of Tissue Engineering

UNIT I **INTRODUCTION** **9**

Introduction To Tissue Engineering: Basic Definition; Current Scope of Development; Use In Therapeutics, Cells As Therapeutic Agents, Cell Numbers And Growth Rates, Measurement Of Cell Characteristics Morphology, Number Viability, Motility And Functions. Measurement Of Tissue Characteristics, Appearance, Cellular Component, ECM Component, *Mechanical Measurements And Physical Properties*.

UNIT II **TISSUE ARCHITECTURE** **9**

Tissue Types and Tissue Components, Tissue Repair, Engineering Wound Healing and Sequence of Events. Basic Wound Healing Applications of Growth Factors: VEGF/Angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, Telomeres and Self renewal, Control of Cell Migration in Tissue Engineering, *ECM remodeling*

UNIT III **BIOMATERIALS** **9**

Biomaterials: Properties of Biomaterials, Surface, Bulk, Mechanical and Biological Properties. Scaffolds & Tissue Engineering, Types of Biomaterials, Biological and Synthetic Materials, Biopolymers, Applications of Biomaterials, Modifications of Biomaterials, *Role of Nanotechnology in prosthesis construction*.

UNIT IV **BASIC BIOLOGY OF STEM CELLS** **9**

Stem Cells: Introduction, Hematopoietic Differentiation Pathway Potency And Plasticity Of Stem Cells, Sources, Embryonic Stem Cells,H ematopoietic And Mesenchymal Stem Cells, Stem Cell Markers, *FACS Analysis*, Differentiation, Stem Cell Systems- Liver, Neuronal Stem Cells, Types & Sources Of StemCellWithCharacteristics:Embryonic,Adult,Haematopoetic,Fetal,CordBlood,Placenta,Bone Marrow, Primordial Germ Cells, Cancer Stem Cells Induced Pleuripotent Stem Cells.

UNIT V **CLINICAL APPLICATIONS** **9**

Stem Cell Therapy, Molecular Therapy, In Vitro Organogenesis, Neuro degenrative Diseases, Spinal Cord Injury, Heart Disease, Diabetes, Burns and Skin Ulcers, Muscular Dystrophy, Ortho pedic applications, Stem Cells and Gene Therapy Physiological Models, Tissue Engineered Therapies, Product characterization, Components, Safety, Efficacy. Preservation –Freezing and Drying. Patent

Protection and Regulation of Tissue engineered Products, Sethical Issues

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1. Understand the concept of tissue engineering application for regenerative medicines

CO 2. Process carried out for tissue engineering application

CO 3. Ability to know the techniques used for tissue engineering

CO4. Ability to grow ES in lab

CO5. Understand the Fundamentals of Tissue Repairing.

TEXT BOOKS

1. Robert Lanza, Robert Langer and Joseph Vacanti, Principles of Tissue Engineering – Elsevier Academic press, 2007.

REFERENCE BOOKS

1. Ulrich Meyer, JörgHandschel, Thomas Meyer and Hans Peter Wiesmann, Fundamentals of Tissue Engineering and regenerative medicine – Springer Verlag Publications, 2009.
2. Anthony Atala and Robert Paul Lanza, Methods of Tissue engineering – Academic Press, 2002.

E books/ Weblinks

https://nptel.ac.in/courses/102/106/102106081/

https://nptel.ac.in/courses/102/106/102106036/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the concept of tissue engineering application for regenerative medicines	2		1		2		2		1		1	2	1	2	2
CO2	Process carried out for tissue engineering application		1	2	1		1		1	2	2		1		1	1
CO3	Ability to know the techniques used for tissue engineering	2		1		2		2		1		1	2	1	2	2
CO4	Ability to grow ES in lab	2		1		2		2		1		1	2	1	2	2
CO5	Understand the Fundamentals of Tissue Repairing.	1		2		2		1		1	2	1	2	2		

818BTE02	TELEMEDICINE	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- Gain the basics of digital technology used in healthcare.
- Understand the various communication networks involved in healthcare system.
- Understand the ethics behind the digital healthcare.
- Learn the picture-based diagnosis techniques in healthcare.
- Understand the various applications of telemedicine.

UNIT I FUNDAMENTALS OF TELEMEDICINE 9

History of telemedicine - Definition of telemedicine - tele-health - tele-care – scope. Telemedicine –

Systems - benefits & limitations of telemedicine.

UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9

Audio – Video - Still images - Text and data - Fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, microwave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, *telemedicine malpractices,*jurisdictional issues, intellectual property rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT V APPLICATIONS OF TELEMEDICINE 9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, eHealth andCyber Medicine.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Knowledge about the advances in healthcare system.

CO 2: Analyze the various modes of communication system in healthcare.

CO 3: Familiarize in the healthcare ethics.

CO 4: Acquaint with the use of picture capturing technologies in telemedicine.

CO 5: Examine the telemedicine applications in various fields.

TEXT BOOKS

1. Norris A C, “Essentials of Telemedicine and Telecare”, John Wiley, New York, 2002.
2. Huang H K, “PACS and Imaging Informatics: Basic Principles and Applications”, John Wiley, New Jersey, 2010.
3. Khandpur R S, “TELEMEDICINE – Technology and Applications”, PHI Learning Pvt Ltd., New

Delhi, 2017.
4. Darkins A W and Cary M A, Telemedecine and Telehealth: Principles, Policies, performance and pitfall. Springer, London, 2000

REFERENCE BOOKS

1. Olga Ferrer Roca and Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta and James H Thrall, "Pacs: A Guide to the Digital Revolution", Springer, New York, 2002.

EBOOKS/WEBLINKS

1. https://www.pdfdrive.com/telemedicine-technologies-information-technologies-in-medicine-and-telehealth-e156716701.html
2. https://www.pdfdrive.com/essentials-of-telemedicine-and-telecare-d161127877.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge about the advances in healthcare system.		1	2	1		1		1	2	2		1		1	1
CO2	Analyze the various modes of communication system in healthcare.	2		1		2		2		1		1	2	1	2	2
CO3	Familiarize in the healthcare ethics.	2		1		2		2		1		1	2	1	2	2
CO4	Acquaint with the use of picture capturing technologies in telemedicine.	2		1		2		2		1		1	2	1	2	2
CO5	Examine the telemedicine applications in various fields.	1		2		2		1		1	2	1	2	2		

818BTE03 **MOLECULAR PATHOGENESIS** **L T P C**
3 0 0 3

Prerequisite **Basic Knowledge of Animal Biotechnology required**

OBJECTIVES

At the end of the course, the students should be able to:

- To understand about the history of microscope and microbial activity.
- To know about the host pathogen interaction and identifying virulence factors.

- To understand virulence factor and its molecular pathogenesis.
- To know about the virulence assay and its characteristic factors.
- To gain knowledge related to control pathogens techniques.

UNIT I **OVERVIEW** **9**

Historical perspective - Discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, Early discoveries of microbial toxins, Toxins assays, Vaccines, Antimicrobial compounds, Antibiotics and Origin of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

UNIT II **HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES** **9**

Attributes & components of microbial pathogenesis, Host defense against pathogens, clinical importance of understanding host defense, components of the host surface defences systems like skin, mucosa, eye, mouth, respiratory tract, physical movements, limitation of free iron, mechanism: humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms.

UNIT III **MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)** **9**

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, molecular pathogenesis of: E. coli, influenza virus, plasmodium. Influenza virus: Intracellular stages, Neuraminidase& Haemagglutinininentry, M1&M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV **EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS** **9**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying

virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses, virulence factors damaging the host tissues.

UNIT V **MODERN APPROACHES TO CONTROL PATHOGENS** **9**

Classical approaches based on serotyping. Immuno& DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - modulation of immune response by vaccines, other immuno modulators

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Knowledge of Different Types of Microscope and Types of Microbial Activity.

CO2: Host Interactions Mechanisms in Organisms

CO3: Concept About Modern Approaches to Control Pathogens

CO4: Knowledge About Different Molecular Pathogen Interactions and Host pathogen interactions at the level of cellular and molecular networks.

CO 5: Modern therapeutic strategies on various pathogens.

TEXT BOOKS

1. Clark V L and Bavoil P M, “Bacterial Pathogenesis”, Academic Press, 1997.
2. Williams and Peter et al., “Bacterial Pathogenesis”, (Methods in Microbiology Vol. 27), 1998.
3. Groisman and Eduardo A, “Principles of Bacterial Pathogenesis”, Academic Press, 2001.
4. Nester, Anderson, Roberts, Pearsall, Nester, “Microbiology: A Human Perspective”,3rd Edition, McGraw-Hill, 2001.

REFERENCE BOOKS

1. Salyers, Abigail A and Dixie D.Whitt, “Bacterial Pathogenesis: A Molecular Approach”, 2nd Edition, ASM, 2002.
2. McClane, Bruce A and Timothy A. Mietzner, “Microbial Pathogenesis: A Principles-Oriented Approach”, Fence Creek Publishing, 1999.
3. Subramanian MA, “Toxicology: Principles and Methods”, MJP Publishers, 2017.
4. “Bergey’s Manual of Systematic Bacteriology”, Vol. 1-3, 2nd Edition, Springer, 2005.

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/102/106/102106025/
2. https://nptel.ac.in/courses/102/103/102103015/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge of Different Types of Microscope and Types of Microbial Activity.	2		1		2		2		1		1	2	1	2	2
CO2	Host Interactions Mechanisms in Organisms	2		1		2		2		1		1	2	1	2	2
CO3	Concept About Modern Approaches to Control Pathogens		1	2	1		1		1	2	2		1		1	1
CO4	Knowledge About Different Molecular Pathogen Interactions and Host pathogen interactions at the level of cellular and molecular networks.		1	2	1		1		1	2	2		1		1	1
CO5	Modern therapeutic strategies on various pathogens.	1		2		2		1		1	2	1	2	2		

818BTE04	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

Prerequisite Basic Knowledge of safety management

OBJECTIVES

At the end of the course, the students should be able to:

- To study the disaster types, control and their effects
- To create awareness on global warming, eco-friendly products, environmental impact assessment and environmental policies with propercase studies
- To familiarize students with the types of industrial hazards
- To help students gain knowledge on hazard identification and their management
- To give the knowledge on environmental education including laws, risk & Disaster

UNIT I DISASTER AND THEIR TYPES 9

Introduction to Disaster mitigation, Types of disasters and their management, Emergencies and control measures, Emergency Centers and their functions, Software on emergency controls, Monitoring devices for detection of gases in the atmosphere.

UNIT II ENVIRONMENTAL DISASTER MANAGEMENT 9

Introduction to Sustainable Development, Atmospheric pollution, Global warming and Ozone

Depletion, Sea level rise, El Nino and climate changes, Eco friendly products, Environmental Policies, Environmental Impact Assessment, Marine pollution and control

UNIT III INDUSTRIAL SAFETY AND INDUSTRIAL HYGIENE 9

Need for safety, Accident sequence theory, Causes of accidents, Accident prevention and control techniques, Plant safety inspections, Safety reports, safety data sheets, First aid, Principles of industrial hygiene, Overview of control measures, Chemical agents, Toxic, hazardous and nuclear wastes Chemicals causing health hazards.

UNIT IV RISK ASSESSMENT & HAZARD IDENTIFICATION 9

Preliminary hazard analysis, What if analysis, Hazard and operability (HAZOP) studies, Safety in material handling: hazards and safe Practices, Safety with storage of materials, Electrical hazards, Chemical hazards, Fire and explosion hazards, Laboratory safety, Bulk handling of chemicals,

Pressurized vessels, Industrial layout, Industrial waste management.

UNIT V OCCUPATIONAL SAFETY, HEALTH, ENVIRONMENT LAWS AND MANAGEMENT 9

Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000 OSHA, Process Safety Management (PSM) principles, OHSAS – 18001, Safety legislation: Acts and rules, Safety standards andcodes, Safety policy: safety organization and responsibilities, Perception of danger and acceptance of risks, Role of Preventive maintenance in safety and health, Safety gadgets and their access.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: The students will gain knowledge on the different disaster management skills

CO 2: The students will analyze the effect of industrialization on the environment

CO 3: Recognize different hazardous zones in Industries

CO 4: The students will understand the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks

CO 5: To understand the functions and activities of Occupational health services
identify notifiable occupational diseases arising out of Occupation

TEXT BOOKS

1. Kofi Asvite-Dualy D, "Risk Assessment and Environmental Management", John Willey & Sons, West Sussex, England, 1998.
2. Herman K and Michel B, "Handbook of Environmental Health and Safety", Jaico Publishing House, Delhi, 1999.
3. Peter C, "Handbook of Environmental Risk Assessment and Management", Blackwell Science Ltd. USA, 1998.

REFERENCE BOOKS

1. Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
2. Fawcett H.H. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition, 1982.
3. Green, A.E, "High Risk Safety Technology", John Wiley and Sons, 1984.
4. "Bergey's Manual of Systematic Bacteriology", Vol. 1-3, 2nd Edition, Springer, 2005.

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/110/105/110105094/
2. https://nptel.ac.in/courses/103/106/103106071/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	The students will gain knowledge on the different disaster management skills	2		1		2		2		1		1	2	1	2	2
CO2	The students will analyze the effect of industrialization on the environment	2		1		2		2		1		1	2	1	2	2
CO3	Recognize different hazardous zones in Industries		1	2	1		1		1	2	2		1		1	1
CO4	The students will understand the role of hazardous waste management and use of critical thinking to	2		1		2		2		1		1	2	1	2	2

	identify and assess environmental health risks															
CO5	To understand the functions and activities of Occupational health services identify notifiable occupational diseases arising out of Occupation	1		2		2		1		1	2	1	2	2		

818BTE05 **STEM CELLS IN HEALTH CARE** **L T P C**
3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- Gain knowledge on the basics of stem cells and their origin
- Learn the methods of stem cells identification and various sources
- Give way to the therapeutic treatment using stem cells
- learn the concepts of adult stem cells
- Application of stem cells

UNIT I **STEM CELLS AND CELLULAR PEDIGREES** **9**

Stem cells: Definition, Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSC, embryonic stem cells, cancer stem cells. – Preservations of Stem cell, preservation protocols.

UNIT II **STEM CELL CONCEPT IN PLANTS** **9**

Stem cell and founder zones in plants – particularly their roots – stem cells of shoot meristems of higher plants. Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells –keratinocyte stem cells ofcornea – skin and hair follicles –tumour stem cells.

UNIT III **STEM CELL CONCEPT IN ANIMALS** **9**

Skeletal muscle stemcell–Mammary stem cells–intestinal stem cells–keratinocyte stemcells of cornea – skin and hair follicles –Tumour stem cells, Ebryonic stem cell biology - Factors influencing proliferation, physical, chemical and molecular methods for differentiation of stem cells–hormonal role in differentiation.

UNIT IV **ADULT STEM CELL** **9**

Hematopoietic SC - Basics, Development and Regulation, Clinical Application of HSC – Gene Therapy –using hematopoietic stem cells HSC for Leukemia Mesenchymal SC (MSC)-Differentiation and Identification, Characteristics of mesenchymal stem cells, Clinical medicine, Induced pluripotent SC – History, Reprogramming factors & Mechanisms.

UNIT V **POTENTIAL USES OF STEM CELLS** **9**

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering –blood and bone

marrow – Fc cells. Stem cells in treatment for major disease and reparative medicine.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Knowledge about various stem cells

CO 2: Knowledge of Analysis on therapeutics using stem cell

CO 3: Knowledge of application of stem cells in organ regeneration

CO 4: Knowledge of animal stem cell derived and its products

CO 5: Knowledge of Potential Uses of Stem Cells in various fields

TEXT BOOKS

1. Potten C S, "Stem cells", Elsevier, 1997.
2. Robert Paul Lanza, "Essentials of stem cell biology", 2006.
3. Clive Svendensen and Allison D. Ebert, "Encyclopedia of stem cell research", volume 1, SAGE Publications, 2008.

REFERENCE BOOKS

1. Odorico J, et al., "Human Embryonic stem cell", Garland/ BIOS Scientific, 2005.
2. Stephan Sullivan Chad. A Cowan, kevinn Eggan, "Human Embryonic stem cells–The practical handbook", John Wiely& Sons Ltd., 2007.

EBOOKS/WEBLINKS

1. https://www.google.com/url?sa=t&source=web&rct=j&url=https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod7.pdf&ved=2ahUKEwj6qr2c5YXzAhXYF3IKHVmRAbEQFnoECAYQAQ&usg=AOvVaw2_UYo_Qokdc-e8QxFkvoeX
2. https://www.google.com/url?sa=t&source=web&rct=j&url=https://nptel.ac.in/content/storage2 /courses/102103038/download/module3.pdf&ved=2ahUKEwj6qr2c5YXzAhXYF3IKHVmRAbEQFnoECBAQAQ&usg=AOvVaw3n5mWxUgryYv2D_3FLvp65

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge about various stem cells	2		1		2		2		1		1	2	1	2	2
CO2	Knowledge of Analysis on therapeutics using stem cell		1	2	1	3	1		1	2	2		1		1	1
CO3	Knowledge of application of stem cells in organ regeneration		1	2	1		1		1	2	2		1		1	1
CO4	Knowledge of animal stem cell derived and its products	2		1		2		2		1		1	2	1	2	2

CO5	Knowledge of Potential Uses of Stem Cells in various fields	2		1		2		2		1		1	2	1	2	2

818BTTE06 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- To focuses on the basic roles, skills and functions of management, with special attention to managerial responsibility for effective and efficient achievement of goals.
- Enable the students to learn about increasing organizational effectiveness.
- Achieve optimum utilization of various resource and co-ordination between various department in the organization.
- Understanding and utilization of TQM tools & techniques
- To gain Management skills

UNIT I **INTRODUCTION** **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) --TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II **TQM PRINCIPLES** **9**

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning--Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III **ORGANIZING** **9**

Organizing – Meaning and Structure – Span of Control – Line and Staff Relationships – Staffing – Sources of Recruitment – Selection Process – Training – Methods – Departmentation – Organization
Charts

UNIT IV **TQM TOOLS & TECHNIQUES** **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures-- Cost of Quality – BPR/software include.

UNIT V **CONTROLLING** **9**

Controlling in Management – Control Process – Innovation Management – Informational Technology in Management – Budgets – Techniques – Importance – Case Studies in General Management-Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001— Requirements of ISO 14001—

Benefits of EMS.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Discuss and describe the elements of effective management

CO 2: Apply the planning, organizing and control processes.

CO 3: Describe various theories related to the development of leadership skills, motivation techniques, team work and effective communication

CO 4: Analysis of TQM tools & techniques

CO 5: Controlling in Management skills

TEXT BOOKS

1. Gupta C.B.- Business Management, Sultan Chand & Sons, Revised Edition 2009.
2. Robbins S.R.- Management, Prentice Hall, 11th Edition, 2012.
3. Heinz Weihrich, Mark. V. Cannice& Herald Koontz-Management: A global and entrepreneurial Perspective-Tata McGraw Hill-2008.

REFERENCE BOOKS

1. Harold Koontz And O'Donnel- Essentials of Management, McGrawHill-2009,
2. DinkarPagare -Business Management, Sultan Chand & Sons-2008
3. Tripathi P.C. and Reddy P.N - Principles of Management, TMH-2009, 4th Edition
4. Prasad L.M.- Principles and Practices of Management, 3rd Edition, Sultan Chand & Sons, 2008.

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/110/104/110104080/
2. https://nptel.ac.in/courses/110/104/110104085/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Discuss and describe the elements of effective management		1	2	1		1		1	2	2		1		1	1
CO2	Apply the planning, organizing and control processes.	2		1		2		2		1		1	2	1	2	2
CO3	Describe various theories related to the development of leadership skills, motivation techniques, team work and effective communication	2		1		2		2		1		1	2	1	2	2

CO4	Analysis of TQM tools & techniques	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**
CO5	Controlling in Management skills	**2**		**1**		**2**		**2**		**1**		**1**	**2**	**1**	**2**	**2**

818BTE07 AGRICULTURAL BIOTECHNOLOGY L T P C

3 0 0 3

Prerequisite PLANT BIOTECHNOLOGY

OBJECTIVES

At the end of the course, the students should be able to:

- Understand the importance of biotechnology in agriculture field.
- Know methods involved in organic farming.
- Increase the soil fertility using biological available materials.
- Increase knowledge in organic farming
- Learn about vermi cell culture

UNIT I VERMICULTURE AND ORGANIC FARMING 9

Introduction, initiation of vermiculture in India. Materials for vermicomposting. Selection and basic characteristics of suitable species. Advantages and types of vermicomposting. Physical properties of soil and criteria of essentiality of nutrients. Scope and Importance of Chemical Farming Vis-à-vis Organic
farming.

UNIT II BIOFERTILIZER AND BIO-PESTICIDES PRODUCTION TECHNOLOGY 9

Biofertilizers, Use of Genetically Engineered Microorganisms for improvement of biofertilizers. Production of biopesticide based on Fungi, bacteria, Viruses and Nematodes Important industries producing biopesticides, marine source as biofertilizer.

UNIT III SEED PRODUCTION TECHNOLOGY 9

Classes of quality seed, Breeder seed, Foundation seed, certified seed. Requirements for certified seed genetic purity, physical purity, germination percentage. Seed production: Isolation, seed crop cultivation. Seed processing: drying, cleaning, grading, testing, treating, bagging and labeling.

UNIT IV PROTECTED CULTIVATION OF FLOWERS AND VEGETABLES 9

Types of Protected structures-glasshouse, polyhouse, shade house, rain shade structures, climate control structures, etc. Cultivation of flower crops like roses, carnation, gerbera, orchids, anthurium etc. andvegetables like capsicum, cucumber, tomato, cherry tomato.

UNIT V GREENHOUSE TECHNOLOGY AND PROTECTED CULTIVATION 9

Types of green house, importance, functions and features of green house. Scope and development ofgreenhouse technology. Location, Planning of various components of green house. Design criteria and calculation. Construction material, covering material and its characteristics, growing media, greenhouse irrigation system. Nutrient management.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Knowledge of Biotechnology in Agriculture Field.

CO 2: Concept of different Techniques of Organic Farming.

CO 3: Information about to Increase the Soil Fertility Using Biological Available Materials.

CO 4: Knowledge of Greenhouse Technology and Protected Cultivation

CO 5: Concept of synthesis and production of artificial seeds

TEXT BOOKS

1. Manohar, "Greenhouse Technology and Management", International Book Distribution Co.,Lucknow, 2006.
2. Subbarao N S, "Advances in Agricultural Microbiology", Oxford and IBH Publication Co., New Delhi.
3. Agrawal PK and Dadlani M, "Techniques in Seed science and Technology', South Asian Publishers, New Delhi, 1987.
4. Prasad S and Kumar U, "Greenhouse Management of Horticultural Crops", Kalyani Publishers, 2017.

REFERENCE BOOKS

1. https://nptel.ac.in/courses/102/103/102103016/
2. https://nptel.ac.in/content/storage2/courses/102103016/module1/lec1/4.html

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Knowledge of Biotechnology in Agriculture Field.	2		1		2		2		1		1	2	1	2	2
CO2	Concept of different Techniques of Organic Farming.	2		1		2		2		1		1	2	1	2	2
CO3	Information about to Increase the Soil Fertility Using Biological Available Materials.		1	2	1		1	3	1	2	2		1		1	1
CO4	Knowledge of Greenhouse Technology and Protected Cultivation		1	2	1		1		1	2	2		1		1	1
CO5	Concept of synthesis and production of artificial seeds	2		1		2		2		1		1	2	1	2	2

818BTE08	COMPUTATIONAL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of the course, the students should be able to:

- To improve the programming skills of the student
- To let the students, know their cent evolution in biological science.
- To improve the knowledge in designing circuits.
- Learn signaling pathways
- Gain knowledge about computational analysis

UNIT I INTRODUCTION 9

Systems Biology- Networks - basics of computer networks and Biological –uses and Integration. Micro array – definition, types of arrays, Micro array analysis: Hierarchical clustering, Applications of Micro Arrays in systems biology- Self-organizing maps- Connectivity maps- definition and its uses- Networks

and Pathways – Types and methods. Metabolic networks or network of metabolites and enzymes.

UNIT II SIMULATION AND PATHWAYS 9

Whole cell: Principle and levels of simulation – Virtual Erythrocytes, Pathological analysis. Flux Balance Analysis – metabolomics- and enzymes - Digestion of proteins and protein metabolism, Transport metabolism, Carbohydrate metabolism – metabolism of glucose – glycolysis, TCA cycle, glycogenesis, Pentose phosphate shunt, Electron transport, Interconnection of pathways, metabolic regulation.

UNIT III SIGNALLING & EXPERIMENTAL METHODS IN SYSTEMS BIOLOGY 9

Slow and auto –regulation the coherent FL- temporal order, FIFO, DOR, Global, Development, memory and irreversibility- signaling networks and neuron circuits-robust adaptation, PBD, CSD, SCOP

UNIT IV ROBUSTNESS AND OPTIMALITY IN BIOLOGY 9

Model and integral feedback-signaling/bifunctional enzymes. Perfect robustness- Role and its measurement-the biochemical paradigm-the genetic paradigm- the systems paradigm. Linking modelsand measurement-concepts- calibration and identification –data Vs metadata.

UNIT V DESIGN OF CIRCUITS AND DATABASES 9

Introduction- databases KEGG and EMP etc. Introduction- databases MetaCyc and AraCyc etc., Expression databases and various databases related to systems biology. Optional design of gene circuits I: cost and benefit: gene circuits II selection of regulation. Stochasticity in gene expression.

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the difference between old biotechnology and modern biotechnology

CO2: Understand and utilize the various pathways and cycles

CO3: Design an experiment with step-by-step instructions to address are search problem.

CO4: Design an experiment with step-by-step instructions to address optimality in biology

CO5: Provide examples of current applications of biotechnology and advances in the different areas

TEXT BOOKS

1. Desrosier, N.W. and Desrosier, J.N. "The Technology of Food Preservation", 4thEdition, CBS, 2007.
2. Bengtsson N., "Minimal Processing Technologies in the Food Industry", Woodhead Publishing,
   2002.
3. E. Klipp, R. Herwig, A. Kowlad, C. Wierling and H. Lehrach Systems Biology in practice: Concepts,
   Implementation and applications. (2005) ISBN 10-3-527-31078-9.

REFERENCE BOOKS

1. Uri Alon, An Introduction to Systems Biology-Design principles of biological circuits (2007) Chapman and Hall/CRC Taylor francis group. ISBN 1-58488-642-0
2. L. Alberghina H. V. westerhoff. Systems Biology: Definitions and perspectives. (2007) Springer ISBN 978 3-540-74269-2
3. A. Kriete, R. Eils Computational systems biology (2005) Academic press. ISBN 0-12-088786-X

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/102/106/102106068/
2. https://nptel.ac.in/courses/102/106/102106035/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the difference between old biotechnology and modern biotechnology	2		1		2		2		1		1	2	1	2	2
CO2	Understand and utilize the various pathways and cycles	2		1		2		2	3	1		1	2	1	2	2
CO3	Design an experiment with step-by-step instructions to address are search problem.		1	2	1		1		1	2	2		1		1	1
CO4	Design an experiment with step-by-step instructions to address optimality in biology		1	2	1		1		1	2	2		1		1	1
CO5	Provide examples of current applications of biotechnology and advances in the different	2		1		2		2		1		1	2	1	2	2

	areas															

818BTE09 **MEDICAL CODING** **L T P C**
3 0 0 3

OBJECTIVES

At the end of the course, the students should be able to:

- Develop comprehensive knowledge in the area of Human Anatomy & Physiology, Medical Coding, and CPT Coding.
- Understand the knowledge of HCPCS Coding RCM, Coding Compliance and HIPAA Laws.
- Understand the knowledge of coding ICD
- Understand the knowledge of E&M coding, medical billing cycle

UNIT I **HUMAN ANATOMY & PHYSIOLOGY PART I** **9**

Cardiovascular System, Blood & its Components, Integumentary System, Endocrine System, Urology, Male Reproductive System. Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies

UNIT II **HUMAN ANATOMY & PHYSIOLOGY PART II** **9**

Female Reproductive Systems, Nervous System, Gastro Intestinal System, Pulmonology, Special Sciences, Orthopedics, Lymphatic System - Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies

UNIT III **CURRENT PROCEDURE TERMINOLOGY CODING (CPT)** **9**

CPT Codes, CPT Description, Medical Record Format, Speciality Listings and its Format, *Usage of CPT Manuals, Software usage*, Examples of CPT Speciality Code Practice, *HCPCS Coding, Basic steps of HCPCS coding, Differentiation of CPT and HCPCS Coding.*

UNIT IV **INTERNATIONAL CLASSIFICATION OF DISEASE CODING (ICD)** **9**

ICD Codes, ICD 9 CM – ICD 10 Transition, Diagnosis Interpretation, Usage of ICD Manuals, Index Listings, Tabular Listings, Software usage, Examples of Dx Code Practice.

UNIT V **MODIFIERS, E&M CODING, MEDICAL BILLING CYCLE &OVERVIEW** **9**

Modifiers Listing, Usage and Indexing, E & M codes, classification, Application of E&M, Tabulation, Listings, Software usage, Examples of E&M Code Practice

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Familiarize in the medical coding procedures for various treatment process.

CO 2: Acquire knowledge about ICD coding and medical billing process.

CO 3: Acquire knowledge about human anatomy &physiology.

CO 4: Familiarize in the software usage.

CO 5: Acquire knowledge about E&M Code Practice.

TEXT BOOKS

1. Current Procedural Terminology (*CPT*®)2013 American Medical Association*:* I & II, Professional Edition *(*American Medical Association*),* CPT AMA Professional Edition, London, UK, 2013.
2. ICD-9 CM Physicians Volume I and Volume II Contexo, A division of Access Intelligence,London,

UK, Medicine & Health Science Books, CPT 2009 Professional Edition,2013.

REFERENCE BOOKS

1. David N. Shier, Jackie Butler and Ricki Lewis, "Hole's Human Anatomy and Physiology Paperback-Import", McGraw Hill Higher Education, 12th edition, 2009.
2. Mader, "Understand Human Anatomy and Physiology Paperback", McGraw-Hill Education, 9th edition, 2006.
3. Carol J. Buck, "Step-by-Step Medical Coding 2014 Text + Workbook Paperback – Import", W B Saunders Co, CSM edition December, 2013.

EBOOKS/WEBLINKS

1. https://nptel.ac.in/courses/108/102/108102117/

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Familiarize in the medical coding procedures for various treatment process.	2		1		2		2		1		1	2	1	2	2
CO2	Acquire knowledge about ICD coding and medical billing process.	2		1		2		2		1		1	2	1	2	2
CO3	Acquire knowledge about human anatomy &physiology.		1	2	1		1		1	2	2		1		1	1
CO4	Familiarize in the software usage.	2		1		2		2		1		1	2	1	2	2
CO5	Acquire knowledge about E&M Code Practice.	2		1		2		2		1		1	2	1	2	2

818BTE10 **BIO SAFETY**

L	T	P	C
3	0	0	3

Prerequisite **Basic Knowledge of environment and gene technology**

OBJECTIVES

At the end of the course, the students should be able to:

- To create awareness and responsibilities about the aspects of biosafety
- To acquire knowledge on biological waste management and disposal
- To make the students aware of the use of GMOS and their associated risks
- To educate the students in detail about the concept of bio risk

- To enable students to conduct safety audit and write audit reports effectively in auditing situations

UNIT I BIOSAFETY 9

Introduction, Historical Background, Introduction to Biological Safety Cabinets, Primary Containment for Biohazards, Biosafety Levels, Biosafety Levels of Specific Microorganisms,

Recommended Biosafety Levels for Infectious Agents and Infected Animals, Biosafety guidelines, Government of India.

UNIT II BIOLOGICAL WASTE MANAGEMENT AND DISPOSAL 9

Transfer stations Optimizing waste allocation, compatibility, storage, labeling and handling of

hazardous wastes, hazardous waste manifests and transport Bio-Medical Waste, Hazardous WasteManagement Rules. Documentation

UNIT III GENETICALLY MODIFIED ORGANISMS 9

Definition of GMOs & LMOs, Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture, Environmental release of GMOs, Risk Analysis,

Risk Assessment, Risk management and communication, Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT IV BIORISK ANALYSIS 9

Overall risk analysis, Emergency planning: on site & off-site emergency planning, Risk management ISO 14000, Quantitative risk assessment, Rapid and comprehensive risk analysis, Riskdue to Radiation, Explosion due to over pressure, Potential hazards, Extreme operating conditions, Toxic chemicals, Safe handling of valuable biological materials, Potential misuse of bioscience,

Elements of a laboratory biosecurity

UNIT V SAFETY AUDITS 9

Hazard identification safety audits, Checklist, What if analysis, Vulnerability models, Event tree analysis, Fault tree analysis, Hazan past accident analysis, Fixborough, Mexico, Madras, Vizag Bopal analysis, Personal safety, Prevention of Chemical Hazards/ Management of Spills

TOTAL HOURS 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO 1: Ability to understand the components of biosafety

CO 2: The candidate at the end of the course will have a basic understanding on the basics of biological waste management

CO 3: Awareness about the properties and broad applications of genetically modified organisms

CO 4: To understand the ethics and responsibility for safety

CO 5: To carry out a safety audit and prepare a report for the audit.

TEXT BOOKS

1. Fleming D.O, and Hunt D.L, "Biological Safety: Principles and Practices", 4th Edition, American Society for Microbiology, 2006.
2. Young T, "Genetically Modified Organisms and Biosafety: A Background Paper for Decision-Makers and Others to Assist in Consideration of GMO Issues" 1st Edition, World Conservation

Union, 2004.
3. Fawatt H.H, and Wood, W.S, "Safety and Accident Prevention in Chemical Operation ", Wiley

REFERENCE BOOKS

1. Handley, W., "Industrial Safety Hand Book ",2nd Edn., McGraw-HillBookCompany,1969.
2. McClane, Bruce A and Timothy A. Mietzner, "Microbial Pathogenesis: A Principles-Oriented Approach", Fence Creek Publishing, 1999.
3. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw-Hill Book Co.,1980.
4. Subramanian MA, "Toxicology: Principles and Methods", MJP Publishers, 2017.
5. "Bergey's Manual of Systematic Bacteriology", Vol. 1-3, 2nd Edition, Springer, 2005.

EBOOKS/WEBLINKS

1. https://nptel.ac.in/content/storage2/courses/102103047/module1/lec1/1.html
2. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod1.pdf

Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Ability to understand the components of biosafety	2		1		2		2		1		1	2	1	2	2
CO2	The candidate at the end of the course will have a basic understanding on the basics of biological waste management		1	2	1		1		1	2	2		1		1	1
CO3	Awareness about the properties and broad applications of genetically modified organisms	2		1		2		2		1		1	2	1	2	2
CO4	To understand the ethics and responsibility for safety	2		1		2		2		1	3	1	2	1	2	2
CO5	To carry out a safety audit and prepare a report for the audit.	2		1		2		2		1		1	2	1	2	2