KUMARAGURU COLLEGE OF TECHNOLOGY,

An Autonomous Institution affiliated to Anna University, Chennai

COIMBATORE – 641 049.

B.TECH., BIOTECHNOLOGY

REGULATIONS 2017

CURRICULUM AND SYLLABI

I to VIII Semesters

Department of Biotechnology

VISION

Strong teaching and research foundation in the area of biotechnology and allied fields through knowledge dissemination to students and the public and to scale new heights in the frontier areas of health and environment and ethics for welfare of humankind globally.

MISSION

- Develop dynamic curriculum and syllabus to promote innovative and creative practices.
- Encourage students for innovation and setting start-ups and equip leadership and entrepreneurial skills
- Train students on issues related to social welfare.

PEOs:

PEO 1: To become successful professional/ entrepreneur by inculcating knowledge in interdisplinary areas in Science, Technology, Engineering and Management

PEO 2: To provide strong foundation in core areas of biotechnology to provide biotechnological solutions to real life problems with economic, social and sustainable viability.

PEO 3: Sensitize on environmental, health and bioethical issues, IPR

POs :

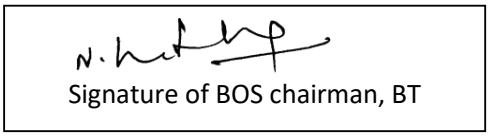
1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and

modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: An ability to apply the knowledge of food/ medical / environmental and computational biology to perform image analysis and processing, data mining and Big data analytics.

PSO2: An ability to understand and design solutions using bioprocess principles, bioanalytical instrumentation and techniques and cell culture techniques.


Signature of BOS chairman, BT

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE – 641 049

REGULATIONS 2017

B.TECH BIOTECHNOLOGY

CURRICULUM

SEMESTER-I

Course Code	Course Title	Course category	Course Mode	L	T	P	J	C
U17ENI1201	English for Cognizance	HS	Embedded	1	0	2	0	3
U17MAT1103	Algebra and Differential Equations	BS	THEORY	3	1	0	0	4
U17PHT1003	Physics for Biotechnology	BS	THEORY	3	0	0	0	3
U17CHT1002	Basic Concepts of Chemistry	BS	THEORY	3	0	0	0	3
U17MET1101	Engineering Graphics	ES	THEORY	2	1	0	0	3
U17CSI1211	Structured Programming using C	ES	Embedded	3	0	2	0	4
U17PHP1501	Physics Laboratory	BS	LAB	0	0	2	0	1
U17MEP1501	Engineering Practice Laboratory	ES	LAB	0	0	2	0	1
U17VEP1501	Personal Values	HS	LAB	0	0	2	0	1
Total Credits								**23**
Total Periods per week								**27**

SEMESTER-II

Course Code	Course Title	Course category	Course Mode	L	T	P	J	C
U17MAT2103	Advanced Calculus and Numerical Methods	BS	THEORY	3	1	0	0	4
U17CHT2004	Chemistry for Biotechnology	BS	THEORY	3	0	0	0	3
U17BTT2001	Introduction to Biotechnology	PC	THEORY	3	0	0	0	3
U17EET2012	Electrical and Electronics Engineering	ES	THEORY	3	0	0	0	3
U17BTP2002	Laboratory skills and calculation for Biotechnology	PC	LAB	0	0	2	0	1
U17ITP2511	Problem Solving and programming for Biotechnology	ES	LAB	0	0	2	0	1
U17CHP2501	Chemistry Laboratory	BS	LAB	0	0	2	0	1
U17ENE----	Language elective	HS	LAB	0	0	4	0	2
U17ISP2701	Social Immersion Project	RIDE	LAB	0	0	0	4	2
U17VEP2502	Inter-Personal values	HS	LAB	0	0	2	0	1
Total Credits								**21**
Total Periods per week								**25**

KUMARAGURU COLLEGE OF TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
B.Tech. Biotechnology
Regulation 2017
Curriculum

Semester III										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17BTT3001	Bioorganic Chemistry	Theory	BS	3	0	0	0	3	-
2	U17BTT3002	Biomolecules & Genetics	Theory	PC	3	0	0	0	3	-
3	U17BTT3003	Bioprocess Calculations	Theory	PC	3	0	0	0	3	-
4	U17BTI3204	Concepts in Biochemistry	Embedded Theory & Lab	PC	3	0	2	0	4	-
5	U17BTI3205	Microbiology	Embedded Theory & Lab	PC	3	0	2	0	4	-
6	U17INI3600	Engineering Clinics I	Embedded Theory & Lab	ES	0	0	4	2	3	-
								Total Credits	20	.
								Total Contact Hour/week	23	

Signature of BOS chairman, BT

Semester IV										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	UI7MAT4105	Biostatistics	Theory	BS	3	1	0	0	4	-
2	U17BTT4001	Fluid and Particle mechanics in Bioprocess	Theory	PC	3	0	0	0	3	U17BTT3003
3	U17BTI4202	Instrumental Method of Analysis	Embedded Theory & Lab	BS	3	0	2	0	4	-
4	U17BTI4203	Cell & Molecular Biology	Embedded Theory & Lab	PC	3	0	2	0	4	U17BTI3204
5	U17BTP4704	Industry Internship/Innovation project*	Project	PC	0	0	0	0	1	-
6	U17INI4600	Engineering Clinics II	Embedded Theory & Lab	ES	0	0	4	2	3	-
								Total Credits	19	
								Total Contact Hour/week	21	

Semester V										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17BTI5201	Genetic Engineering and Genomics	Embedded	PC	3	0	2	0	4	U17BTI4203
2	U17BTI5202	Protein and Enzyme Technology	Embedded	PC	3	0	2	0	4	U17BTI3204
4	U17BTI5203	Heat and Mass Transport in Bioprocess	Embedded	PC	3	0	2	0	4	U17BTT3003 U17BTT4001
5	U17BTE----	Professional Elective-I	Theory	PE	3	0	0	0	3	-
6	U17INI5600	Engineering Clinics III	Embedded Theory & Lab	ES	0	0	4	2	3	-
7	U17----	Open elective -I		OE	3	0	0	0	3	-
								Total Credits	21	
								Total Contact Hour/week	25	

* Conducted during summer vacations

Signature of BOS chairman, BT

Semester VI										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17BTT6001	Biopharmaceutical Technology	Theory	PC	3	0	0	0	3	-
2	U17BTI6202	Bioprocess Engineering	Embedded Theory & Lab	PC	3	0	2	0	4	U17BTT3003 U17BTT4001
3	U17BTI6203	Cell Culture Techniques	Embedded Theory & Lab	PC	3	0	2	0	4	U17BTI4203
4	U17BTI6204	Immunology	Embedded Theory & Lab	PC	3	0	2	0	4	U17BTI4203
5	U17BTI6205	Biological Data Analysis	Embedded Theory & Lab	PC	2	0	2	0	3	U17MAT4105
6	U17INI6600	Engineering Clinics IV	Embedded Theory & Lab	ES	0	0	4	2	3	-
7	U17-----	Open Elective II	Theory	OE	3	0	0	0	3	-
Total Credits									24	
Total Contact Hour/week									29	

Signature of BOS chairman, BT

Semester VII										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17MBT7001	Engineering Economics and Financial Management	Theory	HS	3	0	0	0	3	-
2	U17BTT7002	Preclinical and Clinical Regulatory Affairs	Theory	PC	3	0	0	0	3	U17BTI6001
3	U17BTI7203	Bioinformatics	Embedded Theory & Lab	PC	3	0	2	0	4	-
4	U17BTI7204	Downstream Processing	Embedded Theory & Lab	PC	3	0	2	0	4	U17BTI6202
5	U17BTP7705	Project Phase-I	Project	EEC	0	0	0	4	2	-
6	U17BTE----	Professional Elective-II	Theory	PE	3	0	0	0	3	-
7	U17BTE----	Professional Elective-III	Theory	PE	3	0	0	0	3	-
Total Credits									22	
Total Contact Hour/week									26	
Semester VIII										
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17BTP8701	Project Phase-II	Project	EEC	0	0	0	24	12	
2	U17BTE---	Programme Elective –IV[1]	Theory	PE	3	0	0	0	3	
Total Credits									15	
Total Contact Hour/week									27	

Total Credits	**162**

[1] Self-study elective

Signature of BOS chairman, BT

List of Mandatory Course					
S.No	**Couse Code**	**Course Title**	**Course Mode**	**CT**	**Sem**
1	U17VEP1501	Personal Values	Lab	HS	1
2	U17VEP2502	Inter Personal values	Lab	HS	2
3	U17VEP3503	Family Values	Lab	HS	3
4	U17CHT4000	Environmental Science and Engineering	Theory	MC	4
5	U17VEP4504	Professional Values	Lab	HS	4
6	U17INT4000	Indian Constitution	Theory	MC	4
7	U17VEP5505	Social Values	Lab	HS	5
8	U17VEP6506	National Values	Lab	HS	6
9	U17VEP7507	Global Values	Lab	HS	7

Signature of BOS chairman, BT

Programme Electives									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
Food and Bioprocess technology									
1	U17BTE0001	Chemical Reaction Engineering	Theory	PE	3	0	0	0	3
2	U17BTE0002	Food Process Engineering	Theory	PE	3	0	0	0	3
3	U17BTE0003	Food Preservation Technology	Theory	PE	3	0	0	0	3
Biopharma and medical Technology									
1	U17BTE0004	Cancer Biology	Theory	PE	3	0	0	0	3
2	U17BTE0005	Vaccine Technology	Theory	PE	3	0	0	0	3
3	U17BTE0006	Molecular Diagnostics	Theory	PE	3	0	0	0	3
Research									
1	U17BTE0007	Nanobiotechnology	Theory	PE	3	0	0	0	3
2	U17BTE0008	Neurobiology and Cognitive sciences	Theory	PE	3	0	0	0	3
3	U17BTE0009	Membrane Technology	Theory	PE	3	0	0	0	3
General									
1	U17BTE0010	Bioentreprenership	Theory	PE	3	0	0	0	3
2	U17BTE0011	Industrial Biosafety and Bioethics	Theory	PE	3	0	0	0	3
3	U17BTE0012	Bioprocess Design and Economics	Theory	PE	3	0	0	0	3

List of One Credit Courses		
S.No	**Course code**	**Course Title**
1	U17BTI0101	Pharmacovigilance
2	U17BTI0202	Mushroom Production
3	U17BTI0203	Natural Products
4	U17BTI0204	Protein Purification using FPLC
5	U17BTI020-*	

* Any new course to be included after obtaining approval

Signature of BOS chairman, BT

SEMESTER I

L	T	P	J	C
1	0	2	0	2

U17ENI1201 – ENGLISH FOR COGNIZANCE

(Common to all branches of Engineering and Technology)

COURSE OUTCOMES

After the course the Student will be able to:

CO1: Understand and appreciate vocabulary and syntax with accuracy and clarity.

CO2: Communicate effectively by using appropriate grammar and technical parlance in a range of academic scenarios.

CO3: Interpret and critically evaluate discourses related to functional English.

CO4: Comprehend critical text leading to academic articulation.

CO5: Disseminate professional information through appropriatemeans of communication.

CO6: Demonstrate an understanding for innovative language learning strategies and write texts applying registers formats and language appropriate to the context.

CO/PO Mapping

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

COs	Programme Outcomes(POs)												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
CO1	W	M				W			M	S		M		
CO2		W	M		W	S		W	M	S		S		
CO3	W	S				W	W			S		M		
CO4		M								S		M		

CO5		**S**				**W**			**M**	**S**		**S**		
CO6		**W**				**W**			**W**	**S**		**S**		

Course Assessment methods

Direct
1. Continuous Assessment Test I 2. Open book test 3. Assignment 4. End Semester Examination
Indirect
1. Course-end survey

INTRODUCTION TO LITERARY SKILLS 9

Parts of Speech – Word Formation – Homonyms - Homophones and Homographs, One Word Substitutes, Acronyms and Abbreviations, Reading Aloud, Quick Reading, Sequencing of jumbled sentences, Reading to Predict.

TECHNICAL NUANCES 9

Tense, Voice, Kinds of Syntax, Gerund and Infinitives, Cause and effect expressions, Purpose and functional expressions, Conditional clauses, Reported speech, Diary Writing, Editing (Grammar – Concord, Articles, Parts of Speech, Modifiers – Dangling participles, Misplaced, Squinting and Punctuation).

COMPREHENSION AND ANALYSIS 9

Sub Skills of Reading, Reading Comprehension, Text Visualization, Peer Reading, Cloze Test, Inferring Technical Texts, Reading a Travelogue, Reading for Interrogation, Reading to Respond, Note making – Linear and Non-linear.

PRACTISING LITERARY SKILLS 9

Instructions and Recommendations, Discourse markers – Process description, Writing a Paragraph – Descriptive, Narrative, Compare and Contrast, Persuasive, Creative Writing, Critical Reading, Twirl Reading, Google Reading.

TECHNICAL CORRESPONDENCE 9

Technical Discourse, Modules of a letter, Professional Letters, Industrial Visit/ In-plant Training, Basics of E-Mail writing and E-mail etiquette, Writing Notices, Circulars, Memo and Notes, Report writing.

L: 15 P: 30 Total: 45 Hours

Reference Books:

1. English for Engineers—Regional Institute of English, South India, Bangalore, published by Foundation Books, Chennai.

2. Effective Technical Communication—A Guide for Scientists and Engineers—BarunK.Mitra—Oxford University Press, New Delhi.
3. Interchange, Fourth Edition—Jack.C.Richards et.al,--Cambridge University Press, Sri Maitrey Print Tech., Noida.

U17MAT1103 **Algebra and Differential Equations (Common to Bio, FT)**

L	T	P	J	C
3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify eigen values and eigen vectors of matrices and examine the consistency of system of linear equations. K4

CO2: Estimate the convergence of infinite series through various methods. K4

CO3: Solve first order ordinary differential equations of certain types and apply in some physical situations. K3

CO4: Apply numerical techniques to solve first order ordinary differential equations. K3

CO5: Identify the solution of the higher order ordinary differential equations using various methods. K4

CO6: Know how to find the Fourier Series and half range Fourier Series of a function given explicitly and to find Fourier Series of numerical data using harmonic analysis. K4

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M							M	M		
CO2	S	M							M	M		
CO3	S	M							M	M		
CO4	S	M							M	M		
CO5	S	M							M	M		
CO6	S	M							M	M		

Course Assessment methods

Direct
5. Continuous Assessment Test I, II 6. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) **7.** End Semester Examination
Indirect
1. Course-end survey

MATRICES **8 + 2 Hours**

Rank of a matrix – Linearly dependent and independent vectors – System of linear equations- Consistency-Rouche's theorem - Solution - Eigen values and eigenvectors of a real matrix – Properties of eigen values and eigenvectors – Cayley Hamilton theorem (excluding proof).

SEQUENCE AND SERIES **10 + 3Hours**

Sequences: Definition and examples–Series: Types and Convergence–series of positive terms–Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test–Alternatingseries–Leibnitz's test–Series of positive and negative terms–Absolute and

conditionalconvergence.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 5 + 2 Hours

Leibnitz's equation – Bernoulli's equation–Applications: Exponential growth and decay-Electric circuit problems.

NUMERICAL SOLUTION OFFIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 4 + 2 Hours

Numerical methods for solving first order ordinary differential equations: Taylor series method - Fourth order Runge-Kutta method.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS 8 +3 Hours

Linear equations of second and higher order with constant coefficients – Non-homogeneous term of the type e^{ax}, Sin*ax*, Cos*ax* and x^n, $e^{ax}V(x)$. Euler's and Legendre's linear equations – Method of variation of parameters.

FOURIER SERIES 10 +3 Hours

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition.
2. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
3. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., (2011).
4. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
5. Arunachalam, T., Engineering Mathematics I, Sri VigneshPublications, Coimbatore. (Revised) 2009.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003.
7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
8. Veerarajan T., "Engineering Mathematics" (for semester III), Third Edition, Tata McGraw Hill, New Delhi (2007)
9. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007
10. www.*mathworld.wolfram.com*

U17PHT1003 **Physics for Biotechnology**

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Analyze and identify the crystal structure in materials.
CO2: Understand the imperfections in a crystal system.
CO3: Illustrate the types of lasers, optical fibers and its application to engineering.
CO4: Perceive the basics of quantum for its various applications.
CO5: Understand the production of ultrasonics.
CO6: Acquire the knowledge of medical instrumentation.

Pre-requisites :

-

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M			S							M
CO3	S	M			S							M
CO4	S	M			S							M
CO5	S	M			S							M
CO6	S	M					M					M

Course Assessment methods

Direct
8. Continuous Assessment Test I, II 9. Group Presentation, Project report, Poster preparation, End Semester Examination
Indirect
1. Course-end survey

CRYSTALLOGRAPHY **9 Hours**

Space lattice – unit cell – lattice planes – Bravais space lattices – Miller indices – calculation of interplanar distances – atomic radius – coordination number – packing factor for SC, BCC, FCC and HCP structures – crystal imperfections – point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

LASER SYSTEMS AND FIBER OPTICS **9 Hours**

Air wedge and its applications - lasers – spontaneous and stimulated emissions – Einstein’s

coefficients – Nd : YAG, CO_2 and semiconductor laser – homo junction (qualitative only) - principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers – applications – fiber optic communication system – medical endoscopy.

QUANTUM PHYSICS **9 Hours**

Planck's quantum theory of black body radiation (derivation) – photo electric effect(Qualitative only) – Compton effect (derivation) and experimental verification of Compton effect – De Broglie's concept - Schrodinger wave equation – time independent and time dependent equations (derivations) – physical significance of wave function – particle in a box (one dimensional case) – Electron microscope – Scanning electron microscope – Transmission electron microscope.

ULTRASONICS **9 Hours**

Introduction – production methods of ultrasonics – magnetostriction generator – piezo electric generator – properties – detection – cavitation effect –acoustical grating – velocity measurement – applications: SONAR –velocity of blood flow – ultrasonic flaw detector – A scan, B scan, C scan-Non destructive testing-X ray radiography & X-ray fluoroscopy-thermography- IR camera-optical non destructive testing.

MEDICAL INSTRUMENTATION **9 Hours**

Phonocardiograph (PCG) -sources of radioactivity for nuclear medicine-Geiger Muller counter-photo multiplier tube & scintillation detector (Renogram) and its clinical applications (thyroid and kidney function) – nuclear medicine- imaging devices - gamma camera - positron camera.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
3. Avadhanulu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S. Chand & Company Ltd, New Delhi,2005.
4. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.
5. Palinisamy P.K., Engineering Physics I, Scitech Publications, Chennai, 2011.
6. Alan Holden and Phylis Morrison, Crystals and Crystal Growing, MIT press, 1982.

U17CHT1002 Basic Concepts of Chemistry

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Discuss Basic concepts of electrochemistry (K3)
CO2: Explain the laws of thermodynamics (K2)
CO3: Prepare the solutions of required concentration (K2)
CO4: Explain the concepts of buffer (K3)
CO5: Explain the basic concepts of bonding in organic compounds (K2)
CO6: Outline the basics of Organic Chemistry (K2)

Pre-requisites :

-

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

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M											
CO2	S											
CO3	M											
CO4	M											
CO5	S											
CO6	M											

Course Assessment methods

Direct

10. Continuous Assessment Test I, II
11. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable)
12. End Semester Examination

Indirect

1. Course-end survey

ELECTROCHEMISTRY 9 Hours

Introduction - Electrode potential - Nernst equation and problems - Electrochemical series - Application of EMF measurements and problems - Conductometric titrations (acid - base and precipitation titration)

Electrodes: Standard and Reference electrode (Hydrogen and Calomel) -Types of electrodes (Metal - Metal ion; Metal - Metal insoluble salt, Redox electrode) - Ion selective (glass electrode) - determination of pH using glasselectrode

Cells: Galvanic cell - Types of concentration cells

BASICS OF THERMODYNAMICS 9 Hours

Introduction - Thermodynamic process (isothermic, isobaric, isochoric and adiabatic processes) - Internal energy - First law of thermodynamics (Mathematical derivation and limitation) - Enthalpy - Endothermic, Exothermic reactions - Second law of thermodynamics - Hess laws and problems - work function - Gibbs Helmholtz equation

(derivation, applications and problems) - Van't Hoff isotherm (derivation and problems) - Van't Hoff isochore - (derivation and problems) - Third law and Zeroeth law (Onlystatements) - Energy changes in biochemical reactions.

SOLUTION CHEMISTRY 9 Hours

Basics of Chemical reactions and problems - oxidation-reduction reactions and its importance in biological system energy generation - Intermolecular interactions of Solids, liquid and gases - Types of solutions - Expressing concentration of solutions (Problems) - Concentration of ions and organic compounds in cells and blood.

Acids, Bases and Buffers

Arrhenius concept - Bronsted concept - Lewis concept - Ionic product of water - Strengths of acids and bases - pH scale - Common ion effect - Buffer solutions - Buffer capacity - Calculation of pH values of buffer mixtures - Henderson - Hasselbach equation.

CHEMICAL BONDING 9 Hours

Bonding: Introduction - Ionic bonding - **V**an der Waal's forces (dipole - dipole, dipole - induced dipole, induced dipole - induced dipole interactions) - hydrophobic interaction

Bonding in organic molecules: covalent and co-ordinate bonds (overview only) - hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2in simple molecules) - hydrogen bonding and its consequences.

INTRODUCTION TO ORGANIC CHEMISTRY 9 Hours

Introduction - Common organic functional groups - Naming of organic compounds - Resonance concept - Aromatic and aliphatic molecules - Classification and mechanism of organic reactions - Electrophiles and Nucleophiles - Carbocation and Carbanion - Nucleophilic substitution reaction (SN1, SN2) - Elimination reactions (E1 & E2) reactions.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Atkins, P. and de Paula, J., Atkins, Physical Chemistry, 9th ed., Oxford Univ. Press, 2009.
2. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
3. Jain P.C. and Jain. M., Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
4. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers, Coimbatore, 2013
5. Bahl B.S., Tuli G.D. and ArunBahl., Essential of Physical Chemistry, S.Chand& Co. Ltd., New Delhi, 2014
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, S. Nagin Chand & Co., New Delhi, 2009
7. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, S. Chand & Co., New Delhi (2012)
8. McMurry J., Organic Chemistry, Brooks Cole, 7th Edition, (2007)

U17MET1101 **ENGINEERING GRAPHICS**

L	T	P	J	C
2	1	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Construct various plane curves.
C02: Construct projection of points and projection of lines.
CO3: Develop projection of surfaces and solids.
CO4: Solve problems in sections of solids and development of surfaces.
CO5: Apply the concepts of isometric, and perspective projections
CO6: Apply free hand sketching in engineering practice.

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	S									W	
CO3	S	S									M	
CO4	S	S										
CO5	S											
CO6	S											

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) 3. End Semester Examination (Theory component)
Indirect
1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS AND LINES6+3Hours

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

PROJECTIONS OF SURFACES AND SOLIDS6+3Hours

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane. Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 6+3Hours

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

PICTORIAL PROJECTIONS6+3Hours

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms and pyramids when its base resting on the ground by vanishing point method.

FREE-HAND SKETCHING 6+3Hours

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

Sketching pictorial views from given orthographic views.

Theory: 30	**Tutorial: 15**	**Practical: 0**	**Project: 0**	**Total: 45Hours**

REFERENCES

1. Bhatt ND, Engineering Drawing, Charotar Publishing house, 54th edition, 2014.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2016.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2006.
4. Basant Agrawal and Agrawal C.M, Engineering Drawing and Graphics,McGraw Hill Edition(India), 2013.
5. Gopalkrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2014.

U17CSI1211 **Structured Programming using C**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the basics of problem solving techniques

CO2: Select appropriate data types and control structures for solving a given problem

CO3: Illustrate the representation of arrays, strings and usage of string operations

CO4: Illustrate the importance of pointers and functions

CO5: Explain the fundamentals of structures and unions

CO6: Explain the fundamentals of file handling

Pre-requisite: -

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	M										
CO3	S	L			L				L	L		
CO4	M	L			L				L	L		M
CO5	M	L			L				L	L		M
CO6	L	L										

Course Assessment methods:

Direct
4. Continuous Assessment Test I, II (Theory Component) 5. Assignment (Theory Component) 6. Group Presentation (Theory Component) 7. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 8. Model examination (lab component) 9. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

FUNDAMENTALS OF PROBLEM SOLVING **9 Hours**

Programs and Programming – Classification of Programming Languages based on Generations – Structured Programming Concept – Algorithm – Flowchart – Pseudo code

STRUCTURED PROGRAMMING **9 Hours**

Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements

ARRAYS AND STRINGS **9 Hours**

Defining an array – Processing an array – Passing arrays to functions –Multidimensional Arrays
Defining a string – NULL character – Initialization of Strings – Reading and Writing Strings – Processing Strings – Character Arithmetic – Searching and Sorting of Strings – Library functions for strings

FUNCTIONS, STORAGE CLASSES AND POINTERS **9 Hours**

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Recursion – Storage classes – Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers – Dynamic memory allocation

STRUCTURES, UNIONS AND FILES **9 Hours**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions
Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek

Theory: 45 hours	**Tutorial:0 hours**	**Practical:0 hours**	**Total Hours: 45 hours**

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

Lab Component

List of Experiments **30 Hours**

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays

10. Programs using structures and unions.
11. Programs on file operations and modes.
12. Working with text files, random files and binary files

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 Hours

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, “Programming in C”, Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.

U17PHP1501 **Physics laboratory (Common to AE, AU, BT, CE, CS, IT, MC,TX)**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Determine different physical properties of a material like thermal conductivity, thickness of the material.

CO2: Perform experiments involving the physical phenomena like interference and diffraction

CO3: Apply physical theories in real life situations by also taking into account its limitation.

Pre-requisites :

-

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		M	S									
CO3		S		M								

Course Assessment methods

Direct

1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination
2. End Semester Examination

Indirect

1. Course-end survey

List of Experiments **30 Hours**

1. Determine thermal conductivity of the given cardboard by Lee's disc method.
2. Determine the thickness of a thin sheet by air wedge method.
3. Determine the co-efficient of viscosity of the given liquid by Poiseuille's flow method.
4. Determine the value of acceleration due to gravity by compound pendulum.
5. Calculate the solar panel efficiency by using lux meter.
6. Determine the wavelengths of the violet, blue, green and yellow in mercury spectrum using spectrometer grating method (the green spectral line for which the wavelength is 5461 A^0).
7. Determine Young's modulus of the given bar using non-uniform bending method.
8. Calculate the frequency of the given tuning fork by longitudinal and transverse mode of vibrational methods.
9. Determine the velocity of ultrasonic sound and compressibility of the given liquid by using ultrasonic interferometer.
10. By using semiconductor laser determine:
    i) Wavelength of LASER using grating.
    ii) Acceptance angle & numerical aperture of optical fiber (grating element: N=5,00,000 lines/meter).

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

REFERENCES

1. Laboratory Manual of Engineering Physics by Dr. Y. Aparna & Dr. K.

Venkateswara Rao (V.G.S Publishers)
2. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985. 11. 12.
3. "Great Experiments in Physics", M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966. Gupta S.C, and Kapur, J.N.

CO-PO Mapping

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

COs	Programme Outcomes(POS)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2			M									
CO3			M									
CO4							W					
CO5	M											
CO6	M											

U17MEP1501 ENGINEERING PRACTICES LABORATORY

L	T	P	J		C
0	0	2	0		1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select the various tools and equipment's used in the fabrication workshop.

CO2: Develop various models in carpentry and fitting

CO3: Make components using sheet metal work.

CO4: Select the various tools and joints for different applications in plumbing.

CO5: Demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) and test the components.

CO6: Estimate DC and AC Voltage and currents using appropriate measuring instruments.

Pre-requisites : -

Course Assessment methods

Direct
3. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 4. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 Hours**

GROUP – I

A. CIVIL ENGINEERING

1. Carpentry
   - Study of carpentry tools
   - Preparation of T joint
   - Preparation of dovetail joint

2. Plumbing
   - Study of pipeline joints

B. MECHANICAL ENGINEERING

1. Fitting
   - Study of fitting tools
   - Preparation of L joint
   - Preparation of square joint

2. Sheet Metal Working
   - Study of sheet metal working tools
   - Preparation of cone
   - Preparation of tray

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

C. ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities–voltage, current, power & Power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

D. ELECTRONIC ENGINEERING PRACTICE

1. Testing of Electronic components and Measurements using a digital multimeter.
2. Study of CRO and Function generator.
3. PCB Design and Fabrication.
4. Soldering simple electronic circuits and checking continuity

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30Hours**

U17VEP1501 **PERSONAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Become an individual in knowing the self
CO 2 : Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.
CO 3: Practice simple physical exercise and breathing techniques
CO 4: Practice Yoga asana which will enhance the quality of life.
CO 5: Practice Meditation and get benefited.
CO 6: Procure Self Healing techniques for propagating healthy society

Pre-requisites : -

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												M
CO2										S		
CO3						M						
CO4						S			M			
CO5										M		
CO6								W				S

Course Assessment methods

Direct
5. Group Activity / Individual performance and assignment 6. Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1.Knowing the self : Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.
2. **Mental Health :**Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.
3.Physical Health: Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.
4.Core value : Self love& Self care Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.

5.Fitness: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi suddhi pranayama – Silent sitting and listening to nature – Meditation.

Workshop mode

REFERENCES

1. KNOW YOURSELF — SOCRATES – PDF format at www.au.af.mil/au/awc/awcgate/army/rotc_self-aware.pdf

2. STEPS TO KNOWLEDGE: The Book of Inner Knowing – PDF format at www.newmessage.org/wp-content/uploads/pdfs/books/STK_NKL_v1.5.pdf

3. PROMOTING MENTAL HEALTH - World Health Organization – PDF format at www.who.int/mental_health/evidence/MH_Promotion_Book.pdf

4. LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf

5. PERSONALITY DEVELOPMENT By SWAMI VIVEKANANDA www.estudantedavedanta.net/Personality-Development.pdf

SEMESTER II

U17MAT2103 **Advanced Calculus and Numerical Methods (Common to Bio,FT)**

L	T	P	J	C
3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.	K_3
CO2	Apply the concepts of vector differentiation and various integral theorems for solving engineering problems	K_4
CO3	Transform functions in time domain to frequency domain using Laplace transform and solve ordinary differential equations using Laplace and inverse Laplace transform	K_4
CO4	Solve non –linear equations and system of linear equations numerically	K_4
CO5	Fit a curve, construct the interpolating polynomial for the given data and find the intermediate values.	K_4
CO6	Understand the concepts of Numerical Differentiation and Integration and apply them in Engineering problems.	K_4

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	S	M							M	M				
CO2	S	M							M	M				
CO3	S	M							M	M				
CO4	S	M							M	M				
CO5	S	M							M	M				
CO6	S	S							M	M				
CO7	S	M							M	M				

Course Assessment methods

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course Exit Survey

MULTIPLE INTEGRALS 8 + 2 Hours

Double integration in Cartesian coordinates – Change of order of integration – Triple integration in cartesian coordinates – Application: Area as double integral – Volume as triple integral.

VECTOR CALCULUS **10+3 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

LAPLACE TRANSFORM **10+3 Hours**

Definition of the Laplace Transform; Properties of the Laplace Transform – Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral-Initial Value Theorem - Final Value Theorem; Transform of periodic functions - Inverse transforms - Convolution theorem – Application to solution of linear ordinary differential equations of second order with constant coefficients - Solution of integral equations.

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS **3+3 Hours**

Solution of nonlinear equations: Newton Raphson method for a single equation - Solution of linear system of equations by Gauss - Seidel method.

CURVE FITTING AND INTERPOLATION **6 +2 Hours**

Curve fitting – Method of least squares –Interpolation: Newton's forward and backward difference formulae - Lagrange's method.

NUMERICAL DIFFERENTIATION AND INTEGRATION **8 +2 Hours**

Numerical differentiation by using Newton's forward and backward difference method, Lagrange's method – Numerical integration by Trapezoidal and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules .

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total : 60 Hours

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition.
2. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
3. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., (2011).
4. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
5. ArunachalamT., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore. (Revised) 2009,Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003.
7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
8. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co.Ltd., New Delhi, 2007

Online Courses and Video Lectures:

http://nptel.ac.in/course.php?disciplineId=111

www.*mathworld.wolfram.com*

U17CHT2004 Chemistry for Biotechnology

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Outline the basic concepts of Stereochemistry (K3)
CO2: Discuss the chemical concepts of Carbohydrates (K2)
CO3: Discuss the importance of Carbohydrates in real life situations (K3)
CO4: Discuss the chemistry of lipids (K2)
CO5: Discuss the biological role of steroids (K2)
CO6: Discuss the theory of amino acids (K2)

Pre-requisites :

-

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

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M											
CO2	S											
CO3	M											
CO4	M											
CO5	S											
CO6	M											

Course Assessment methods

Direct

4. Continuous Assessment Test I, II
5. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable)
6. End Semester Examination

Indirect

1. Course-end survey

INTRODUCTION TO STEREOCHEMISTRY 9 Hours

Isomerism: Introduction and classification of isomerism
Structural isomerism: Definition - chain - position - functional -tautomerism
Conformational isomerism: Definition - in simple organic molecules
Notation: d and l; R and S; E and Z notation of simple organic molecules
Geometrical isomerism: Definition - in alkenes and cyclopropanes
Optical isomerism: Definition and conditions of optical isomerism - optical activity - chirality-optical isomerism in tartaric and lactic acids - optical activity without asymmetric carbon (allelenes, Biphenyl derivatives) - definition of enantiomers, diastereomers, mesocompounds, racemic mixture, Walden inversion.

CHEMISTRY OF CARBOHYDRATES 12 Hours

Introduction - Classification - Isomerism in Carbohydrates - Sources and Biochemical Importance of Carbohydrates - Reactions of Monosaccharide - Structure and functions of Monosaccharide, Disaccharides and Polysaccharides - Glycoprotein.

CHEMISTRY OF LIPIDS 14 Hours

Introduction - Classification of lipids - Function of lipids - Nomenclature of fatty acids - Biochemically important fatty acids (Saturated and Unsaturated Fatty Acids, Essential Fatty Acids) - Properties of Triacylglygerol - Tests to check purity of Fats and Oils - Steroids: Structure of steroid nucleus - Biological role of cholesterol and ergosterol

CHEMISTRY OF AMINOACIDS 10 Hours

Introduction To Amino Acids - Naturally Occurring Amino Acids And Their R Groups - Amino Acid As Zwitter Ion - Reactions Of Carboxyl And Amino Groups Of Amino Acid, Chemical Synthesis Of Amino Acids: Streckers Synthesis, Nucleophilic Substitution Reaction - Protecting Group For Amino Acids - Role Of Base Stacking In Structural Organization Of Proteins And Nucleic Acids – Solid Phase Peptide Synthesis.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Finar I.L, Organic chemistry, Pearson Publishers, UK, 2012
2. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th edition Blackwell Publishing, London, 2000
3. Syed Shabudeen P.S. and Shoba U.S., Chemistry for Textiles, Inder publications, Coimbatore, 2014
4. Bahl B.S. and ArunBahl., Advanced *Organic Chemistry*, S. Chand & Co., New Delhi, 2014
5. Nelson, D.L and Cox M.M Lehninger Principles of Biochemistry, W. H. Freeman & CO, New York, 2012
6. Satyanarayana U., Biochemistry, Elsevier India, 2013
7. McMurry J., Organic Chemistry, 7th Edition, Brooks Cole, (2007)
8. McMurry J., Organic Chemistry with biological applications, Brooks Cole, (2011)

U17BTT2001 Introduction to Biotechnology

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the basics of cells and metabolism (K2)

CO2: Introduce the foundation of molecular biology and genetics (K1)

CO3: Familiarize with the various modern biotechnology process and technology (K1)

CO4: Be aware of the opportunities in healthcare sector (K2)

CO5: Obtain an idea on the scope, growth and laws in biotechnology(K1)

CO6: Develop an idea on the entrepreneurship activities in biotechnology (K1)

Pre-requisites :

1. -

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M							M
CO2	S	M										
CO3	S											
CO4	S	M		M								
CO5	M				W							

Course Assessment methods

Direct
7. Continuous Assessment Test I, II 8. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) 9. End Semester Examination
Indirect
1. Course-end survey

CHEMISTRY, CELLS AND METABOLISM 9Hours

Introduction to macromolecules of life – Carbohydrates, Protein, Nucleic acids, Lipids – structure and function in biology; Basics – molecular and biochemical structure of microbes (bacteria, virus, fungi etc.,)

MOLECULAR BIOLOGY AND GENETICS 9Hours

Overview – DNA and RNA: the molecular basics of heredity; cell division – proliferation and reproduction; patterns of inheritance, Basics – Central dogma of life; Principles – molecular tools to study biology – sequencing, PCR, Clustered Regularly Inter Spaced Short Palindromic Repeats(CRISPR); Application of biotechnology in cloning.

MODERN BIOLOGY AND TECHNOLOGIES 9Hours

Introduction – molecular farming, DNA fingerprinting, GMOs, stem cells, plant and mammalian Cell culture, Introduction to fermentation technology and basics of debottlenecking.

ROLE OF BIOTECHNOLOGY IN INDUSTRIES **9Hours**

Biotechnology ethics, disease and their treatment – Cancer, AIDS; gene therapy, production– human insulin, somatotropin, interferons, biogenetic drugs, designer babies.

BIOTECHNOLOGY IN INDIA AND GLOBAL SCENARIO **9Hours**

Introduction – Scope, Growth, laws, employment and domains, major biotechnology labs in India; recent advancement in biotechnology; future direction of biotechnology. food technology – an overview, food technology labs in India; Bio-entrepreneurship.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Starr, Cecie, Christine Evers, and Lisa Starr. Biology: concepts and applications without physiology. Cengage Learning, 2010.
2. Brown, Charles Malcolm. Introduction to biotechnology. No. 581.0724 B7. 1987..
3. Damron, W. Stephen, and W. Stephen Damron., Introduction to animal science: global, biological, social, and industry perspectives. 2013.
4. Smyth, Stuart J., Peter WB Phillips, and David Castle, eds. Handbook on agriculture, biotechnology and development. Edward Elgar Publishing, 2014.

WEB REFERENCES:

1. http://www.dbtindia.nic.in/
2. http://bcil.nic.in/
3. https://www.ibef.org/download/Biotechnology-March-2017.pdf
4. http://pibphoto.nic.in/documents/rlink/2017/jan/p201711802.pdf

U17EET2012

ELECTRICAL ANDELECTRONICS ENGINEERING

(Common to Civil & Bio Technology)

L	T	P	J	C
3	0	0	0	**3**

Course Outcomes

After successful completion of this course, the students should be able to

CO1: acquire basic knowledge on DC and AC circuits.
CO2: identify electronics components and use them to design circuits.
CO3: understand the operation of DC machines, characteristics and their applications.
CO4: understand the operation of AC machines, characteristics and their applications.
CO5: acquire basic knowledge on semiconductor devices and their applications.
CO6: gain basic of knowledge logic gates

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S	S										
CO3	S	M										
CO4	S	M										
CO5	S		W									
CO6	S		M									

Course Assessment methods

Direct
10. Continuous Assessment Test I, II 11. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) 12. End Semester Examination
Indirect
1. Course-end survey

ELECTRICALCIRCUITS — 9 Hours

Ohm's Law – Kirchhoff's Laws – series, parallel DC circuits – Introduction to AC Circuits – Waveforms and RMS Value – Single Phase series RLC circuits- Power and Power factor- solving simple AC circuits.

DCMACHINES — 9 Hours

Construction, Principle of Operation-Types, characteristics - Applications of DC Generators, DC Motors - Principle of Operation- types – back emf – torque equation - speed torque characteristics – speed control of DC motor..

ACMACHINES — 9 Hours

Single Phase Transformer- Construction, Principle of Operation- Types, Emf equation-3 phase Induction Motor -construction– Principle of operation – types – torque equation - speed torque characteristics – 1 phase Induction Motor – Principle of operation- types-Applications.

SEMICONDUCTOR DEVICES AND APPLICATIONS **9 Hours**

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation, Bipolar Junction Transistor – CB, CE, CC Configurations andCharacteristics.

DIGITAL ELECTRONICS **9 Hours**

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

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical,Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition,2006.
2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press2005.
3. Mehta V K, “Principles of Electronics”, S.Chand& Company Ltd,1994.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ OutlineSeries, McGraw Hill, 2002.
5. Prem kumar N, “Basic Electrical Engineering”, Anuradha Publishers,2003.
6. Mittle N., “Basic Electrical Engineering”, Tata McGraw Hill Edition, New Delhi,1990.
7. Sedha R.S., “Applied Electronics”, S. Chand & Co.,2006.

U17BTP2002 Laboratory Skills in Biotechnology

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the basic of lab safety, report writing and GMP practices

CO2: Understand the concept of solution preparation**.**

CO3: Usage of basic analytical instruments in biotechnology

CO4: Isolate, identify the biomolecules from various samples.

CO5: Learn data analysis and interpretation

CO6: Understand the theory behind various analytical instruments.

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M			S	S			
CO2	S	M										
CO3	S											
CO4	S	M		M								
CO5	S				M							

Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments 45Periods

1. Introduction to Bio-laboratory
    a. Biotechnology laboratory security & safety, SOP and GMP
    b. Documentation: The lab Notebook & Lab Report.
    c. Lab Equipment & Reagent Orientation.
    d. Math skills for the laboratory – SI Units, scale-up calculations.
2. Basic equipment in Biotechnology Laboratory and SOP.
3. Preparation of solution Molarity, Normality and Molality calculation
4. Titration of acid/base – Standard Deviation, Mean calculation using MS-excel.
5. Preparation of buffers and estimating buffering capacity.
6. Quantification of DNA.
7. Isolation of biomolecules – DNA and protein & electrophoretic techniques.
8. Rheology of different fluids.
9. Data analysis, graphing and interpretation.
10. Basics of Centrifugation.

Theory: 0	Tutorial: 0	Practical: 45	Project: 0	Total: 45 Hours

REFERENCES

1. Thieman, William J., and Michael A. Palladino. Introduction to Biotechnology: International Edition, 2 E, Question Bank." (2016).
2. Hegyi, Gyrgy, et al. Introduction to Practical Biochemistry. ELTE Faculty of Natural Sciences, Institute of Biology (2013).
3. Sharp, James J. BASIC fluid mechanics. Butterworth-Heinemann, 2013.
4. Gunstone, Frank D., and Frank A. Norris. Lipids in foods: chemistry, biochemistry and technology. Elsevier, 2013.

U17ITP2511 **Problem Solving and Programming For Biotechnology**

L	T	P	J	C
0	0	2	0	1

COURSE OBJECTIVES

- 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.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1 Read, write, and execute simple Python programs. K2

CO2 Structure simple Python programs for solving problems. K3

CO3 Decompose a Python program into functions. K3

CO4 Represent compound data using Python lists, tuples, and dictionaries. K2

CO5 Read and write data from/to files in Python Programs. K2

Pre-requisite: -

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S							
CO2	S	M			M							M
CO3	S	M	M		M							M
CO4	M				M							
CO5	M				M							

Course Assessment methods:

Direct	Indirect
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment;Comprehensive report / Model Examination 2. End Semester Exam	1. Course Exit Survey

Python interpreter and interactive mode - data types, expressions, variables, statements,

strings. Control statements, functions, lists, tuples, dictionaries, files.

List of Experiments:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Linear search and Binary search
5. First n prime numbers
6. Find the maximum of a list of numbers
7. Sorting a group of numbers
8. Removing all the duplicate elements in a list
9. Simple calculator using functions
10. Student Mark sheet Processing using tupes
11. Multiply matrices
12. Programs that take command line arguments (word count)
13. Find the most frequent words in a text by reading from a file

Theory: 0 hours Practical:30 hours Total Hours: 30 hours

REFERENCES

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
7. The Python Tutorial, https://docs.python.org/2.7/tutorial/

U17CHP2501 **Chemistry Laboratory (COMMON TO AE, AU, BIO, CE & MCE)**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Prepare standard solutions (S1)

CO2: Analyse the properties of water by applying the chemical concepts (S2)

CO3: Analyse the solutions by electrochemical techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

CO4: Analyse the solutions by spectroscopic techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

Pre-requisites :

-

CO/PO Mapping

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M											
CO3	M					M						
CO4	M					M						

Course Assessment methods

Direct
1. Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 hours**

1. Preparation of normal solutions of the following substances - Sodium carbonate, Hydrochloricacid and Buffer solution

WATER TESTING

2. Determination of total, temporary and permanent hardness by EDTA method.
3. Estimation of DO by Winkler'smethod
4. Estimation of alkalinity by Indicatormethod.
5. Estimation of chloride by Argentometricmethod.

ELECTRO CHEMICAL ANALYSIS

6. Estimation of hydrochloric acid by pHmetry.
7. Conductometric estimation of mixture of acids and strongbase
8. Estimation of corrosion of Iron byPotentiometry

PHOTOMETRY

9. Estimation of the extent of dissolution of Copper / Ferrous ions by Spectrophotmetry.
10. Estimation of sodium and potassium in water by Flamephotometry.

DEMONSTRATION

11. Determination of Fire point and Flash point
12. Determination of Cloud and Pour point
13. Microscopic usage in Metallurgy.
14. Determination of Molecular weight by Viscometer

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London,2012.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London,2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2011.

U17ISR2001–SOCIAL IMMERSION PROJECT

L	T	P	J	C
0	0	0	4	2

(Common to all branches of Engineering and Technology)

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Achieve the desirable awareness regarding significant social problems and identify the needs to provide a possible and innovative solution.

CO2: Acquire and demonstrate effective professional and technical skills to deal with social issues through innovative leadership and sustainable services / approaches.

CO3: Provide students with a rich practical and socially oriented team work approach.

CO4:Explain how to make leadership decisions concerning organizational structure and the role of project resources on a project's team.

CO5: Enhance technical knowledge in addressing the needs of a community problem.

CO6: Identify tools and techniques for planning and working on a project.

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

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			S			S	S					
CO2			M	S		S	M	M	M			
CO3			S	W		S	S		S			M
CO4			S			S	S		W		M	
CO5	S		M			S	M					
CO6			S			S	S					

Course Assessment methods

Direct	Indirect
1. Project Review 2. General report preparation 3. Team Presentation	1. Impact study 2. Field Visit & Observation Skill 3. Course end survey

SOCIAL BONDING AND ENGINEERING

Society and its impact on the individual – Responsibility of individuals towards community building – Essential requirement of the society – Role of an engineering graduate in approaching the requirements - Developing social consciousness.

ENGINEERING PREREQUISITE FOR ENHANCED SOCIAL LIVING

Theoretical reading (Based on the project / general – Books to be identified by the team) - Inculcating Social immersion and Leadership- Study on the society and identifying problems -

Social immersion and Engineering implementation - Analysis of problems on issue based - Identification of causes and effects of the social issue identified.

ESSENTIAL ENGINEERING INNOVATION

Essential Engineering Concepts - Multiple approaches towards the problem &Selection for addressing- Addressing a theoretical social problem -Providing multiple solutions for the problem

PROJECT PLANNING AND APPROACHES

Knowledge on budgeting and fund raising - Approaching agencies related to problems. Partnering with agencies- Presentation Skills - Report preparation

BROAD AREA OF PROJECTS

(Students can also identify their own social issue)

Water / Sanitation and Hygiene - Waste Management -Women Empowerment- Community health - Child health/ Poverty/Education/others - Energy management -Environment Management - Adult Education - -Youth Empowerment - Green Industry - Given above are the broad areas of projects recommended. Projects may vary to individuals/ groups/ class/ branch.

TOTAL: 60 Hours

References:

Nicholls Alex and Murdock Alex, Social Innovation Blurring Boundaries to reconfigure markets, Palgrave Macmillan., New York, 2012. :

Osburg Thomas and Schmidpeter Rene`, Social Innovation Solutions for sustainable Future. Springer, Germany 2013.

Adedeji B. Badiru, STEP Project Management: Guide for Science, Technology, and Engineering Projects. Taylor and Francis Group., Florida 2009.

U17VEP2502 INTERPERSONAL VALUES

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop a healthy relationship & harmony with others
CO 2: Practice respecting every human being
CO 3: Practice to eradicate negative temperaments
CO 4: Acquire Respect, Honesty, Empathy, Forgiveness and Equality
CO 5: Practice Exercises and Meditation to lead a healthy life
CO 6: Manage the cognitive abilities of an Individual

Pre-requisites :

2. U17VEP1501 / PERSONAL VALUES

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

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										S		
CO2									S			
CO3											M	S
CO4						M						
CO5												M
CO6											M	

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities: 30 hours

1. Introduction: Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.
2. Maneuvering the temperaments: From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.
3. Core value : **Truthfulness -**Honesty –Helping–Friendship – Brotherhood – Tolerance – Caring & Sharing – Forgiveness – Charity –Sympathy — Generosity – Brotherhood - Adaptability.
4.Pathway to Blissful life :
Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.
5.Therapeutic measures: Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 hours

REFERENCES

1. INTERPERSONAL SKILLS Tutorial (PDF Version) - TutorialsPoint www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska www. publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1
3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishi www.ijhssi.org/papers/v5(5)/F0505034036.pdf
5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publications - www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pd...

ENGLISH ELECTIVES

U17ENP2501 – ENGLISH FOR PLACEMENT PURPOSES

(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

1. To enhance the logical, analytical and critical thinking skills of the students leading to effective corporate communication.
2. To develop relevant employability skills to cater to the communicative demands of the industry.
3. To adopt relevant job related oral and written communication skills to competently perform in campus recruitments.
4. To train students in presentation skills, persuasive skills and career skills.

COURSE OUTCOMES

After the course the student will be able to:

CO1: Enhance the logical, analytical and critical thinking skills of the students leading to effective corporate communication.

CO2: Develop relevant employability skills to cater to the communicative demands of the industry.

CO3: Adopt relevant job related oral and written communication skills to competently perform in campus recruitments.

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

COs	Programme Outcomes(POs)												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
CO1	W	M				W			M	S		M		
CO2		W	M		W	S		W	M	S		S		
CO3	W	S				W	W			S		M		

Assessment Methods

Direct
1. Continuous Assessment of Skills 2. Placement Paper Test 3. End Semester Examination
Indirect
1. Course-end survey

No	Topic	Hours
UNIT -1 – Verbal Ability – 12Hrs		
1.1	Introduction to corporate culture	1
1.2	Verbal and Analytical Reasoning	2
1.3	Transcoding Graphics	2
1.4	Picture Perception & Video Sensitization	3
1.5	Placement Test Papers	4
UNIT -2 – Presentation Skills – 12Hrs		
2.1	Thematic Oral Presentation	2
2.2	Extempore	4
2.3	Effective PowerPoint Presentation	2
2.4	Email Writing and Resume Writing	2
2.5	Copy Editing	2
UNIT -3 – Interactive Employability Skills – 12Hrs		
3.1	Introduction to Employability Skills	1
3.2	Corporate Interaction	1
3.3	Interview Process &Kinds of Interviews	1
3.4	Self-Introduction	4
3.5	Mock Interview & Stress Interview Practice	5
UNIT -4 – Oral Discussion – 12Hrs		
4.1	Introduction to Structure of GD	1
4.2	Types of GD	1
4.3	GD Practice	4
4.4	Introduction to Role-play	1
4.5	Role-play Practice	5
UNIT -5 – Corporate Skills – 12Hrs		
5.1	Receptive skills	2
5.2	Polite English, Placement Behaviour	2
5.3	Negotiation Skills	3
5.4	Rapid interpretation	2
5.5	Business Writing	3
Total		60

Reference:

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. Aptitude Guru : Tricks & Tips - Android Apps on Google Play
3. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary (By Norman Lewis)
4. Effective Technical Communication Tata Mc Graw Hills Publications (Ashraf Rizvi)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)

U17ENP2502 - ENGLISH FOR RESEARCH PURPOSES

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

The students will be facilitated to:

1. Recognize and understand fundamental concepts of research and its methodology.
2. Use the resources to read, interpret and critically evaluate the information.
3. Employ and organize the components of writing skills for research.
4. Craft a research paper in a particular discipline.
5. Present and defend the hypothesis of their research proposal.

COURSE OUTCOMES:

After the course the student will be able to:

- Apply some basic concepts of research and its methodologies.
- Identify appropriate research topics and define research problem.
- Demonstrate knowledge of data analysis and interpretation in relation to the research process.
- Draft a review article/ paper effectively using the components of research writing.
- Participate and present professionally in a research forum.

CO/PO Mapping (S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak													
COs	**Programme Outcomes(POs)**											**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**
CO1				**M**	**M**				**W**	**M**		**S**		
CO2				**M**	**M**				**W**	**M**		**S**		
CO3				**S**	**M**				**W**	**M**		**S**		
CO4									**M**			**S**		
CO5									**M**		**S**	**S**		

UNIT-1	INTRODUCTION TO RESEARCH	8 Periods
1.1	Research – Objectives, benefits and types	1

1.2	Choice of topic	1
1.3	Looking for resources	2
1.4	Reading literature review	2
1.5	Citing sources and formation of preliminary bibliography	2
UNIT-2	FORMATION OF RESEARCH	10 Periods
2.1	Preparing a working outline of research	3
2.2	Formation of hypothesis	2
2.3	Plagiarism	1
2.4	Taking notes and strategies for organizing notes	2
2.5	Planning and organizing the review of literature	2
UNIT-3	OPERATION OF RESEARCH	16 Periods
3.1	Different types of surveys	2
3.2	Exploring research idea and constructing the research	4
3.3	Finding background information and gathering more information on the chosen area	4
3.4	Locating current research on the topic chosen	2
3.5	Interpreting data and graphics	4
UNIT-4	MANUSCRIPTION OF RESEARCH	13 Periods
4.1	Writing the first draft	3
4.2	Quality and Style of writing	3
4.3	Editing and proof reading	3
4.4	Writing the introduction and conclusion	3
4.5	Summarizing the research paper and preparing title page	1
UNIT-5	PRESENTATION AND PUBLICATION OF RESEARCH	13 Periods
5.1	Final revision and proof reading	3
5.2	Final presentation	3

5.3	Benefits of publishing an article	1
5.4	How to publish an article	4
5.5	Funding agencies	2

Reference Books:

1. **How to write and publish a research paper. Robert A Day, 4th edition, Cambridge University Press, 1995.**
2. **The Craft of Research. Wayne C Booth, Gregory G. Colomb, Joseph M Williams, The University of Chicago Press, 2008.**
3. **Engineering Research Methodology, Krishnan Nallaperumal, 2013.**
4. **How to write a Paper, ed George M Hall, BMJ Publishing Group, 2003.**

U17ENP2503 – English for Competitive Exams

(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

Course Objectives:

1. To impart specific training for various Competitive Examinations like IELTS and TOEFL, DEFENCE EXAMS, BANK & LIC EXAMS, CAT etc.
2. To familiarize the learners with online examinations.
3. To improve the writing skills of students through combination of theory and practice for various competitive exams.
4. To create awareness of job prospects in government and defense service.

Course Outcomes:

By the end of the course the students will be able to:

1. Comprehend the necessity of English competitive exams in the current scenario.
2. Acquire awareness of English content in Government service and defense service Jobs.
3. Accomplish the prediction skills and interpretative excellence required for Competitive Exams.
4. Gain ideas on various Competitive exams and mark out their own capability.
5. Develop the credibility of competitive spirit.

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

COs	Programme Outcomes(POs)												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
CO1				M	M				W	M		S		
CO2				M	M				W	M		S		
CO3				S	M				W	M		S		
CO4									M			S		
CO5									M			S		

No	Topic	Hours
UNIT -1 – Various Competitive Exams – An over view – 5 Hrs		
1.1	General over view of various competitive exams	**1**
1.2	Requirements and eligibility for various competitive exams.	**1**
1.3	Introduction to specialized English exams for work or study abroad	**1**
1.4	Scope for engineering graduates in defence service.	**1**
1.5	Pattern and weightage for English in different competitive exams	**1**
UNIT -2 – English Requirement for Higher Education and Work Abroad– 10 Hrs		
2.1	Conversation social / general context – brief presentation	**2**
2.2	Interpretation of data into text	**2**
2.3	Inferring details from conversation / announcements/ information	**2**
2.4	Understanding specific information- Reading long and short passages	**2**
2.5	Formal and informal Email communication	**2**
UNIT -3 – Verbal Aptitude to Compete – Part I– 10 Hrs		
3.1	Analogy, Cloze test	**2**
3.2	Spot the Error	**2**
3.3	Ordering of Sentences	**2**
3.4	Reading Comprehension	**2**
3.5	Synonyms and Antonyms– One Word Substitutes, Miscellaneous Vocabulary and Spellings	**2**
UNIT -4 – Verbal Aptitude to Compete – Part II– 10 Hrs		
4.1	Verbal Puzzle	**1**
4.2	Idioms and Phrases	**2**
4.3	Essay and Letter	**3**
4.4	Sentence Improvement	**2**
4.5	Fill in the Blanks, Sentence Completion	**2**
UNIT -5 – Training for Competency – 15Hrs		
5.1	Practice Test - I (TOEFL/ IELTS)	**3**
5.2	Practice Test -II (CAT)	**3**
5.3	Practice Test - III (BANK EXAMS)	**3**
5.4	Practice Test - IV(DEFENCE EXAMS / BANK EXAMS)	**3**
5.5	Group Discussion	**3**
Total		**60**

Reference Books:

Cambridge BEC Preliminary Book 4, Cambridge University Press, March,2009.

Complete IELTs, Guy brook- Hart &VanessaJakeman, Cambridge University Press, March,2009

A modern approach to verbal & non-verbal reasoning,Dr.R.SAgarwal, S Chand publications

McGraw-Hill Education TOEFL iBT with 3 Practice Tests and DVD-ROM

SEMESTER III

Signature of BOS chairman, BT

U17BTT3001	BIOORGANIC CHEMISTRY	L	T	P	J	C
		3	0	0	0	3

COURSE OBJECTIVES:

- To enable understanding chemical principles governing biochemical reactions
- To learn synthetic strategies and molecular models of biomolecules

COURSE OUTCOMES (Cos):

At the end of the course student will be able to:

CO1: Recognize role of organic chemistry in biology

CO2: Explain the chemical reactions of coenzymes

CO3: Understand the role of animo acids in enzyme catalysis

CO4: Outline the synthesis of natural products

CO5: Describe the chemistry of nucleic acids

CO6: Correlate the importance and influence of metal ions on protein function

Pre-requisite(s): -

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

Cos	Programme Outcomes(Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S			M									M	
CO2				S									M	
CO3		M	M		M									
CO4		S												
CO5					M									
CO6		M			M								M	

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

GENERAL REACTIONS IN BIOORGANIC CHEMISTRY **9 Hour**

Reactions of Fatty acids – Saponification and transesterification, acid number and iodine, number of oils; Isoelectric points of amino acids; General reactions of amino acid - side chain, carboxyl and amino group, Chemical reactions of amino acids with Ninhydrin, Sanger's reagent, and Dansyl chloride; Biologically important peptides and their applications; Chemistry of carbohydrates – hemiacetal formation.

BIOORGANIC CHEMISTRY OF ENZYMES: **9 Hour**

Coenzymes in catalysis, Mechanism and role of: pyridoxal phosphate aminotransferases), NAD/NADP (dehydrogenases); Thiamine pyrophosphate (carboxylases); Case studies of structure and mechanism- Horse Liver alcohol dehydrogenase, alpha –chymotrypsin; Enzymes in organic transformations- hydrolysis of amide bond, esters; reduction of aldehydes and ketones using enzymes and whole cells; Enzymes in organic solvents- ester, lactone and peptide synthesis; Cyclodextrins

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CHEMISTRY OF NATURAL PRODUCTS **9 Hour**

Alkaloids: properties and reactions; Synthesis and biological properties of coniine, piperine; Terpenoids and Carotenoids: General methods of synthesis of terpeniods; Isoprene rule; Structure and synthesis of menthol; General methods of Anthocyanines and flavones synthesis; Cyanidine chloride and Quercetin; Curcumin, structure and synthesis

BIOORGANIC CHEMISTRY OF NUCLEIC ACIDS: **6 Hour**

History, Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix ; DNA intercalators; Chemical synthesis of DNA; Catalytic RNA, siRNA; micro RNA; Fluorescently Labeled Nucleosides and oligonucleotide probes; Homogeneous DNA Detection; Microarray based DNA Detection;

METAL-LIGAND COMPLEXES IN PROTEINS **9 Hour**

Transition metal ions and oxidation states; Coordinate bonds in proteins and ligands; Types of ligands; Role of iron in Myoglobin, Haemoglobin and cytochromes; Copper in Hemocyanin; Magnesium in chlorophyll; Cobalt in vitamin B-12 and Molybdenum in nitrogenase; Role of important Metaloenzymes; Geometrical and optical isomerism in coordination complexes

Theory: 45 Hour **Tutorial: 0 Hour** **Practical: 0 Hour** **Project: 0 hour** **Total : 45 Hour**

REFERENCES:

1 McMurry, J. E. (2014). *Organic Chemistry with Biological Applications*. Cengage Learning

2 Kalsi, P. S., & Jagtap, S. (2013). *Pharmaceutical, medicinal and natural product chemistry*. Alpha Science.

3 Berg, J. M., Tymoczko, J. L., Stryer, L., Berg, J. M., Tymoczko, J. L., & Stryer, L. (2002). Biochemistry: International version (hardcover).

4 Davies, J. S. (Ed.). (1998). *Amino acids, peptides and proteins* (Vol. 29). Royal society of chemistry.

5 Dugas, H. (1996). A chemical approach to enzyme action. *Biochemistry and Molecular Biology Education*, *25*, 173-188.

		L	T	P	J	C
U17BTT3002	**BIOMOLECULES AND GENETICS**	**3**	**0**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To expose the students to the area of biochemistry/cell biology and basic genetics. This knowledge is required to understand Biochemistry, Molecular biology and Genetic engineering.

COURSE OUTCOMES (COs):

After successful completion of this course, the students should be able to

CO1: Illustrate the structure and explain the classification and functions of carbohydrates and lipids

CO2 Understand the structure and function of lipids

CO3: Classify and discuss the properties and functions of amino acids, vitamins and minerals

CO4: Describe the concepts of mendelian genetics and multiple allelism

CO5: Understand and explain the structure of chromosomes and related disorders

CO6: Compare sex chromosome linked disorder in human chromosomes

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PRE-REQUISITE(S): -

CO/PO Mapping S-Strong, M-Medium, W-Weak														
Cos	**Programme Outcomes(Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1			S			S							S	
CO2	S			W								M	S	
CO3	S			W								M	S	
CO4	S											M	S	
CO5	S		M			M							S	
CO6	S	M			S								S	

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

CARBOHYDRATES **9 Hour**

Definition; Carbohydrates-; Classification- Monosaccharides - Structure, and function, Disaccharides- Structure and function- Sucrose, Lactose, Polysaccharides- Starch, cellulose, heparin, hyaluronicacid.

LIPIDS **9 Hour**

Definition: Classification of lipids- Simple lipids -Physical and chemical properties of fats. Saponification number; Compound lipids-structure and function of phospholipids and Glycolipids. Fatty acids (C16, C18) - Saturated and unsaturated fatty acids; Essential fatty acids. Steroids : Cholesterol Structure and functions

AMINO ACIDS, PEPTIDES, VITAMINSANDMINERALS **9 Hour**

Amino acid- Definition, Structure and classification; Essential amino acids; Peptides- Definition, Structure and properties. Vitamins- Definition, Structure; Physiological functions of fat and water soluble vitamins. Minerals - Essential macro and micro minerals, sources and functions.

CLASSICAL GENETICS **9 Hour**

Mendelian genetics- Introduction, Principles; Monohybrid, Dihybrid and Trihybrid crosses; Backcross and testcross; Linkage, Crossing over, Genetic mapping, recombination; Multiple alleles- Blood group antigens

CHROMOSOME STRUCTUREAND ORGANIZATION **9Hour**

Nucleic acids: structure of DNA, RNA; Chromosome organization of eukaryotes. Ploidy- polyploidy and Aneuploidy; Human karyotypes; Human sex Chromosome-linked disorders - Hemophilia, Fragile X; Special chromosomes - Polytene chromosomes and Lamp Brush chromosome.

Theory: 45 Hour Tutorial: 0 Hour Practical: 0 Hour Project: 0 Hour Total : 45 Hour

REFERENCES

1. Enger, E. (2012). Concepts in Biology'2007 Ed. 2007 Edition. *Rex Bookstore, Inc.*
2. Bhutani, S. P. (2009). Chemistry of Biomolecules. Ane Books Pvt Ltd.
3. Gardner, E. J. (1999). *Principles of genetics* (No. 4). London, UK, John Wiley & Sons, Inc..

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4. McKee, E., & Mckee, T. (1996). Biochemistry–an Introduction‖, Win. *C. Brown Publ., Dubuque*.
5. Taylor, D. J., Green, N. P., Stout, G. W., & Soper, R. (1997). *Biological science* (Vol. 983). Cambridge, United Kingdom: Cambridge University Press.

		L	T	P	J	C
U17BTT3003	**BIOPROCESS CALCULATIONS**	**3**	**0**	**0**	**0**	**3**

Course Objectives:

- To learn the stoichiometric principles related to material and energy balance pertaining to bioprocess
- To learn in detail the role of product and yield in bioprocess

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Apply the unit conversion and basic calculations.
CO2 Understand the material balance without and with involving chemical reactions.
CO3: Acquire knowledge on energy balance involving chemical reactions.
CO4: Acquire knowledge on energy balance without involving chemical reactions.
CO5: Understand the concept of thermodynamic preliminaries.
CO6: Apply the stoichiometry for growth and product formation

PRE-REQUISITE(S): -

	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs		**Programme Outcomes(POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	M													**S**
CO2	S	S	S						M			M		S
CO3	S	M	S						M			M		S
CO4		M							M					S
CO5					M		W							S
CO6					M		W							S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

CONVERSION AND BASIC CALCULATIONS **9 Hour**

Dimensions and System of units - Fundamental and derived quantities, Unit conversions, Representation of units, Dimensional consistency. Composition calculations: Solid, liquid and gaseous mixtures. Gas Laws: Ideal gas law, Boyle's Law, Charles' Law, Dalton’s law, Amagat’s law, Raoult’s law, Henry’s law.

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MATERIAL BALANCE WITHOUT AND WITH INVOLVING CHEMICAL REACTION 9 Hour

Material balances without chemical reactions: Material balances involved in distillation, extraction, drying, evaporation, and crystallization - recycle, bypass and purge streams Material balances with chemical reactions: Selectivity, conversion and yield, Limiting and excess reactant.

ENERGY BALANCE WITHOUT AND WITH INVOLVING CHEMICAL REACTION 9 Hour

Thermophysics: Energy balance equation formulation, Components of energy balance, Heat capacity of solids, liquids and gases, Sensible and latent heat. Thermochemistry: Hess's law, Standard heat of reaction: formation and combustion, Enthalpy determination.

THERMODYNAMIC PRELIMINARIES 9 Hour

System: Homogeneous, Heterogeneous, Closed and Open. Processes: Reversible and Irreversible. Properties: Intensive, Extensive, Reference, Energy and Derived. Process involving ideal gases: Constant Volume, Pressure, Temperature, Adiabatic and Polytropic Process. Energy: Entropy, Internal energy, Enthalpy, Heat capacity, Helmholtz free energy and Gibbs free energy. Exact Differential Equations, Fundamental Property Relations, Maxwell's Equations

STOICHIOMETRY OF GROWTH AND PRODUCT FORMATION 9 Hour

Growth stoichiometry and elemental balances, Respiratory quotient, Degree of reduction, Electron balances, Biomass yield, Product Stoichiometry, Theoretical Oxygen Demand, Unsteady and steady state operation, Material and Energy Balances with Recycle, By-Pass and Purge Streams.

Theory: 45 Hour Tutorial: 0 Hour Practical: 0 Hour Project: 0 hour Total : 45 Hour

REFERENCES

1. Narayanan, K. V., & Lakshmikutty, B. (2016). Stoichiometry and Process Calculations. PHI Learning Pvt. Ltd..
2. Doran, P. M. (2013). Bioprocess engineering principles. Elsevier.
3. Bhatt, B. I., & Thakore, S. B. (2010). Stoichiometry. Tata McGraw-Hill Education.
4. Narayanan, K. V. (2004). A textbook of chemical engineering thermodynamics. PHI Learning Pvt. Ltd..
5. Smith, J. M. (2003). Introduction to chemical engineering thermodynamics

U17BTI3204 **CONCEPTS IN BIOCHEMISTRY**

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES

- To learn about the elements of nutrition
- To learn about the metabolism of carbohydrates, lipids, proteins and nucleic acids and their associated disorders
- To learn about the bioenergitic, oxidative phosphorylation and hormonal regulation of metabolism

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COURSE OUTCOMES (COS):

After successful completion of this course, the students should be able to

CO1: Describe the daily requirement, digestion and absorption of carbohydrates, proteins and lipids.

CO2: Discuss the metabolic pathways of carbohydrates and metabolic disorders associated with it.

CO3: Explain the metabolic pathways of lipids and metabolic disorders associated with it.

CO4: Demonstrate the metabolic pathways of amino acids, nucleic acids and associated disorders.

CO5: Summarize the hormonal regulation of metabolic pathways and Illustrate the concepts of bioenergetics and oxidative phosphorylation.

CO6: Perform the quantitative estimation of various biomolecules.

Pre-requisite courses: -

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S			S							S	
CO2	S			W								M	S	
CO3	S			W								M	S	
CO4	S											M	S	
CO5	S		M			M							S	
CO6	S	M			S								S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

ELEMENTS OF NUTRITION **6 hour**

Dietary requirement of carbohydrates, lipids and proteins; Essential amino acids; essential fatty acids and their physiological functions. Nutritional importance of carbohydrates, lipids and proteins. Digestion and absorption of carbohydrates, proteins and lipids.

Case study - Impact of green revolution in Haryana and Punjab on nutrition.

METABOLISM OF CARBOHYDRATES AND LIPIDS **12 hour**

Introduction to metabolism; Glycolysis, Gluconeogenesis, Pentose Phosphate pathway.TCA cycle: Glycogenesis and Glycogenolysis; Biosynthesis of fatty acids, beta oxidation Biosynthesis of Cholesterol; Biosynthesis of triglycerides. Metabolic disorders of carbohydrate metabolism (pathophysiology, clinical symptoms and treatment): Diabetes mellitus; Metabolic disorders of lipid metabolism: familial hypercholesterolemia.

Case study- Importance of zinc supplementation in diabetes mellitus.

METABOLISM OF PROTEINS AND NUCLEIC ACIDS **9 hour**

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Formation of Urea; Biosynthesis and degradation of select aliphatic and aromatic amino acids (to mention 1 from each). Biosynthesis of Purines and Pyrimidines; Biodegradation of Purines and Pyrimidines. Metabolic disorders of amino acid metabolism: Phenyl ketonuria, Albinism; Metabolic disorders of nucleic acid metabolism: Lesch-Nyhan syndrome, Gout

HORMONAL REGULATION OF METABOLISM **6 hour**

Interconnection of pathways of metabolism. Hormonal regulation of glycolysis and gluconeogenesis: insulin, glucagon and glucocorticoides.

BIOENERGETICS AND OXIDATIVE PHOSPHORYLATION **12 hour**

Biological oxidation-reduction reactions; High energy phosphate compounds; free energy of hydrolysis of ATP and sugar phosphates. Mitochondrial respiratory complexes; oxidative phosphorylation: chemiosmotic theory; ATP synthase and mechanism of ATP synthesis; photosynthetic electron transport and generation of NADPH &ATP

List of Experiments: **15 hour**

1. Estimation of free reducing sugars by 3,5-dinitrosalicylicacid.
2. Estimation of starch by Anthronemethod.
3. Estimation of protein by Lowrymethod
4. UV spectrophotometric analysis ofproteins.
5. Estimation of glycine by Ninhydrinmethod
6. Estimation of cholesterol by Zak's method
7. Estimation of DNA by diphenylaminemethod
8. Estimation of RNA by orcinolmethod
9. Determination of salivary amylaseactivity

Theory: 45 Hour Tutorial: 0 Hour Practical: 30 Hour Project: 0 hour Total : 75 Hour

REFERENCES:

1 Puri, D. (2014). *Textbook of Medical Biochemistry*. Elsevier Health Sciences

2 Voet, D., Voet, J.G. and Pratt, C.W.(2011).*Fundanentals of Biochemistry* 4th edition, New York: Wiley.

3 Sathyanarayana. U (2008)., *Biochemistry*, Kolkata, Books and Allied (P) Ltd.

4 Cox, M. M., & Nelson, D. L. (2008). Lehninger Principles of Biochemistry. WH Freeman.

5 Sadasivam.,S and Manickam A (2005). Biochemical Methods. 3rd Edition, New Age International (P) Limited Publishers.

6 Lubert Stryer (2003) *Biochemistry*, 5th Edition, New York,W.H Freeman & Co.

7 Murray, R.K., Granner, B.K., Mayes,P.A., Rodwell , V.W.(2003) *Harper's Biochemistry*, 29th edition, Prentice Hall International.

WEB REFERENCES:

1. http://nptel.ac.in/courses/102105034
2. http://web.expasy.org/pathways/

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		L	T	P	J	C
U17BTI3205	**MICROBIOLOGY**	**3**	**0**	**2**	**0**	**4**

Course objectives

- The course helps the student to understand the microbial world and their nutritional requirements for growth and metabolism
- Understand the controlling of microbes using physical and chemical methods
- Understand and evaluate the working principles, procedures of microbiology lab experiments

Course Outcomes

After successful completion of this course, the students should be able to

CO1 : Comprehend knowledge about the taxonomical classifications and fundamental perspective of microscopy

CO2 : Recognize the fundamental concepts in the structure and functioning of a cell

CO3 : Understand the basic concepts of nutritional requirements for microbial growth and pure culture isolation

CO4 : Demonstrate the microbial nutritional requirements for growth and metabolism

CO5: Understand the controlling of microbes using physical and chemical methods

CO6: Understand and evaluate the working principles, procedures of microbiology lab experiments

Pre-requisites : -

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		S		M	S	S	S	S		M	S	S
CO2	S				M		S		S	S		S	S	S
CO3	S	S	S	S		M	W		S	S		S	S	S
CO4	S	M	S	S		M	W		S	S		S	S	S
CO5	S	M	M	S		M	M		M	M		M	M	M
CO6	M			M		M	M		M	S		M	M	M

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

N. Hutchp

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FUNDAMENTALS OF MICROBIOLOGY AND MICROSCOPY **10 Hour**

Classification and nomenclature of microorganisms; light microscopy: compound, Phase Contrast, Fluorescence; Electron microscopy: Transmission and Scanning Electron Microscopy, Specimen preparations in brief; Principles of staining methods to differentiate microbes.

MICROBIAL STRUCTURE AND MULTIPLICATION **11 Hour**

Morphology, Structure and Functional anatomy of Prokaryotic and Eukaryotic Cells; Multiplication of bacteria, viruses, algae, protozoa and fungi; Actinomycetes and yeast; Mycoplasma; Bacteriophage. Bacterial Genetics: Transduction, Transformation & Conjugation

MICROBIAL NUTRITION, GROWTH AND METABOLISM **12 Hour**

Nutritional requirements and Microbiological media; chemical elements as nutrients; different media for culture; Maintenance of strain improvement. Definition of microbial growth; Cell division; Growth curve in batch culture or closed system; Different methods to quantify bacterial growth; Mathematics of growth: generation time and growth rate constant, factors affecting growth; Microbial metabolism: Entner–Doudoroff pathway, Aerobic and anaerobic respiration.

CONTROL OF MICROORGANISMS AND ANTIMICROBIALS **12 Hour**

Physical and chemical control of microorganisms; Sterilization: Heat sterilization (moist heat, autoclave, dry heat), radiation and filtration; Disinfection: phenol, alcohol and detergents; Chemotherapy and antibiotics: antibacterial, anti-fungal agents, anti-viral agents, common mode of actions to control microbes and resistance to antibiotics.

LIST OF EXPERIMENTS **15 Hour**

1. Handling of Microbiology laboratory equipment (SOP/ Biological Safety/ Microbial Air Monitoring Systems)
2. Preparation of microbial growth media
3. Culture Inoculation: Bacterial & fungal culture
4. Staining methods: Simple, Gram's, Negative, endospore; Lacto phenol cotton blue staining
5. Pure culture techniques: Serial dilutions, Pour plate, Spread plate and Streak plate.
6. Turbidimetry and Nephelometry (McFarland standards)
7. Enumeration of yeast cells: Direct and Indirect methods (Haemocytometer & Total viable counts).
8. Determination of growth Curve and Kinetics
9. Anaerobic Cultivation: Anaerobic jar methods & fluid thioglycollate medium)
10. Antibiotic sensitivity assay : Diffusion assay and K+ leakage (MIC & MBC)

Theory: 45 Tutorial : 0 Practical: 30 Project: 0 Total: 75 Hour

REFERENCES

1. Ray, B., Bhuniya, (2013). A. Fundamental Food Microbiology, 5th Ed., CRC Press, USA.
2. Talaro, K. P. (2011) Foundations in Microbiology. 8thEd. NY: McGraw Hill.
3. Michael J. Pelczar , E.C.S. Chan, (2010). Microbiology (An Application Based Approach) Tata McGraw Hill; 1st edition.

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4. Talaron K, Talaron A, Casita, Pelczar and Reid (2005), Foundations in Microbiology, W.C.Brown Publishers.
5. Waksman G, (2005), Structural Biology of Bacterial Pathogenesis, ASM press
6. Lim D (2001), "Microbiology", Second Edition, WCB-McGraw Hill..

U17INI3600 ENGINEERING CLINIC - I

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

Nil

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	S
CO2											S			
CO3										S			M	M

Course Assessment Methods:

Direct
1. Project Review 2. Workbook report 3. Demonstration & Viva voce

Content:

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The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

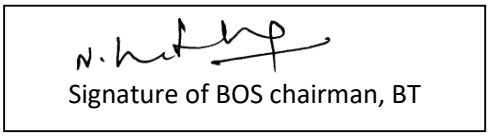
In this semester, students will focus primarily on IOT with C programming using aurdino

Course	Semester	Focus
Engineering Clinic I	1	IOT with C programming using Audino
Engineering Clinic II	2	Raspberry pi based controllers with Python programming
Engineering Clinic III	3	Design project combining concepts learnt in Engineering clinics I and II
Engineering Clinic IV	4	Reverse engineering project to improve performance of a product
Engineering Clinic V	5	Design and developing a prototype

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hour: 90



U17VEP3503 **FAMILY VALUES** (Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop skills in maintaining the harmony in the family.
CO 2: Create impulsive activities for healthy family
CO 3: Be receptive to troubled Individuals
CO 4: Gain healthy life by practicing Kundalini Yoga & Kayakalpa
CO 5: Possess Empathy among family members.
CO 6: Reason the life and its significance

Pre-requisites :

1. U17VEP1501 / Personal Values
2. U17VEP2502 / Interpersonal Values

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									S					
CO2							M							
CO3										M				
CO4												S		
CO5						S								
CO6														

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

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1. Family system: Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
2. Peace in Family : Family members and their responsibility - Roles of parents, children, grant parents -. Respectable women hood
3. Core value: Empathy: Unconditional love - Respect - Compassion - sacrifice–Care &share - helping – emotional support- hospitality – cleanliness
4. Blessing: Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.
5. Healthy Family: Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

Workshop mode

REFERENCES

1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf
2. FRAMEWORK FOR ACTION ON VALUES EDUCATION IN EARLY CHILDHOOD – UNESCO – PDF –www.unesdoc.unesco.org/images/0012/001287/128712e.pdf
3. TRUE FAMILY VALUES Third Edition - Tparents Home www.tparents.org/Library/Unification/Books/TFV3/_TFV3.pdf
4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf
5. PROBLEMS OF INDIA'S CHANGING FAMILY AND STATE ... - the United Nations - www.un.org/esa/socdev/family/docs/egm09/Singh.pdf

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SEMESTER IV

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L	T	P	J	C
3	1	0	0	4

U17MAT4105 BIOSTATISTICS

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Compute measures of central tendencies, dispersions and correlate the variables.

CO2: Analyze random or unpredictable experiments and investigate important features of random experiments.

CO3: Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

CO4: Analyze sample data and interpret the same for population.

CO5: Analyze the data when the sampling distribution is unknown.

CO6 Analyze the experimental designs for one way, two way and three way classified data.

Pre-requisite courses:

Frequency distribution, Sample and Population.

CO/PO /PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S											S	
CO2	S	S											S	
CO3	S	S			M								S	
CO4	S	S		S	M				M	S	M		S	
CO5	S	S		S					M	S	M		S	
CO6	S	S	S	S					M	S	M		S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

STATISTICAL MEASURES **9+3 Hour**

Measures of central tendency: Arithmetic Mean, Median and Mode – Measures of variation: Range, Mean deviation, Standard deviation and Coefficient of variation – Correlation (Discrete Data) – Karl Pearson's Correlation coefficient – Spearman's Rank Correlation – Regression lines (Discrete Data).

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PROBABILITY AND RANDOM VARIABLE **9+3 Hour**

Axioms of probability - Conditional probability – Total probability – Baye's theorem - Random variable – Distribution function – properties – Probability mass function – Probability density function – moments and moment generating function – properties.

STANDARD DISTRIBUTIONS **9+3 Hour**

Binomial, Poisson and Normal distributions – Moments, Moment Generating functions and properties for the above distributions - Fitting of Binomial and Poisson distributions.

TESTING OF HYPOTHESIS **9+3 Hour**

Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) – Small samples tests based on t and F distributions (single mean, difference of means, paired *t*- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit.

3+1 Hour

NONPARAMETRIC TESTS

Mann Whitney U test, Kruskal Wallis Test and Run test.

DESIGN OF EXPERIMENTS **6+2 Hour**

Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – Factorial Design – 2^2 design.

Theory: 45 hour **Tutorial: 15 hour** **Practical: 0 hour** **Project: 0 hour** **Total Hour: 60**

REFERENCES

1. Gupta S. P (2014), Statistical Methods, Sultan Chand & Sons Publishers.
2. Veer Bala Rastogi (2009), Fundamentals of Biostatistics, Ane books Pvt. Ltd, Second edition
3. Veerarajan T., (2008). Probability, Statistics And Random Processes, Tata McGraw Hill, 3rd edition
4. Gupta.S.C and Kapoor.V.K (2007), Fundamentals of Mathematical Statistics, 11th extensively revised edition, Sultan Chand & Sons.
5. Wayne W. Daniel (2007), Biostatistics- A Foundation for Analysis in the Health Sciences, Wiley India, Seventh edition
6. Shein-Chung Chow (2002), Jun Shao Statistics in drug research methodologies and recent developments, Marcel Dekker, Inc.,

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U17BTT4001	FLUID AND PARTICLE MECHANICS IN BIOPROCESS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To familiarize the principles and concepts of fluid flow and particle properties for application in bioprocess.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Conceptualize fluids properties and its behaviour under static conditions.
CO2 Identify and analyse the significance of pressure drops and boundary layers concepts.
CO3: Elucidate the flow measurements and transportation of fluids.
CO4: Apply the principles of size reduction and equipments.
CO5: Solve importance of mixing and agitation and scale up
CO6: Elaborate the principles of filtration, centrifugal and sedimentation.

Pre-requisite Course:

1. U17BTT3003 Bioprocess Calculations

CO/PO /PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M			S		S			S
CO2	S	S		M	S					M		M		M
CO3	S	M	S							S				
CO4				S	S	M			M		M			M
CO5	S	M		M										S
CO6	M					M			S		S		M	M

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

PROPERTIES OF FLUIDS **9 hour**

Newtonian and non-Newtonian fluids: Nature of fluids, Newton's law, Shear dependent, Time dependent fluids. Classification of fluid flow: Laminar, Transient, Turbulent. Fluid statics: Pressure variation in a static fluid. Manometry: Types of manometers, Pressure drop calculation. Dimensional analysis: Rayleigh method and the Pi-theorem.

FLUID DYNAMICS **9 hour**

Flow through pipes: Straight pipe, Annular, Conduits. Pressure drop under laminar and turbulent flow conditions: Continuity equation, Euler's equation, Bernoulli equation, Hagen-Poiseuille equation, Darcy-Weisbach equation. Flow past body: Boundary layer concepts, Flow over a sphere. Flow through fixed and Fluidized beds - Ergun equation.

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FLOWMETERY AND TRANSPORTATION **9 hour**

Constant and variable head meters: Venturi, Orifice, Rotameter. Mass Flow meter: Coriolis meter. Anemometer. Valves: Types, characteristics and sizing of valves. Pumps: Centrifugal pump, Piston pump, Gear pump, Screw pump, performance characteristics and sizing of pumps. Compressors and fans

COMMUTATION AND EQUIPMENTS **9 hour**

Concepts of shape factor, surface area and particle size. Particle fracture mechanisms, Laws of comminution. Screening: Mechanism, Screen analysis, Screen effectiveness, Ideal and actual screening, Screening equipments. Size enlargement: Granulation. Laws of size reduction, Size reduction equipment - crushers, grinders, disintegrators.

PARTICLE DYNAMICS **9 hour**

Agitation: Purpose, Flow patterns, Standard design, Dimensional analysis for power correlation, Flow number, Agitator scale-up, Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed, Agitation equipments. Filtration: Introduction, Filter media and filter aids, Basic theory of filtration, Filtration equipments. Sedimentation (Thickening and Clarification): Sedimentation test, Sedimentation theory, Thickeners and clarifiers.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1. Gavhane, K.A., (2016). "Unit Operations-I [Fluid Flow and Mechanical Operations]", 7th Edition, Nirali Prakashan.
2. Frank M. White (2015). "Fluid mechanics", McGraw-Hill Education
3. R.K.Bansal (2009), "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi publications (P) Ltd., New Delhi.
4. Warren Lee McCabe, (2005). "Unit Operations of Chemical Engineering", New York: McGraw-Hill.
5. Badger W.L. and Banchero J.T. (1997) "Introduction to Chemical Engineering", Tata McGraw Hill.

Web references

1. https://nptel.ac.in/courses/103104043/
2. https://nptel.ac.in/courses/103107127/

U17BTI4202	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To discuss the basic concepts and applications of fundamental statistical, and extraction methods
- To apply and interpret the data originated from spectroscopy, chromatography and electrophoretic methods
- To know the concept of centrifugal technique, and apply mass spectrometry, x-ray diffraction and NMR techniques

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Understand and apply the statistical principles to solve biological issues, and apply appropriate extraction methodologies to process biological samples

CO2 Compare, apply and interpret the data of biological solutions acquired from different spectroscopy techniques

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CO3: Describe, apply and evaluate the data originated by chromatographic techniques to solve biological problems

CO4: Explain, apply and evaluate the data obtained from different electrophoretic techniques

CO5: Describe and apply mass spectrometry, x-ray diffraction and NMR techniques in the broad field of biotechnology

CO6: Discuss the fundamentals of centrifugation techniques

Pre-requisite Course: U17CHT2004 Chemistry for Biotechnology

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M	W	S	M			S	S		S	S	S
CO2	S	S	S	S	S				S	S		S	S	S
CO3	S	S	S	S	M				S	S		S	S	S
CO4	S	S	S	W	M							S	S	S
CO5	S	S	M	S						M		M	S	S
CO6	S	M		W									M	M

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

BASICS OF MEASUREMENT AND EXTRACTION METHODS **9 Hour**

Classification of instrumental methods; Fundamentals of accuracy, precision and limits of detection (LOD) and limits of quantification (LOQ); Quality control/ assurance – definition, standard operating procedure, calibration, validation; Introduction and significance of signal to noise ratio (S/N); Solvent extraction – introduction and principle; Factors affecting extraction process; Principle and applications – Temperature assisted and supercritical fluids based extraction.

SPECTROSCOPY **9 Hour**

Principle, instrumentation and applications - UV-Vis, IR and atomic absorption spectroscopy; Principle, instrumentation and applications - Fluorometry, nephelometry and circular dichroism (CD); Principle and applications of laser light scattering (LLS) technique

CHROMATOGRAPHY AND ELECTROANALYTICAL METHODS **9 Hour**

Factors affecting the resolution of chromatography; Rate and plate theory; Significance of VanDeemter equation; Principle, technique and applications - Thin layer chromatography, Supercritical fluid chromatography, Gel permeation chromatography, ion exchange chromatography, High Performance Chromatography (HPLC), High Performance thin layer Chromatography (HPTLC), Ultraperformance liquid chromatography (UPLC) and Gas chromatography (GC); pH electrodes – principle, instrumentation and applications.

ELECTROPHORESIS **9Hour**

Electrophoresis – introduction & trouble shooting parameters; Paper, agarose gel, polyacrylamide gel (PAGE), SDS-PAGE, denaturing gradient gel electrophoresis (DGGE) or temperature gradient gel electrophoresis (TGGE), capillary electrophoresis, isoelectric focusing – principle, instrumentation and applications.

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Case study – PAGE and SDS PAGE

CENTRIFUGATION AND STRUCTURAL ELUCIDATION METHODS **9 Hour**

Basic principle of sedimentation; Preparative centrifugation – principle and classification; Analytical centrifugation – instrumentation; Mass spectrometry – principle, instrumentation (electron spray ionization [ESI] & chemical ionization [CI]) and applications; x-ray diffraction and nuclear magnetic resonance (NMR) – principle, instrumentation and applications.

Theory: 45 hour **Tutorial: 0 hour** **Practical: 30 hour** **Project: 0 hour** **Total Hour: 75**

LIST OF EXPERIMENTS

1. Temperature assisted extraction of analytes from a sample and estimation of a targeted analyte (spectroscopy method) by construction of calibration curve (standard operating procedure (SOP), simple regression method, Karl Pearson correlation and coefficient of variation (CV))
2. Calculation of ED_{50} or IC_{50} of a bioanalyte (Spectroscopy method)
3. Prediction of functional group of a standard bioanalyte using IR spectroscopy and interpretation with unknown sample
4. Analysis of an analyte using flourimetry method (simple regression method, Karl Pearson correlation and coefficient of variation (CV))
5. Preparation of buffers and determination of pH of an unknown solution
6. Interpretation of R_f value using TLC analysis
7. Interpretation of HPLC and GC peaks (DEMO: model Chromatogram peaks), and structural analysis of bioanalyte fingerprints using MS spectral analysis (DEMO using graphs)

References:

1. Skoog, D., Holler, F., & Crouch, S. (2014). Principles of Instrumental analysis (6th ed.). USA: Brooks Cole Publishing Company.
2. Sharma, B. (2014). Instrumental methods of chemical analysis (analytical chemistry)(24th ed.). India: GOEL Publishing House.
3. Gurdeep R. Chatwal and Sham K. Anand, G. (2012). Instrumental Methods of Chemical Analysis (5th ed.). India: Himalaya Publishing House.
4. Patil, V.P., Tathe, R. D., Devdhe, S. J., Angadi, S.S and Kale, S. H. (2011). Ultraperfromance liquid chromatography: A review, International Research Journal of Pharmacy, 2 (6): 39-44
5. Avis, K., Wagner, CM., (2009). Biotechnology Quality Assurance and Validation: Drug Manufacturing Technology (Vol:4). CRC press.
6. Wilson, K., & Walker, J. (2006). Principles and techniques of biochemistry and molecular biology (7th ed.). Cambridge: Cambridge University Press.

Web links:

1. http://nptel.ac.in/courses.php
2. http://nptel.ac.in/downloads/102103044/
3. http://nptel.ac.in/courses.php?disciplineId=102

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U17BTI4203	CELL AND MOLECULAR BIOLOGY	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To gain conceptual understanding on central dogma of biology.
- To acquire in-depth knowledge on prokaryotic and eukaryotic genome organization and evaluate the feasibility of gene expression and molecular biology tools.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Critically evaluate and comprehend the fundamental concepts of cell and cell membrane structure and functions.

CO2 Imbibe the concept of membrane transport and signal transduction in cells.

CO3: Critique the concepts of genome organization and replication of prokaryotes and eukaryotes.

CO4: Comprehend the process involved in transcription and translation and interpret the consequences of mutation.

CO5: Apply the concept of gene activity regulation and DNA repair mechanisms in prokaryotes.

CO6: Gain hands-on experience in cell and molecular biology experiments.

Pre-requisite Course:

1. U17BTI3204 Concepts in Biochemistry

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S									S		S		
CO2	S											S		
CO3	S				S	M			S	S		S		
CO4	S	M	S	S		S			S	S		S	S	
CO5	S	M	S									S	S	
CO6	S			M	S				S	S		S	M	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CELL STRUCTURE AND FUNCTIONS **8 hour**

Introduction to prokaryotic and eukaryotic cells ; Intracellular organelles of eukaryotic cells – Structure and functions (Nucleus, Mitochondria and Golgi apparatus); Plasma membrane – structure. Composition of Biomolecules, properties (fluidity and asymmetry) and functions. Cell cycle and Cell Division. Regulation of cell cycle.

Case study - Cancer cell cycle.

MEMBRANE TRANSPORT AND CELL SIGNALING **7 hour**

Membrane transport – passive and active transport, roles of channel proteins, carrier proteins and pumps in membrane transport, bulk transport. Cell signaling - autocrine, endocrine and paracrine models of cell

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signaling; signal transduction cascade – role of signaling molecules, receptors, second messengers and protein kinases.

Case study: Quorum sensing and cell-cell communication in bacteria.

NUCLEIC ACIDS AND DNA REPLICATION **8 hour**

Griffith; Hershey and Chase; Avery McLeod & McCarty experiments. ;Cot value; C-value paradox; satellite DNA; Complexity of genes - Pseudogenes, jumping genes, split genes. Prokaryotic replication: Unidirectional and bidirectional replication; Replication in eukaryotic chromosomes; Replication of telomeres in eukaryotes. Inhibitors of replication.

TRANSCRIPTION **8 hour**

Features of promoters and enhancers; Transcription factors; Classes of RNA molecules; Transcription in prokaryotes – initiation, elongation, termination. Transcription in eukaryotes. Post-transcriptional processing – RNA splicing – trans-splicing of mRNA, processing of tRNA and rRNA, capping, polyadenylation. An outline of snRNA

TRANSLATION AND MUTATION **9 hour**

Elucidation of genetic code, Wobble hypothesis, Redundancy, Codon-Anticodon interaction; Polycistronic mRNA. Protein synthesis in prokaryotes and eukaryotes (Initiation, elongation, termination).Inhibitors of translation, Post translational modifications. Introduction to Mutations – Physical, Chemical and Biological mutagens; Reversion.

REGULATION OF GENE ACTIVITY AND REPAIR MECHANISMS **9 hour**

Principles of Regulation. Constitutively expressed genes and Inducible genes. Transcriptional Regulation (*Lac* Operon, Tryptophan Operon) Attenuation; Autoregulation; Constitutively Expressed Genes.DNA Repair Mechanisms: Photo reactivation; Direct Reversal; Excision Repair; The SOS Response. **Case study:** DNA integrity scanning proteins in bacteria.

List of Experiments

30 hour

1. Dose dependant mutation studies using UV irradiation.
2. Chemical carcinogenicity test: Ethidium Bromide intercalation.
3. Analysis of the size of DNA fragments using agarose gel electrophoresis.
4. Isolation of genomic DNA from plant and analyse using agarose gel electrophoresis.
5. Isolation of total RNA from bacteria and analyse of the size of RNA using agarose gel electrophoresis.
6. Chromosome staining and Karyotyping.
7. Analysis of Single and Double stranded DNA using hydroxyapatite column.
8. Visualization of sub-cellular organelles (mitochondria or cell membrane) using fluorescent dyes.
9. Subcellular fractionation by differential centrifugation and assessment of purity.

Theory: 45 hour Tutorial: 0 hour Practical: 30 hour Project: 0 hour Total Hour: 75

References:

1. Harvey Lodish, Arnold Berk, S.L Zipursky, Paul Matsudaira, David Baltimore and James Danell (2016). *Molecular Cell Biology*, 4thEdition, New York: W.H Freeman and company.
2. Malacinski, G.M (2015*). Freifelder's Essentials of Molecular Biology*, 4th edition, Nasora Publishing House, New delhi.
3. Waston, B.B. & Gann, L.L (2014) "*Watson Molecular Biology of the Gene*", 7th Edition, Pearson Education.

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4. Benjamin L. (2013). *Genes IX*, 9th Edition, Jones & Bartlett Publishers Inc.
5. Weaver, R.F. (2011), "*Molecular Biology*", 3rd Edition, McGraw Hill.
6. Rastogi, S.C. (2010) *Cell and Molecular Biology*, 2nd Edition, New Delhi: New Age International Publishers.
7. Bruce A., Dennis B., Karen H., Alexander J., Julian L., Martin R., Keith R., Peter W. (2006). *Essential Cell Biology*, 2nd edition, Garland Science (Taylor and Francis Group).

Web References:

1. http://leadingstrand.cshl.edu/Course/Keynote/2013/A-MEMBRANE/93
2. http://leadingstrand.cshl.edu/Course/Keynote/2012/A-SYSTEM/83

U17INI4600 ENGINEERING CLINIC - II

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

U17INI3600 ENGINEERING CLINICS I

CO/PO Mapping

(S/M/W indicates strength of correlation)

S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	S
CO2											S			
CO3										S			M	M

Course Assessment Methods

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Direct
1. Project Review 2. Workbook report 3. Demonstration & Viva voce

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on Raspberry pi based controllers with python programming

Course	Semester	Focus
Engineering Clinic I	1	IOT with C programming using Audino
Engineering Clinic II	2	Raspberry pi based controllers with Python programming
Engineering Clinic III	3	Design project combining concepts learnt in Engineering clinics I and II
Engineering Clinic IV	4	Reverse engineering project to improve performance of a product
Engineering Clinic V	5	Design and developing a prototype

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hour: 90

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U17VEP4504 PROFESSIONAL VALUES

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop the ethical values in both professional and personal life
CO 2: Develop ability to take decision to reinforce professional life
CO 3: Rational in professional skills required for diverse society
CO 4: Excel in ingenious attitude to congregate professional life
CO 5: Research into the professional stand
CO 6: Spruce an Individual with decorum to achieve professional life

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								S						
CO2				M										
CO3			S											
CO4												S		
CO5								M						
CO6										M				

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1.Professional skills With Values: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence

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2.Building Innovative work cultures: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making

3.Professional Work Ethics: Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility

4.Engineering Ethics: Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures

5.Case studies in engineering ethics: Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

Workshop mode

REFERENCES

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
   www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS
   www.garda.ie/Documents/User/declarationvalues.pdf

3. KARMA YOGA - SWAMI VIVEKANANDA
   www.vivekananda.net/PDFBooks/KarmaYoga.pdf

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering
   www.sasurieengg.com/.../GE2025%20Professional%20Ethics%20in%20Engineering.

5. ENGINEERING ETHICS CASE STUDY; Challenger
   www.ucc.ie/en/processeng/staff/academic/ebyrne/.../PE1006PptNotesLect7.pdf

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U17CHT4000 **Environmental Science and Engineering**
(Common to All branches)

L	T	P	C
3	0	0	0

Course Outcomes

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.
CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.
CO 3: Highlight the importance of ecosystem and biodiversity.
CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.
CO 5: Paraphrase the importance of conservation of resources.
CO 6: Play an important role in transferring a healthy environment for future generations.

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M					S		M				S	
CO2						M				M			S	
CO3							M						M	
CO4						M	S						S	
CO5							S						S	
CO6			W				S						M	M

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **14 Hour**

Definition, scope and importance – 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 overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

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, case studies.

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.

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Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY **9 Hour**

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – 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).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – 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.

ENVIRONMENTAL POLLUTION **8 Hour**

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hour**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

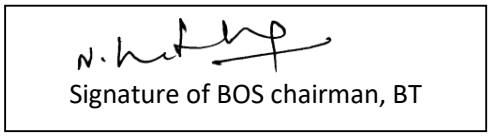
HUMAN POPULATION AND THE ENVIRONMENT **7 Hour**

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Hour	Tutorial: 0 hour	Practical: 0 hour	Project: 0 hour	Total: 45 Hour

REFERENCES

1. Masters, G. M., & Ela, W. P. (2013). Introduction to environmental engineering and science (Vol. 3). Englewood Cliffs, NJ: Prentice Hall.
2. Miller, G. T., & Spoolman, S. (2012). Environmental science. Cengage Learning.
3. Colin R. Townsend(2008). Michael Begon and John L. Harper, 'Essentials of Ecology', Third Edition, Blackwell Publishing.
4. Trivedi R.K and P.K.Goel (2003), 'Introduction to Air Pollution', Techno-Science Publications.
5. Bharucha, E. (2002). *The Biodiversity of India* (Vol. 1). Mapin Publishing Pvt Ltd.



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6. Cunningham, W.P.Cooper and T.H.Gorhani, (2001)., 'Environmental Encyclopedia', Jaico Publication House, Mumbai.
7. Wager K.D.,(1998). 'Environmental Management', W.B. Saunders Co., Philadelphia, USA.
8. Trivedi R.K., (1996)., 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.

U17INT4000 **CONSTITUTION OF INDIA (Mandatory course)**

L	T	P	J	C
2	0	0	0	0

Course Outcomes:

After successful completion of this course, the students will be able to:

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites : NIL

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M			W			S		
CO2						S		S				M		
CO3									M	S		W		
CO4								W	M			M		
CO5						M		M				S		
CO6														

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment

THEORY COMPONENT:

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Module.1: Introduction to Indian Constitution **4 hour**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module.2: Fundamental Rights **8 hour**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

Module.3: Federal Structure **8 hour**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4: Amendment to Constitution **6 hour**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5: Emergency Provisions **4 hour**

National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India

Total **30 hour**

Theory: 30	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 30 hour**

REFERENCES

1. Constitution of India - Ministry of Law & Justice – PDF format awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by Durgadas Basu
3. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html
4. Parliament of India – PDF format *download.nos.org/srsec317newE/317EL11.pdf*
5. The Role of the President of India – By Prof.Balkrishna
6. Local Government in India – E Book - Pradeep Sachdeva https://books.google.com/books/.../Local_Government_in_In...

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SEMESTER V

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U17BTI5201 **GENETIC ENGINEERING AND GENOMICS** **L T P J C**
3 0 2 0 4

Course Objectives:

- To apply types of host-vector systems and steps in creating a recombinant DNA molecule
- To gain knowledge on various recombinant DNA techniques and their applications.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Comprehend and choose cloning steps for recombinant DNA construction

CO2 Analyse the features of various types of gene cloning vectors and design a suitable vector for recombinant protein expression

CO3: Interpret various types of gene isolation and screening methods

CO4: Apply suitable modern molecular techniques to solve real life problems

CO5: Evaluate regulatory issues of GMOs and their environmental and societal impact

CO6: Analyse and interpret various genome analysis methods

Pre-requisite Course:

U17BTI4203 Cell and Molecular Biology

CO/PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO 12	PSO1	PSO 2
CO1	S								S				M	S
CO2	S		S						S				M	S
CO3	S			S					S				S	S
CO4	S				S	S			S			S	S	S
CO5	S	M							S			S	M	S
CO6	S		S	S					S				M	S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

BASICS OF RECOMBINANT DNA TECHNOLOGY **15 hour**

DNA manipulating enzymes, construction of recombinant DNA molecules, transformation of r-DNA molecules into target host organisms: Calcium chloride mediated, electroporation, microinjection, gene gun, selection methods for recombinants: antibiotic resistance, reporter assays: blue and white selection, GFP and Luciferase, Cloning vector; properties of a cloning vector: origin of replication, polylinker region, selectable

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marker genes; Plasmid Vectors: Lambda phage vectors, phagemid, cosmid, yeast vectors , Baculoviral based vector, mammalian expression vectors, plant transformation vector; binary vector,
Case study: TOPO vector- Vector Map

GENE CLONING AND APPLICATIONS **15 hour**

Construction and screening of genomic and cDNA libraries, over-expression and purification of recombinant His tag fusion proteins using Ni+ column. Blotting techniques, Polymerase Chain Reaction (PCR); DNA fingerprinting, gene silencing: RNAi and gene knock-out; site directed mutagenesis, genome editing: CRISPR-Cas9 technology, TALEN tool, Modern molecular diagnostic tools; Q –PCR, Spectral karyotype Imaging, MPLA, Application of genetically modified organisms: medicine, agriculture, Biosafety guidelines and release procedure for GMOs in India
Case study: BT cotton -Safety issues

GENOME MAPPING AND SEQUENCING **15 hour**

History and mile stones of human genome project, Genome organization: prokaryote, eukaryote; complexity of genomes; genome mapping: FISH, STS content mapping, Advanced DNA sequencing methods: pyrosequencing, nanopore sequencing, genome sequencing methods: top down approach, bottom- up approach; genome sequence assembly; comparative study on the genome sequencing methods, Differential gene expression analysis; DDRT- PCR, subtractive hybridization, representational display analysis, Serial Analysis of Gene Expression, Microarray: fabrication of cDNA based array, DNA chip; application microarray in gene expression analysis.
Case study: Analysis and interpretation of microarray data

List of Experiments **30 Hour**

1. PCR amplification of DNA fragment using gene specific primers
2. Elution of DNA from agarose gel using silica column and calculation of Insert-vector ratio and Ligation of a PCR product in plasmid vector
3. Preparation and Transformation of competent cells (*E.coli* by heat-Shock/electroporation method)
4. Selection of recombinant clones using blue & white selection.
5. Confirmation of presence of insert in the recombinant clones by colony PCR.
6. Optimization of inducer concentration for recombinant protein expression.
7. Confirmation of recombinant protein using Western blotting.
8. DNA fingerprinting by RAPD analysis.
9. Molecular diagnosis of pathogens in water sample.
10. Metagenomic analysis of soil microbes.

Theory:45 hour Tutorial: 0 hour Practical: 30 Hour Project: 0 hour Total Hour: 75

References:

1. Brown T.A., (2017), Genomes 4, Bios Scientific Publishers Ltd, Oxford, 3rd edition.
2. Glick B.R.,and Pasternick J.J., (2017), Molecular Biotechnology: Principles and Applications of Recombinant DNA, 5th Edition, ASM press, Eashington.
3. Sathyanarayana U (2008) Biotechnology, Books & Allied (p) ltd.-Kolkata
4. Primrose S.B., Twyman RM., (2006), Principles of Gene Manipulation and Genomics , 7th Edition, Blackwell Science

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5. Sambrook (Joseph) and Russell(David W), (2001), Molecular Cloning :A manual, Cold Spring Harbour Laboratory Press.

Web References

1. http://nptel.ac.in/courses/102103013/
2. http://www.lsic.ucla.edu/ls3/tutorials/gene_cloning.html
3. https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/

U17BTI5202	PROTEIN AND ENZYME TECHNOLOGY	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To learn the various topologies of proteins structures
- To understand the relationship between protein structure and function
- To apply the knowledge on enzymes for their applications

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Analyze and demonstrate the secondary, super-secondary, tertiary and quaternary structures of proteins and structure-function relationship

CO2: Apply the knowledge on protein structures in protein engineering and protein prediction

CO3 Compare the enzyme properties and kinetics

CO4: Evaluate the immobilization of enzymes and its effectiveness

CO5: Apply the knowledge on design of enzyme based biosensors and their applications

CO6: Conduct experiments and interpret results on protein structure / enzyme isolation immobilization and their applications

Prerequisites: U17BTI 3204 Concepts in Biochemistry

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO 1	PS O2
CO1	S			S	S					M		S	S	
CO2	S	M	M	S	W					M		S	S	
CO3	M	S	W	S	W					M		M	S	
CO4	M		S	S	S				S	M		M	S	
CO5	S	S		M	M					M		S	S	S
CO6	S		S	S					S				S	S

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Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

SUPER SECONDARY, TERTIARY AND QUATERNARY STRUCTURES **9 hour**

Primary structure: Insulin; Secondary structures: Alpha (keratin), beta (silk fibroin), loop structures, structure of collagen; Super secondary structures: Helix-turn-helix, hairpin β motif; Ramachandran plot. α-Domain: Four helix bundle; β-domain: Greek key; α / β domains: TIM barrel, Horseshoe fold; Protein folding by chaperones. Quaternary structure: Modular nature, formation of complexes.

PROTEIN STRUCTURE-FUNCTION RELATIONSHIP AND PROTEIN ENGINEERING **9 hour**

DNA-binding proteins: helix-turn-helix motif of TRP- repressor & CRO protein in DNA binding; Eukaryotic transcription factors: TATA box-binding proteins, TFIIA and TFIIB and Zn-fingers; Membrane Proteins: Photosynthetic reaction center and Bacteriorhodopsin. de novo protein design

Case study: Site directed mutagenesis to increase the thermal stability of T4-lysozyme

ENZYMES AND KINETICS **9 hour**

Nomenclature and Classification of enzymes; concept of active site, substrate binding site, allosteric site, and allosteric regulation of enzymes; specificity of enzyme; Kinetics of single substrate reactions: Michaelis & Menten equation, LB Equation; Bisubstrate reactions: single displacement Types of enzyme inhibition – Competitive, non-competitive and un-competitive.

ENZYME PURIFICATION AND IMMOBILIZATION **9 hour**

Extraction and purification of enzyme from plant, animal and microbial sources; Methods of characterization of enzymes; Development of enzymatic assays; Physical and chemical techniques for enzyme immobilization: adsorption, matrix entrapment, encapsulation, cross-linking and covalent binding. Kinetics of immobilized enzymes.

Case study - Extraction and purification of bromelain enzyme

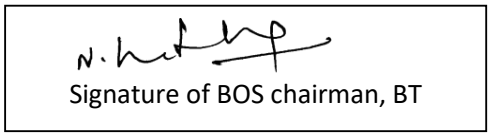
ENZYME APPLICATIONS **9 hour**

Design of enzyme electrodes and their applications as biosensors in industries and health care. Application of enzymes in industries: Food, detergent, leather, wool, brewery, and environment;

Case study - Development of enzyme-based biosensors for environmental applications.

List of Experiments **30 hour**

1. Exploring the Protein Data bases for protein structures
2. Conducting DNA mobility shift assay to understand DNA-protein interaction
3. Perform and interpret the results of an enzyme assay: α-Galactosidase / Amylase / Cellulase / laccase
4. Analyzing Enzyme kinetics: Michaelis-Menten parameters
5. Conduct enzyme inhibition studies and interpret the results: Sugars, metal ions and reagents



6. Prepare immobilized enzymes and evaluating their effectiveness : Agar-agar / sodium alginate / chitin
7. Extraction of papain enzyme from papaya leaf and fruit
8. Removal of blood stain from the cloth by papain / removal of starch stain by amylase
9. Partial purification of enzymes: Ultrafiltration / solvent & salt precipitation

Theory: 45 hour Tutorial: 0 hour Practical: 30 hour Project: 0 hour Total Hour: 75

REFERENCES

1. Shanmugham.S and Sathishkumar.T, (2012); Enzyme Technology, 2nd edition, I.K. International Publishing House Pvt. Ltd., New Delhi, India.
2. Voet D and Voet G. (2010), Biochemistry,4th edition, John Wiley & Sons
3. Nicholas Price and Lewis Stevens, (2009); Fundamentals of Enzymology, 3rd Edition, Oxford University Press, India.
4. Trevor Palmer, Enzymes (2007); Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, Horwood Publishing Limited, United Kingdom
5. Branden C and Tooze J. (1999), Introduction to protein structure. 2nd Edition, Garland Science.
6. Fersht, Alan. (1999), Structure and mechanism in protein science: A Guide to Enzyme Catalysis and Protein Folding.3rd revised edition, W.H.Freeman & Co Ltd.
7. Moody, Peter CE, Anthony J. Wilkinson, and Tony Wilkinson. (1990), Protein engineering. 2nd Edition, Oxford University Press, USA.

Web references

http://www.novozymes.com(/en/about-us/our-business/what-are enzymes/Pages/default.aspx

2 https://nptel.ac.in/courses/104105076/7

		L	T	P	J	C
U17BTI5203	**HEAT AND MASS TRANSPORT IN BIOPROCESS**	**3**	**0**	**2**	**0**	**4**

Course Objectives:

- To comprehend and apply the principles and operations of heat transfer
- To understand the fundamentals and applications of mass transfer in bioprocess engineering.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Outline the modes of heat of transfer
CO2 Design the heat transfer equipment in bioprocess industries
CO3: Illustrate the principles of diffusion and apply the concepts of interphase mass transfer in bioreactor
CO4: Apply the concept of distillation and drying in bioprocess
CO5: Comprehend the extraction separation in bioprocess
CO6: Interpret the membrane separation in bioprocess

Prerequisite

1. U17BTT3003 Bioprocess Calculations

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CO/PO/PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO 1	PS O2
CO1	M								M	M				S
CO2	S	S	M	M	S				S	S				S
CO3	S	M							S	S				S
CO4				M	S				S	S				S
CO5	S	M		M	S				S	S				S
CO6	S	S	M	S	S				S	S				S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

FUNDAMENTALS OF HEAT TRANSFER **9 hour**

Modes of heat transfer; Conduction: Fourier's law, Thermal conductivity of biological materials, Conduction through plane wall, hollow cylinder and hollow sphere; Convection: Individual and overall heat transfer coefficients, Dimensional analysis for free and forced convection.

HEAT TRANSFER EQUIPMENTS **9 hour**

Heat Exchangers: Basic calculations, Heat exchanger types, Design heat exchanger for Food and Bioprocess; LMTD and NTU concepts: Industrial evaporators - types, Methods of operation, Single effect evaporator and its enthalpy calculations.

DIFFUSION AND INTERPHASE MASS TRANSFER **9 hour**

Modes of mass transfer; Diffusion: Fick's first law, Molecular diffusion in gases, liquids and solids; Interphase mass transfer: Individual and overall mass transfer coefficients, Theories of mass transfer; Mass transfer in bioreactors: Factors affecting oxygen transfer rate.

DISTILLATION AND DRYING **9 hour**

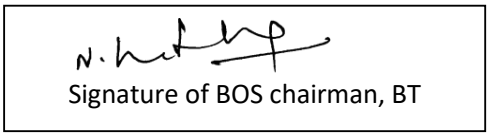
Distillation: Overview of vapour-liquid equilibria, Flash, differential, continuous, steam, azeotropic and extractive distillation, Determination of number of stages by McCabe-Thiele method; Drying– theory; classification of dryers; batch drying – Mechanism and time of cross through circulation drying.

EXTRACTION AND MEMBRANE SEPARATION **9 hour**

Extraction and leaching: Ternary liquid-liquid equilibria, choice of solvents, Single and multistage extraction, Co-current and cross - current extraction. Extraction and leaching equipments, Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

LIST OF EXPERIMENTS **30 hour**

1. Heat transfer calculation in double pipe exchanger
2. Heat transfer calculation in shell and tube heat exchanger
3. Studies on simple distillation



4. Studies on steam distillation
5. Convective drying of food/biological materials
6. Mass transfer studies on rotating disc contactor
7. Liquid membrane separation of bioactive compounds

Theory: 45 hour **Tutorial: 0 hour** **Practical: 30 hour** **Project: 0 hour** **Total Hour: 75 hour**

REFERENCES

1. Treybal, R.E., (2017) *Mass-transfer operations*. McGraw-Hill.
2. Doran, P. M. (2012). *Bioprocess engineering principles*. Elsevier.
3. Rajput, R.K. (2008) Heat and Mass Transfer, S. Chand and Co.
4. Shuler, M. L., & Kargi, F. (2002). Bioprocess Engineering: Basic Concepts. 2nd edition. *Upper Saddle*.

WEB REFERENCES

1. http://nptel.ac.in/courses/103103032
2. http://nptel.ac.in/courses/103103035

U17INI5600 ENGINEERING CLINIC - III

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

U17INI4600 ENGINEERING CLINICS II

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CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

Course Assessment Methods

Direct
1. Project Review 2. Workbook report 3. Demonstration & Viva voce

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II

Course	Semester	Focus
Engineering Clinic I	1	IOT with C programming using Audino
Engineering Clinic II	2	Raspberry pi based controllers with Python programming
Engineering Clinic III	3	Design project combining concepts learnt in Engineering clinics I and II
Engineering Clinic IV	4	Reverse engineering project to improve performance of a product
Engineering Clinic V	5	Design and developing a prototype

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hour: 90

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SOCIAL VALUES

U17VEP5505

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the transformation from self to society
CO 2: Acquire knowledge about disparity among Human Beings
CO 3: Realize the new ethics in creating a more sustainable Society
CO 4: Develop skills to manage challenges in social issues
CO 5: Acquire the skills for Management of Social work & Holistic Society
CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S								
CO2							S							
CO3								M						
CO4												S		
CO5													S	
CO6									M					

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

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Values through Practical activities:

1. Self and Society: Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society
2. Social Values: Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace-nonviolence - right conduct- Unity – forgive – dedication – Honest
3. Social issues : Disparity among Human beings- Poverty-Sanitation -corruption- un employment-superstition – religious intolerance & castes – terrorism.
4. Emerging Ethics for Sustainable Society: Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society
5. Social Welfare: Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

Workshop mode

REFERENCES

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF
   discuss.forumias.com/uploads/File upload/.../711b18f321d406be9c79980b179932.pd...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...
   www.un.org/en/events/culturaldiversityday/pdf/Investing_in_cultural_diversity.pdf

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut
   www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E- class
   www.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU
   www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf

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SEMESTER VI

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U17BTT6001	BIOPHARMACEUTICAL TECHNOLOGY	L	T	P	J	C
		3	0	0	0	3

Course Objective

- To understand the importance of regulatory affairs in drug control, standards and drug manufacture process.

Course Outcomes

After successful completion of this course, the students should be able to

CO1 : Outline National, International drug Standards, Control and pharmacopoeia commission

CO2 : Describe the principles of drug action and mechanism of action

CO3:Discuss and obtain knowledge on the drug development, manufacture process and Regulatory practices

CO4 : Understand the importance of biopharmaceutical final products production using upstream downstream process and ensure the quality of the product analysis

CO5 : Explain the principles and materials involved during the drug manufacture in pharmaceutical industries

CO6 : Discuss the clinical uses of biopharmaceutical therapeutics

Pre-requisites : -

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M		M						M		S	
CO2	M		M								M	S	S	
CO3	M		S		M							S	S	
CO4			M								M	M	S	
CO5	M			S									S	
CO6	M	S		S									S	

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

DRUG CONTROL AND STANDARDS **8 Hour**

Drug standards, regulation and control organizations: National agencies (Central Drug Standards and Control Organization (CDSCO); Indian Pharmacopoeia commission (IPC); Drugs Controller General of India (DCGI) and Indian Council for Medical Research (ICMR). International agencies (WHO guidelines

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on medicines policy; Food and Drug Administration (FDA); New Drug Application (NDA); Medicines and Healthcare products Regulatory Agency (MHRA).

PHARMACOKINETICS AND PRINCIPLES OF DRUG ACTION **7 Hour**

Route of drug administration: Enteral and parenteral; Pharmacokinetics: Drug Absorption, Distribution, Metabolism and Elimination (ADME); factors influencing ADME process; Pharmacodynamics: basic principles of drug action, Mechanism of drug action through enzymes, drug receptor interactions; radiopharmaceutical

DRUG DEVELOPMENT AND MANUFACTURE PROCESS **7 Hour**

New Drug development: Drug discovery, patenting, preclinical and clinical trials, and regulatory authorities; Manufacturing process: special manufacturing facilities, sources of biopharmaceuticals, production of final product and analysis of the final products

REGULATORY PRACTICES **7 Hour**

Good manufacturing practices (GMP); Good clinical practices (GCP); Good laboratory practices (GLP); The Drugs & Cosmetics Act, 1940; Schedule M & Y; Applications monitoring quality control; types of validation

PRINCIPLES OF DRUG MANUFACTURE IN PHARMACEUTICALS **9 Hour**

Dosage form design: Need for dosage forms, General considerations in Dosage form design; Solid dosage forms: powders, granules, capsules and tablets; Semisolid dosage forms: ointments, creams and gels; transdermal drug delivery system; Pharmaceutical inserts: suppositories and inserts; Liquid dosage forms: solutions; Sterile dosage forms: parenteral (injections), Biologics (vaccine).

BIOPHARMACEUTICAL THERAPEUTICS AND CLINICAL USES **7 Hour**

Various categories of therapeutics production and uses: Cytokines: interferons, interlukins, tumour necrosis factor. Haemotopoietic growth factors; Colony stimulating factor (granulocyte, macrophage), erythropoietin; Hormones: insulin, glucagons.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total: 45 hour

REFERENCES

1. Brahmankar, D.M. and Jaiswal, S.B. (2009) Biopharmaceutics and Pharmacokinetics. 2nd Edition, Vallabh Prakashan Publication.
2. Ansel H.C., et al. (2007) Pharmaceutical dosage forms and drug delivery systems- 8th edition, Lippincott Williams & Wilkins.
3. Gary Walsh. (2005) Biopharmaceutical technology-biochemistry and biotechnology, 1st Edition, John Wiley and Sons, Ltd.
4. Remington (2000) Pharmaceutical sciences, 20th edition, Mack publishing and Co., PA

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1. http://onlinelibrary.wiley.com/book/10.1002/9780470259818
2. https://ocw.mit.edu/courses/health-sciences-and-technology/hst-151-principles-of-pharmacology-spring-2005/lecture-notes/

Signature of BOS chairman, BT

U17BTI6202	BIOPROCESS ENGINEERING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To apply and analysis the various chemical engineering principles for production of biological products using various bioreactor.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Apply the knowledge of various optimization methods to design the media for fermentation broth

CO2 Evaluate the sterilization kinetics of media and able to design the holding time for batch sterilization

CO3: Develop a suitable mathematical models for batch, fed-batch and continuous fermentation and able to simulate and evaluate the constants for microbial fermentation

CO4: Understand and analyse the application of various bioreactors and importance of mass transfer effect in bioprocess engineering

CO5: Apply the various scale-up criteria to design the bioreactors

CO6: Identify and provide the solution for non- ideal performance of bioreactor

Pre-requisite Course:

1. U17BTT3003 Bioprocess Calculation; U17BTT4001 – Fluid and Particle mechanics in Bioprocess

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		S	S					M				S
CO2	S	S		S	M					M				S
CO3	S	S		S	M					M				S
CO4	S	S		S	S		M			M				S
CO5	S	S		S	S					M				S
CO6	S	S		S	S					M				S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Signature of BOS chairman, BT

Course Content

MEDIA AND ITS OPTIMIZATION METHODS **9 Hour**

Criteria for good medium; Various carbon, nitrogen, minerals, vitamins and other complex nutrients for fermentation industry; Simple and complex media for microbial, plant and animal cells; oxygen requirements; medium formulation for optimal growth and product formation; Stoichiometric analysis of media . Medium optimization methods: Plackett-Burman design, simplex design and response-surface methodology.
Case study: Enzyme production using Plackett-Burman design.

STERILIZATION KINETICS **9 Hour**

Thermal death kinetics of microorganisms; batch and continuous heat sterilization of liquid media; filter sterilization of liquid media; sterilization of air; design of sterilization equipment for batch and continuous process.

FERMENTATION KINETICS **9 Hour**

Modes of operation – batch, fed-batch and continuous cultivation, Simple unstructured kinetic models for microbial growth - Monod model; Growth of filamentous organisms and yeast. Product formation kinetics; Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

TRANSPORT PHENOMENA IN BIOREACTOR AND TYPES OF BIOREACTOR **9 Hour**

Aeration and agitation in gas-liquid mass transfer, Oxygen transfer rate (OTR), determination of K_La, Factor affecting in OTR in bioreactor, Mass transfer correlation in Oxygen transfer. Types and industrial applications of bioreactors; Stirred-tank reactor and its ancillaries; Bubble-column reactor; Packed-bed reactor; Fluidized-bed; Air-lift reactor; and Photobioreactor.
Case study: alagal cultivation

SCALE-UP OF BIOREACTORS AND NON-IDEAL REACTOR **9 Hour**

Scale-up criteria for bioreactors; Major factors involved in scale-up; Scaling-up of mixing systems: Scale-up of aeration/agitation regimes in stirred tank reactors. Introduction to non- ideal reactors: Residence time distribution (RTD), Reasons for non-ideality in reactors, RTD function and measurement, RTD in plug flow and mixed flow reactor.

List of Experiments **30 Hour**

1. Medium optimization by Plackett-Burman design/response surface methodology (RSM) using design expert software
2. Batch sterilization design
3. Determination of specific growth rate for production of bacterial cells
4. Estimation of K_La – power correlation / sulfite oxidation / dynamic gassing method
5. Production of microbial metabolites (enzymes / antibiotics) in bioreactor
6. Production of biofertilizers / biopesticides / mushroom
7. Residence Time Distribution (RTD) studies to find non-ideality of a fermenter
8. Introduction to SuperPro Designer – Material and Energy balance
9. Unit Operations, Component Library and registration, Pure and stock mixtures in Super pro
10. Production of monoclonal antibodies in Super pro

Theory: 45 hour **Tutorial: 0 hour** **Practical: 30 hour** **Project: 0 hour** **Total Hour: 75**

Signature of BOS chairman, BT

References:

1. Stanbury P. F., Hall, S., and Whitaker A, (2016). Principles of Fermentation Technology 3/e.' Butterworth-Heinesmann.
2. Pauline M. Doran, (2012). Bioprocess Engineering Principles, 2nd.. Academic Press, New York.
3. Bailey and Ollis, (2010). Biochemical Engineering Fundamentals, 2nd.. McGraw-Hill, New Delhi.
4. Lee, J. M (2010). Biochemical Engineering NJ: Prentice Hall.
5. Rajiv Dutta (2008). Fundamentals of Biochemical Engineering. Ane Books India, New Delhi.
6. Blanch H. W. And Clark D. S. (2007). Biochemical Engineering, 2nd. CRC Press, London.
7. Shuler, M. L., and F. Kargi. (2002). Bioprocess Engineering: Basic Concepts, 3rd . New Delhi, Prentice-Hall of India.

Web References:

1. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=102107029
2. http://users.ox.ac.uk/~dplb0149/publication/NPRBiocatalysisRev.pdf 4

U17BTI6203	CELL CULTURE TECHNIQUES	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To elucidate the general requirements and fundamentals of plant and mammalian cell culture.
- To understand the different cell culture techniques in both plant and animal cell culture and its applications

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Outline and design model laboratory layout for setting up a plant tissue culture and animal cell culture lab.

CO2 Compare and illustrate plant and mammalian cell culture techniques and media for culturing of plant and mammalian cells

CO3: Elaborate and compare various plant tissue culture techniques.

CO4: Significant applications of tissue culture techniques in generating transgenic plants.

CO5: Explain and illustrate techniques for development of primary and established cell culture and measurement of cell viability.

CO6: Illustrate the plant and mammalian cell techniques for economic importance

Prerequisite

U17BTI4203 Cell and Molecular Biology

Signature of BOS chairman, BT

CO/PO/PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S		S								S	
CO2	S		S		S	S							S	
CO3	S		M			M		S					S	
CO4	S					S		S			S		S	
CO5	S							S					S	
CO6											M			

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

GENERAL REQUIREMENTS FOR CELL CULTURE **9 hour**

Basic operations and general equipment's and facility for mammalian and plant tissue culture lab; Maintenance of Aseptic Laboratory; Precautions to maintain aseptic conditions; Biosafety cabinet, inverted microscope, biosafety level in plant and animal cell culture lab.

BASICS OF PLANT AND MAMMALIAN CELL CULTURE **9 hour**

Media requirement and stock solution preparation; Callus induction and differentiation; primary and secondary hardening; Importance and progress in animal cell culture; Importance of serum and serum free media; mycoplasma detection and control; Passage procedures; Doubling and generation time; cryopreservation of mammalian cell line and characterization.

PLANT TISSUE CULTURE TECHNIQUES **9 hour**

Types of culture techniques: callus, root tip, shoot tip, anther culture, pollen culture; endosperm culture etc.., Callus induction and differentiation; primary and secondary hardening; Protoplast culture and protoplast fusion and cell viability test

Case study - Commercialization of banana tissue culture /Micro propagation of tissue culture plants

MAMMALIAN CELL CULTURE TECHNIQUES **9 hour**

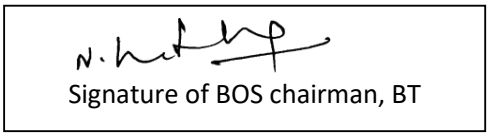
Primary culture and established cell lines; cell strain, continuous cell line- finite and infinite cell line, commonly used cell lines; Maintenance of cell culture; Measurement of viability and cytotoxicity; Monolayer culture, Anchorage dependent and independent cultures; suspension cell cultures; Cell culture reactors: scaling up

Case study – Development of monoclonal antibodies

APPLICATION OF PLANT AND MAMMALIAN CELL CULTURE **9 hour**

Gene transfer methods in plants; Transgenic plants with beneficial traits: herbicide, drought, virus resistance; Transgenic plants as bioreactors- Concept of Molecular farming and pharming.

Gene transfer methods in mammalian cells; Transgenic animal for production of recombinant proteins - vaccines, diagnostic antigens and other pharmaceutical agents (insulin, growth factors); Transfection Technology.



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List of Experiments **30 hour**

1. Media and Stock solution preparation and sterilization
2. Selection of explants and Induction of callus
3. Suspension culture and production of secondary metabolites
4. Micro propagation of commercial plant for economic importance (Potato / Banana / Bamboo / Jatropha etc.)
5. Establishment of primary culture from leaves and stem explants
6. Establishment of organogenesis from leaves and stem explants
7. Sterilization techniques, media and stock solution and sera preparation
8. Establishment of primary culture using chick embryo
9. Establishment of cell lines by using primary and / or secondary cell culture
10. Staining, Cell counting and viability (Tryphan Blue assay)
11. Preservation of cell line- Cryopreservation
12. Field visit : - Animal handling and care
    - Culture of virus in chick embryo

Theory: 45 hour Tutorial: 0 hour Practical: 30 hour Project: 0 hour Total Hour: 75

REFERENCES

1. Ian R Freshney (2011) Animal cell culture: A manual of basic technique and specialized applications, Wiley and sons.
2. Ranga,M.M (2007), Animal Biotechnology, fourth Edition, Agrobios India limited, Jodhpur.
3. Rama Dass,P.and Meera Rani S (2007) Text Book of Animal Biotechnology, Akshara Printers, New Delhi
4. Masters, J.R.W (2007) Animal Cell culture. Practical Approach, Oxford University Press, UK
5. Sant Saran Bhojwani and M. K. Razdan (1996) Plant Tissue Culture: theory and practice; Elsevier Science.

WEB REFERENCES

1. http://nptel.ac.in/courses/102103012/34
2. http://nptel.ac.in/courses/102103016/4

		L	T	P	J	C
U17BTI6204	**IMMUNOLOGY**	**3**	**0**	**2**	**0**	**4**

Course Objectives:

- To gain an in-sight into the cells and effectors of immune system and mechanisms of immunity.
- To learn the concept of antigen-antibody interactions and demonstrate the techniques for their evaluation.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Comprehend the general concepts of immune system and elaborate the cells and organs of the immune system.

CO2 Analyze and evaluate the properties of antigens and antibodies with special emphasis on haptens.

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CO3: Demonstrate and evaluate various antigen-antibody interactions and techniques.
CO4: Apply the concept of cell mediated immunity and complement system.
CO5: Illustrate the mechanisms behind hypersensitivity and autoimmunity mechanisms.
CO6: Imbibe the concept of transplantation and cancer immunology

Pre-requisite Course:

1. U17BTI4203 Cell and Molecular Biology

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M						S	S		S	S	
CO2	S			W	S				S	S			S	
CO3	S	M			S				S	S			S	
CO4	S												S	
CO5	S		S			S							S	
CO6	S		S	M		S							S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CELLS AND ORGANS OF IMMUNE SYSTEM **6 hour**

General concepts of the immune system. Innate and adaptive immunity. Hematopoeisis.Structure, properties and functions of the immune cells and organs: T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils Mast cells and dendritic cells. Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and CALT.

ANTIGENS AND ANTIBODIES **6 hour**

Antigens and haptens; Properties; B and T cell epitopes. T-dependent and T- independent antigens. Adjuvants. Antibodies: Classification, Structure, function and properties of the antibodies; Antibody as B cell receptor, antigenic determinants on antibodies (isotype, allotype and idiotype).

TECHNIQUES ON ANTIGEN-ANTIBODY INTERACTIONS **9 hour**

Immunological principles of various reactions and techniques: Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA –types and applications, Western Blotting. Hybridoma technology-Monoclonal antibodies production and applications.

Case study: AIDS diagnosis by monoclonal antibodies.

CELL MEDIATED IMMUNITY & COMPLEMENT **12 hour**

Major histocompatibility gene complex: Organization of MHC- Types and Functions, Structure and cellular distribution of HLA antigens. Cell mediated immunity: Cell types (CTLs, NK cells, macrophages and TDTH cells), effector mechanisms and molecules of cell mediated reactions. Cytokines – interleukins and interferons (outline only).Complement system: Components of the complement activation - classical, alternative and lectin pathways. Biological consequence of complement activation and complement deficiencies.

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HYPERSENSITIVITY,AUTOIMMUNITY&TRANSPLANTATION IMMUNOLOGY 12 hour

Hypersensitivity: Types and mechanism of hypersensitive reactionsAutoimmunity: Mechanisms of induction of organ specific and systemic, autoimmune diseases (rare genetic disorders). Therapeutic approach. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, properties and types of rejection, tissue typing, immunosuppressive therapy. Cancer Immunology: types of tumors, tumor antigens (TSTA and TATA), immune response to tumors. **Case study:** Immunotherapy of breast cancer.

LIST OF EXPERIEMENTS 30 hour

1. Blood smear preparation and identification of leucocytes by Giemsa stain
2. Separation of Peripheral Blood Mononuclear cells(PBMC) and analysis of cell viability by Tryphan blue staining
3. Separation of leucocytes by dextran method
4. IgE estimation by myeloperoxidase assay
5. Cytokine assay by ELISA

Assays for Antigen/antibody interactions

6. Determination of antigen/antibody concentration by Single radial immunodiffusion test.
7. Assay for antigen / antibody specificity- Ouchterlony Double Immuno Diffusion.
8. Assay for analysis of heterogeneity of antibody by Immuno-electrophoresis.
9. Determination of antigen concentration by rocket electrophoresis.
10. Determination of antigen/antibody concentration by ELISA

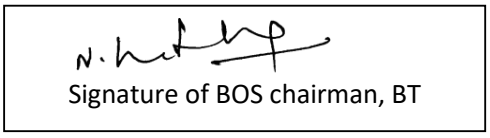
Theory: 45 hour Tutorial: 0 hour Practical: 30 hour Project: 0 hour Total Hour: 75

References:

1. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Essential immunology*. 13th edition. John Wiley & Sons.
2. Abbas. A., Lichman, A.H., Pillai, S. (2017).Cellular and Molecular Immunology, 9th edition, Elsevier Health Services
3. Owen, J. A., Punt, J., & Stranford, S. A. (2016). *Kuby immunology*. 7th edition, WH Freeman, New York
4. Pillai, A.(2008). *A Textbook of Immunology and Immunotechnology*. 1st edition, S.Chand & Co. New Delhi.
5. Tizard, R.I. (2007). *Immunology: An Introduction*, 4th Edition, Brooks/Cole publisher

Web References:

1. http://www.raymondcheong.com/Year1/immuno.html
2. http://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-and-molecular-immunology-fall-2005/lecture-notes/
3. http://www.umich.edu/~bmsteach/lopatin/Immunology/Immunology.html



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U17BTI6205	BIOLOGICAL DATA ANALYSIS	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To introduce the concept of massive data mining from biological experiments.
- To identify basic experimental design principles in solving biological questions.
- To develop and test hypothesis statistically using data using R – programming.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Understand and apply the biological annotation for macromolecules; apply and interpret the structural analysis of macromolecules using high throughput experiment.

CO2 Apply and interpret the biological data through fundamental statistical analysis.

CO3: Apply and interpret biological data related with hypothesis testing

CO4: Explore and infer biological data using visualization.

CO5: Understand and apply R-programming for biological data analysis

CO6: Provide optimal solution and statistics to biological problems

Pre-requisite

1. U17MAT4105 Biostatistics

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S			S	S					M	S		S	S
CO2	S			S	S									
CO3	S			S	S									
CO4	S			S	S									
CO5	S			S	S									
CO6	S			S	S					S		M	S	S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

BIOINFORMATICS: MINING THE MASSIVE DATA FROM HIGH THROUGHPUT GENOMICS EXPERIMENTS **6 hour**

Introduction – Sequence alignment, Genome sequencing - Nanopore and illumina sequencing, gene annotation, RNA folding - RNAhybrid, protein structure prediction - Secondary structure information; Microarray analysis, proteomics, Protein-Protein Interaction

INTRODUCTION TO BIOSTATISTICAL ANALYSIS **6 hour**

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Statistical methods in the context of biological research – Data exploration and Analysis - Arithmetic mean, standard deviation, coefficient of variation, standard error of mean, correlation analysis; regression analysis [Problems alone should be solved]

HYPOTHESIS TESTING **6 hour**

Introduction to general concepts; characteristics - Type I and II error; Student's t-test, chi-square test, One Way ANOVA (Kruskal–Wallis H test), Mann–Whitney U test; Wilcoxon signed-rank test

DATA EXPLORATION **6 hour**

Data visualization and summary statistics – variable types, Exploring categorical variable – Relative frequency and percentage, Bar graph, Pie chart; Exploring numerical variables – Histogram, Mean and median, Variance and Standard deviation, quantiles, Box plots; Data Preprocessing – Outliers, data transformation

BIOLOGICAL DATA ANALYSIS USING R PROGRAMMING **6 hour**

Overview – Variable, Data types, Operators, Useful Function, Data frames, Working with images and strings, Library functions.

List of Experiments **15 hour**

1. Introduction to R installation, package management and basic operators
2. Bioconductor tools – Introduction & usage
3. Biological sequences and sequence analysis
4. Basic plot and customized plot using ggplot2
5. R for large biological datasets
6. Descriptive statistics and One-way ANOVA
7. Image analysis using EBImage
8. Case Study : Microarray data analysis using Bioconductor package [Demo only]

Theory: 30 hour **Tutorial: 0 hour** **Practical: 30 hour** **Project: 0 hour** **Total: 60 hour**

REFERENCES

1. Hartvigsen, G. (2014). A primer in biological data analysis and visualization using R. Columbia University Press.
2. O'Brien, C. M. (2013). Biostatistics with R: An Introduction to Statistics Through Biological Data by Babak Shahbaba. International Statistical Review, 81(3), 472-473.
3. McDonald, J. H. (2009). Handbook of biological statistics (Vol. 2, pp. 173-181). Baltimore, MD: sparky house publishing.
4. Whitlock, M. C., & Schluter, D. (2009). The analysis of biological data (No. 574.015195 W5).
5. Sanghamitra, B., Ujjwal, M., & TL, W. J. (Eds.). (2007). Analysis of biological data: a soft computing approach (Vol. 3). World Scientific.

Web References:

1. http://bioconductor.org/
2. https://onlinecourses.science.psu.edu/statprogram/r
3. http://www.r-tutor.com/r-introduction

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U17INI6600 ENGINEERING CLINIC - IV

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

U17INI5600 ENGINEERING CLINICS III

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

Course Assessment methods:

Direct
1. Project Review 2. Workbook report 3. Demonstration & Viva voce

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

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In the semester, students will focus primarily on Reverse engineering project to improve performance of a product.

Course	Semester	Focus
Engineering Clinic I	1	IOT with C programming using Audino
Engineering Clinic II	2	Raspberry pi based controllers with Python programming
Engineering Clinic III	3	Design project combining concepts learnt in Engineering clinics I and II
Engineering Clinic IV	4	Reverse engineering project to improve performance of a product
Engineering Clinic V	5	Design and developing a prototype

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hour: 90

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U17VEP6506 **NATIONAL VALUES** (Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Acquire knowledge on the Essence of Indian Knowledge Tradition

CO 2: Know the great Indian personalities and follow their trail

CO 3: Understand the specialty of democracy

CO 4: Disseminate our Nation and its values to propagate peace

CO 5: Contribute with their energy and effort for a prosperous India

CO 6: Propagate the youth and the contribution for development of our Nation

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S								
CO2									M					
CO3							M							
CO4								S						
CO5											S			
CO6												M		

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect

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1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Essence of Indian Knowledge Tradition:
Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition -
Indian Linguistic Tradition - Indian Artistic Tradition.
2. Great Indian Leaders : Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates -Scientists – Statesman.
3. Largest Democracy : Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.
4. India's Contribution to World peace : Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.
5. Emerging India : World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

Workshop mode

REFERENCES

1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, *CBSE Publication* *___cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_6_2.pdf*

2. CULTURAL HERITAGE OF INDIA - SCERT Kerala
www.scert.kerala.gov.in/images/2014/HSC.../35_Gandhian_Studies_unit-01.pdf

3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO
www.unesdoc.unesco.org/images/0014/001480/148021e.pdf

4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick
www2.warwick.ac.uk/fac/arts/history/students/modules/hi297/.../week1.pdf

5. INDIA'S CONTRIBUTION TO THE REST OF THE WORLD - YouSigma
www.yousigma.com/interesting facts/indiasgifttotheworld.pdf

6. INDIA AS AN EMERGING POWER - International Studies Association
web.isanet.org/Web/Conferences/.../11353cac-9e9b-434f-a25b-a2b51dc4af78.pdf


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SEMESTER - VII

U17MBT7001	ENGINEERING ECONOMICS & FINANCIAL MANAGEMENT	L	T	P	PJ	C
		3	0	0	0	3

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Evaluate the economic theories, cost concepts and pricing policies
CO2: Analyze the market structures and integration concepts
CO3: Apply the concepts of national income and understand the functions of banks and concepts of globalization
CO4: Apply the concepts of financial management for project appraisal and working capital management
CO5: Understand accounting systems
CO6: Analyze financial statements using ratio analysis

Pre-requisite:

Nil

CO/ PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M			M						M		M	
CO2				M	M						M		M	
CO3					M						M			
CO4				M							M			M
CO5											M			
CO6		M		M							M			M

Course Assessment Methods			
Direct		Indirect	
1	Internal Tests	1	Course end survey
2	Assignments		
3	End semester examination		

Course Content **45 hours**

1. **ECONOMICS, COST & PRICING CONCEPTS** **9 hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing Policies – Pricing methods.

2. **CONCEPTS ON FIRMS & MANUFACTURING PRACTICES** **9 hours**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

3. **NATIONAL INCOME, MONEY & BANKING, ECONOMIC ENVIRONMENT**

9 hours

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

4. **CONCEPTS OF FINANCIAL MANAGEMENT** **9 hours**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

5. **ACCOUNTING SYSTEM, STATEMENT & FINANCIAL ANALYSIS** **9 hours**

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory: 45 hours Tutorial: 0 hours Practical: 0 hours Project: 0 hours Total hours: 45

Textbooks:

1. Chandra, P. (2009). Projects 7/E. Tata McGraw-Hill Education.
2. Besley, S., & Brigham, E. F. (2008). Essentials of managerial finance. Thomson South-Western.

References:

1. Pandey, I. M. (1988). Financial management research in India.
2. Fenner, W. G. (1978). Fundamentals of financial management: James C. Van Horne, Prentice-Hall, 1977, Price:[UK pound] 11.95. Engineering and Process Economics, 3(3), 221-222.
3. Bhaskar S. (2003). Engineering Economics and Financial Accounting, Anuradha Agencies, Chennai, 2003.
4. Van Horne James, C. (2002). Financial Management & Policy, 12/E. Pearson Education India..
5. Khan, M. Y., & Jain, P. K. (2006). Management accounting and financial analysis.
6. Saravanavel, P. (2018). Management Accounting Principles & Practice.
7. Ramachandra Aryasri.A., & Ramana Murthy V.V. (2006). Engineering Economics & Financial Accounting, Tata McGraw Hill, New Delhi.
8. Varshney, R. L., & Maheshwari, K. L. (2001). managerial Economics. Chand.
9. Samuelson, P. A., & Nordhaus, W. D. (2009). Economics. 19th International Edition.

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U17BTT7002	PRECLINICAL AND CLINICAL & REGULATORY AFFAIRS	L	T	P	PJ	C
		3	0	0	0	3

Course Objectives:

- Understand key areas of drug development: preclinical and clinical research regulations
- Understand the basic concepts of trial management, clinical data analysis and reporting

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Understand the regulatory aspects and ethical considerations involving human subjects.
CO2: Understand the timelines and resources required to discover and develop new drugs in a preclinical setting.
CO3: Demonstrate an understanding of the critical features of each stage of the preclinical drug development process.
CO4: Classify different types of trial designs.
CO5: Apply and demonstrate critical analysis of clinical data using statistical analysis tools
CO6: Identify quality parameters of clinical research report.

Pre-requisite:

1. U17BTI6205 Biological Data Analysis
2. U17BTT6001 Biopharmaceutical Technology

CO/ PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M										S	S
CO2	S			W									S	
CO3	S	M			S								S	
CO4	S											M	S	
CO5			S									M	S	
CO6										S			S	

Course Assessment Methods			
Direct		Indirect	
1	Internal Tests	1	Course end survey
2	Assignments		
3	End semester examination		

Course Content **45 hours**

1. **REGULATORY BODIES AND ETHICAL GUIDELINES** **9 hours**

Regulatory bodies: National and International perspective, Drug and in vitro diagnostic device regulatory submissions, approvals and registrations, Ethical guidelines in Clinical Research: Nuremberg code, Declaration of Helsinki, Belmont report; International Conference on Harmonization, Drug and cosmetic act; Schedule Y, ICMR Guidelines: National Ethical Guidelines for Biomedical and Health Research Involving Human Participants

2. **DRUG DISCOVERY AND PRECLINICAL RESEARCH** **9 hours**

Drug development phases, Preclinical drug development, Types of Pre-clinical trials, safety studies, dose response information to support drug registration, Guidelines for animal studies, carcinogenicity studies, chronic toxicity testing in animals, Importance of CYP Metabolism studies, Pharmacodynamics (PD): Toxicity LD_{50} and ED_{50}.

Signature of BOS Chairman

3. **CLINICAL RESEARCH** **9 hours**

Scope of Clinical Research, Good Clinical Practices (GCP), History of clinical research, Belmonte report, Thalidomide disaster, Types of clinical trials, Special Clinical Trials, Medical Devices Trials, Investigator Brochure, Informed Consent Form, Sponsor Monitor and Investigator responsibility, SOP in Clinical Trials, Clinical Trial Monitoring, Role of CRA, QA and QC in Clinical Trials, CRF Design, Study management: Monitoring process, Coordinating protocol implementation

4. **CLINICAL RESEARCH STUDY DESIGNS** **9 hours**

Overview of study design, Types of studies: Experimental, uncontrolled, RCTs, other designs – equivalence, non-inferiority, observational, retrospective, sample size, bias and confounding, Experimental Design – Randomized Clinical Trials: parallel-group design, stratified parallel group design, parallel group randomized block design, complete cross-over design, simultaneous treatments design, factorial design. Types of randomization: simple, blocked, stratified and Adaptive, Blindness:– unblinded, Single Blind, Double-blind and Triple blind trials. Case Study: Clinical Trial Study Design

5. **CLINICAL DATA ANALYSIS AND REPORT** **9 hours**

Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, Good Clinical Data Management Practices, Data Management Plan, CRF designing. Serious adverse event data reconciliation, Database closure, Design and analysis of surveys, CDISC standards, Dataset preparation for analysis, Overview of reporting, Internal and external reporting.

Theory: 45 hours Tutorial: 0 hours Practical: 0 hours Project: 0 hours Total hours: 45

Textbooks:

1. Tom Brody, (2016) Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, Academic Press.

2. Stephen B Hulley, Steven R Cummings, Warren S Browner, Deborah G Grady, Thomas B Newman,(2008) Designing clinical research, Second edition Lippincott Williams & Wilkins Publishers.

3. T.A. Durham and J Rick Turner. (2008) Introduction to statistics in pharmaceutical clinical trials. Pharmaceutical Press.

4. Antonella Bacchieri, Giovanni Della Cioppa (2007). Fundamentals of Clinical Research , First edition, Springer publishers

Web-References:

1. `http://www.ich.org/products/guidelines/safety/safety-single/article/preclinical-safety-evaluation-of-biotechnology-derived-pharmaceuticals.html`

2. `http://clinicalcenter.nih.gov/training/training.html`

3. `https://onlinecourses.science.psu.edu/stat509/node/6/`

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U17BTI7203 BIOINFORMATICS

L	T	P	PJ	C
3	0	2	0	4

Course Objectives:

- Introduce the student to biological data resources, algorithms and alignment tools
- Apply various algorithms and computational tools for protein structure and stability analysis.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: To introduce the concept of biological sequence alignment and various genome sequence protocols.
CO2: To familiarize with various biological database searches, parameters and algorithm.
CO3: To apply, interpret and analyze multiple sequence alignments.
CO4: To construct, interpret and access molecular phylogenetic tree prediction .
CO5: To apply, interpret and analyze protein structures prediction algorithms.
CO6: To introduce the concept of computer-aided drug designing (CADD).

Pre-requisite:

1. U17BTI3204 Concepts in Biochemistry
2. U17BTI4203 Cell and Molecular Biology
3. U17BTI5202 Protein and Enzyme Technology

CO/ PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S	M										
CO2	S	S		M	S							M	M	M
CO3	S	S		M	S							S	S	S
CO4	S	M		M	S								S	S
CO5	S	S	M	M	M							M	S	S
CO6	S	S	M	M	M							M	M	M

Course Assessment Methods			
Direct		Indirect	
1	Internal Tests	1	Course end survey
2	Assignments		
3	End semester examination		

Course Content **60 hours**

1. **INTRODUCTION TO BIOINFORMATICS** **9 hours**

Introduction to Bioinformatics; Biological Sequences – Formats; Databases – types, architecture of Biological Databases; Sequence Identify and Similarity, Edit distance – Levenstein and Hamming Distance. Dot plot analysis.

2. **SEQUENCE ALIGNMENT** **12 hours**

Sequence alignment – Pairwise alignment; Gaps – Constant, Linear, Affine, Convex and Profile-based gaps; Dynamic Programming algorithm – Needleman and Wunch Algorithm, Smith-Waterman Algorithm; Scoring Matrices – PAM and BLOSSUM; BLAST. Limits of detection & significance. Advanced BLAST: PSI-BLAST & PHI-BLAST. Introduction to Next Generation Sequencing techniques and applications.

Case Study: NGS-based sequencing for infectious diseases.

3. **MULTIPLE SEQUENCE ALIGNMENT** **7 hours**

Multiple Alignment Methods – Block-based methods for multiple-sequence alignment, Algorithm of multiple sequence alignments: Sums of pairs method (SP), CLUSTAL W, PILEUP; Overview of iterative MSA methods; Construction of Position-Specific Scoring Matrices (PSSM).

4. **PHYLOGENETICS** **7 hours**

Molecular Phylogenetics – Newick Format, Methods for tree construction – Unweighted pair group method of arithmetic mean (UPGMA), Fitch-Margoliasch algorithm (FM), Neighbor-Joining method (NJ); Character based methods: Maximum parsimony, maximum likelihood, Tree Reconstruction and evaluation - Bootstrapping technique.

Case Study: Computational exploration of coevolution.

5. **APPLICATIONS IN BIOINFORMATICS** **12 hours**

Prediction of secondary structure – Globular and Transmembrane protein, Prediction of Tertiary structure – Homology Modeling and Threading. Methods for predicting conserved patterns in protein sequence and structure; Comparison of protein tertiary structures.

Introduction to Drug Discovery Process, Target Identification and Validation, Virtual Screening of lead compounds, Docking – Principles, Rigid and Flexible docking.

Case study: Drug discovery approaches targeting a metabolic pathway.

List of Experiments:

1. Basics of Unix Commands & Scripting
2. Biological Sequence Retrieval
3. Molecular Visualization using Pymol
4. Sequence Homology using BLAST
5. Multiple Sequence Alignment
6. Phylogenetic Analysis
7. NGS Data Analysis of SNP Identification
8. Molecular Modelling of Protein structure and Loop refinement
9. Molecular Docking

Theory: 45 hours Tutorial: 0 hours Practical: 30 hours Project: 0 hours Total hours: 60

Textbooks:

1. Pevzner, P., & Shamir, R. (Eds.). (2011). Bioinformatics for biologists. Cambridge University Press.
2. Higgins, D., & Taylor, W. (2000). Bioinformatics: sequence, structure and databanks. New York: Oxford University Press.
3. Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2008). Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery 3Rd Ed. PHI Learning Pvt. Ltd..
4. Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (Eds.). (2020). Bioinformatics. John Wiley & Sons.
5. Gu, J., & Bourne, P. E. (Eds.). (2009). Structural bioinformatics (Vol. 44). John Wiley & Sons.
6. Stawinski, P., Sachidanandam, R., Chojnicka, I., & Płoski, R. (2016). Basic Bioinformatic Analyses of NGS Data. In Clinical Applications for Next-Generation Sequencing (pp. 19-37). Academic Press.

7. Gromiha, M. M. (2010). Protein bioinformatics: from sequence to function. Academic Press.

8. Yu, W., & MacKerell, A. D. (2017). Computer-aided drug design methods. In Antibiotics (pp. 85-106). Humana Press, New York, NY.

Web-References:

1. https://nptel.ac.in/courses/102106065/

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U17BTI7204 DOWNSTREAM PROCESSING

L	T	P	PJ	C
3	0	2	0	4

Course Objectives:

- To provide an insight about the chemical engineering concepts for bio-product recovery from biological sources.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Apply the various unit operation principles and engineering fundamentals to design the separation processes specific to biologically derived products.
CO2: Analyze and design the various solid-liquid unit operations and different cell-disruption techniques used in downstream processing.
CO3: Apply and analyse the various principles underlying the different unit operations used for the isolation and extraction of bio-products.
CO4: Select and design the various methods of chromatography used in protein purification.
CO5: Apply the different unit operations for polishing and packing the final bioproducts .
CO6: Evaluate the techno-economical analysis for purification of bioproducts.

Pre-requisite:

1. U17BTI6202 Bioprocess Engineering

CO/ PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		S	S					M				S
CO2	S	S		S	S					M				S
CO3	S	S		S	S					M				S
CO4	S	S		S	S					M				S
CO5	S	S		S	S					M				S
CO6	S	S		S	S					M	S			S

Course Content **60 hours**

1. **INTRODUCTION TO DOWNSTREAM PROCESSING AND PRIMARY SEPARATION** **9 hours**

Downstream processing principles, classification and characteristics of biomolecules; cell disruption methods for intracellular products release: mechanical methods, chemical, physical and enzymatic methods; unit operations for solid-liquid separation-filtration, types of equipment, batch-continuous, pretreatment methods and centrifugation, scale-up of centrifugation, centrifugal filtration.

2. **ISOLATION OF PRODUCTS** **9 hours**

Adsorption, Extractive separation: Solvent extraction, Aqueous Two Phase Extractions, Reverse Micelle Extraction, Super Critical Extraction. Precipitation methods: Salts; Organic solvents and Polymers. Membrane Based Separation: Ultrafiltration; Microfiltration; Nanofiltration; Reverse Osmosis; Dialysis and Electrodialysis.

3. **PURIFICATION OF PRODUCTS** **9 hours**

Size exclusion Chromatography, Ion exchange chromatography, Reverse-phase chromatography, hydrophobic interaction chromatography (HIC), Affinity chromatography, HPLC, FPLC and GC – Operations & application.

4. **POLISHING OF PRODUCTS** **9 hours**

   Crystallization: Methods of super saturation, types of nucleation and crystal growth, Material and energy balance, yield of crystal, Types of crystallization and equipment's. Drying: types of moistures, batch drying process, mechanism of drying, drying time calculation, drying equipment's; Freeze-drying and Spray drying.

5. **TECHNO-ECONOMICAL ANALYSIS FOR BIOPRODUCT PRODUCTION 9 hours**

   Techno-economical analysis of bioproducts, Illustrative Example of Citric Acid Production, Human Insulin Production. Case studies: Therapeutic Monoclonal Antibody Production.

List of Experiments:

1. Disruption of cell walls and estimation of intracellular proteins using cell disruption techniques
2. Concentration of yeast cells using Micro filtration
3. Isolation of proteins using precipitation techniques
4. Recovery of proteins using aqueous two phase extraction
5. Chromatography column packing
6. Purification of enzyme using ion exchange chromatography
7. Purification of enzyme using size exclusion chromatography
8. Purification of enzyme using affinity chromatography
9. Purification of high value product using Fast Protein Liquid Chromatography (FPLC)
10. Freeze-Drying
11. Simulation of production and purification of bioproducts using Superpro software (demo)

Theory: 45 hours Tutorial: 0 hours Practical: 30 hours Project: 0 hours Total hours: 60

Textbooks:

1. Li, Y. (2016). Bioenergy: principles and applications. John Wiley & Sons.
2. Roger G.Harrison, Paul Todd, Scott R.Ruger and Demetri P. Petrides. (2009). Bioseparation Science and Engineering. Oxford University Press, 2nd ed. NewYork.
3. Sivashankar, B (2005). Bioseparation : Principles and Techniques, Prentice Hall of India, New Delhi.
4. Scopes, R.K. (2005). Protein Purification – Principles and Practice, 2nd ed. Narosa Publications.
5. Ladisch, M. R. (2001). Bioseparations Engineering: Principles. Practice and Economics, Wiley.
6. Belter P.A, Cussler,E.L and Wei-Houhu . (1998). Bioseparations- Downstream Processing for Biotechnology, Wiley Interscience Publications, USA.
7. BIOTOL series-(1995). Product recovery in Bioprocess Technology VCH publications,

Web-References:

1. `http://nptel.ac.in/courses/102106022/`
2. `http://www.intelligen.com/superpro_features.html`

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U17BTP7705 PROJECT PHASE-I

L	T	P	PJ	C
0	0	0	4	2

Course Objectives:

- To develop skills to identify and find solutions to various problems using biotechnology.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Ability to survey literature relevant to the topic under consideration.
CO2: Design a research problem using sound scientific principles.
CO3: Conduct experiments with suitable controls and safety considerations.
CO4: Perform statistical operations and analyze results.
CO5: Interpret results and derive new information.
CO6: Present and communicate results to a scientific audience.

Pre-requisite:

1. All core theory and lab courses

CO/ PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S												
CO2			S											
CO3			S		S				S					
CO4														
CO5								M						
CO6					S					S				

Course Content **30 hours**

Student in discussion with the guide chooses to design and carry out a novel research problem

Theory: 0 hours Tutorial: 0 hours Practical: 0 hours Project: 60 hours Total hours: 30

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U17VEP7507 GLOBAL VALUES

L	T	P	PJ	C
3	0	0	0	3

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Aware of the concept of Universal Brotherhood and support the organizations which areworking for it.
CO2: Follow the path of Ahimsa in every aspect of their life
CO3: Uphold the Universal declaration of Human Rights
CO4: Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth
CO5: Sensitize the environmental degradation and work for the sustainable development
CO6: Amalgamate harmony through Non-violence and edify the nation headed for upholding development.

Pre-requisite:

1. U17VEP1501 Personal Values
2. U17VEP2502 Interpersonal Values
3. U17VEP3503 Family Values
4. U17VEP4504 Professional Values
5. U17VEP5505 Social Values
6. U17VEP6506 National Values

CO/ PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							M							
CO2								S						
CO3									M					
CO4						S								
CO5											M			
CO6												S		

Course Assessment Methods			
Direct		Indirect	
1	Group Activity/ Individual Performance	1	Mini project on values
2	Assignment	2	Goodwill Recognition
3	Assessment on values work sheet/ test		

Course Content

1. **Universal Brotherhood**

Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings -Red Cross, UN Office for Humanitarian Affairs – Case study on humanitarian problems and intervention - Active role of Students/Individual on Universal Brotherhood.

2. **Global Peace, Harmony and Unity**

Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.

Signature of BOS Chairman

3. **Non-Violence**

Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence– Practicing nonviolence in everyday life.

4. **Humanity and Justice**

Universal declaration of Human Rights - Broad classification - Relevant Constitutional Provisions– Judicial activism on human rights violation - Case study on Human rights violation– Adherence to human rights by Students/Individuals.

5. **Inclusive growth and sustainable development**

Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality –Protection of environment – Case study on inequality and environmental degradation and remedial measures.

WORKSHOP MODE

Web-References:

1. Teaching Asia-Pacific Core Values Of Peace And Harmony – Unicef
2. Three-Dimensional Action For World Prosperity And Peace- Iim Indore -
3. My Non-Violence - Mahatma Gandhi
4. Human Rights And The Constitution Of India 8th ... - India Juris
5. The Ethics Of Sustainability – Research Gate

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SEMESTER - VIII

U17BTP8701 PROJECT PHASE-II

L	T	P	PJ	C
0	0	0	24	12

Course Objectives:

- To develop skills to identify and find solutions to various problems using biotechnology.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Ability to survey literature relevant to the topic under consideration.
CO2: Design a research problem using sound scientific principles.
CO3: Conduct experiments with suitable controls and safety considerations.
CO4: Perform statistical operations and analyze results.
CO5: Interpret results and derive new information.
CO6: Present and communicate results to a scientific audience.

Pre-requisite:

1. All core theory and lab courses

CO/ PO Mapping

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

	PROGRAMME OUTCOMES (Pos)												PSOs	
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S												
CO2			S											
CO3			S		S				S					
CO4														
CO5								M						
CO6					S					S				

Course Content **30 hours**

Student in discussion with the guide chooses to design and carry out a novel research problem

Theory: 0 hours Tutorial: 0 hours Practical: 0 hours Project: 180 hours Total hours: 180

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ELECTIVES

Signature of BOS chairman, BT

U17BTE0001	CHEMICAL REACTION ENGINEERING	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To familiarize the principles and concepts of kinetics and application of reactors.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Elucidate the basic laws on chemical kinetics and its application on different types of reactions
CO2 Apply the various ideal reactors and their design equations
CO3: Elaborate the non-ideal behaviour of reactors
CO4: Conceptualize the basic of heterogeneous reacting systems
CO5: Identify and analyse the various multiphase reactors
CO6: Solve the importance of multiphase rectors

Pre-requisite Course:

1. U17BTT4001: Fluid and Particle mechanics in Bioprocess

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M			S		S			S
CO2	S	S		M	S					M		M		M
CO3	S	M	S							S				
CO4				S	S	M			M		M			M
CO5	S	M		M										S
CO6	M					M			S		S		M	M

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CHEMICAL REACTION KINETICS **9 hour**

Classification of chemical reactions, order and molecularity, rate equation, rate constant; Activation energy, Concentration and temperature dependence; Search for reaction mechanism, Methods of analyzing batch reactor data - Integral and differential, Analysis of total pressure data obtained in constant volume system

IDEAL REACTORS **9 hour**

Performance equations - batch, plug flow and mixed flow reactors; Space time and Space velocity; Size comparison of single reactors, multiple reactor systems, Recycle reactor and autocatalytic reactions.

NON-IDEAL REACTORS **9 hour**

Reasons for non-ideality in reactors; RTD function and measurement; RTD in plug flow and mixed flow reactor ; conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models- tank in series and dispersion models.

HETEROGENEOUS REACTING SYSTEM **9 hour**

Signature of BOS chairman, BT

Introduction to heterogeneous reacting systems, Ideal contacting patterns, Solid catalysed reactions - Surface kinetics and pore resistance, Kinetics of non catalytic fluid particle systems - Progressive conversion model and shrinking core model, Determination of rate controlling step

INDUSTRIAL REACTORS **9 hour**

Reactors to carry out G/L reactions on solid catalysts - Trickle bed, slurry, three phase fluidized bed, fluid-fluid and fluid-particle reactors.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1. Coulson & Richardson's, (2009) "Chemical Engineering, Volume.3: Chemical & Biochemical Reactors & Process control", 3rd Edition, Butterworth – Heinemann, United Kingdom.
2. Levenspiel, Octave, (2008), "Chemical Reaction Engineering", John Wiley & Sons.
3. Walker, D. (2007). Chemical Reactions. Evans Brothers.
4. Fogler, H.S.(1999), Elements of Chemical Reaction Engineering, 2nd Edition, New Delhi: Prentice Hall of India.
5. Carberry, J. J., & Varma, A. (1987). Chemical reaction and reactor engineering.

Web reference

1. https://nptel.ac.in/courses/103108097/

U17BTE0002	FOOD PROCESS ENGINEERING	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To illustrate various pre-processing techniques in food processing
- To discuss the methods in processing foods

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Apply and analyse the pre-cleaning techniques in food processing
CO2 Apply different types of high temperature processing operations
CO3: Illustrate different drying and dehydration techniques
CO4: Categorize several low temperature processing and preservation techniques
CO5: Classify various post -processing operations
CO6: Apply and analyse various packaging operations

Pre-requisite Course: U17BTI3205 Microbiology

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M	S	S	S							S	
CO2	S	M											S	
CO3		M	M			S							S	
CO4		M											S	
CO5	S												S	
CO6		M											S	

Signature of BOS chairman, BT

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

INTRODUCTION TO PRE-PROCESSING **12 Hour**

Raw material preparation: cleaning, air screen cleaners, disk, indent cylinder, spiral, and specific gravity, stone, inclined belt, pneumatic , aspirator; separators: magnetic, cyclone, colour separator, grading; sorting; washing; peeling: flash peeling, steam peeling , knife peeling , abrasion peeling ,lye peeling , flame peeling.

HIGH TEMPERATURE PROCESSING **9 Hour**

Concepts and equipment used in blanching: Blanching theory, equipment, steam blanchers, hot water blanchers; pasteurization and heat sterilization techniques; extrusion; Case Study :evaporation.

PROCESSING USING HOT AIR AND OIL **9 Hour**

Drying: advantages of drying, moisture content, definition, direct and indirect methods of determination; drying methods: heated air and heated surface drying: hot air dryer, contact dryer, rehydration; drying methods and equipment; osmotic dehydration; baking and roasting: theory and equipment; frying: theory and equipment, Osmotic dehydration

PRESERVATION BY LOW TEMPERATURE **9 Hour**

Chilling: theory and equipment, freezing equipment, freeze drying equipment, freeze drying, freeze concentration, thawing, Modified atmospheric storage(MAS),controlled atmospheric storage (CAS).

POST PROCESSING OPERATIONS **6 Hour**

Coating, enrobing, packaging-, Modified atmospheric packaging(MAP), controlled atmospheric packaging(CAP),filling, sealing.

Theory: 45 hour **Tutorial: 0 hour** **Practical: 0 hour** **Project: 0 hour** **Total Hour: 45**

REFERENCES:

1 Barbosa-Canovas, G. V., & Ibarz, A. (2014). Introduction to food process engineering. CRC Press.

2 Sahu, J. K. (Ed.). (2014). Introduction to advanced food process engineering. CRC Press.

3 Earle, R. L. (2013). Unit operations in food processing. Elsevier(e-book).

4 Fellows, P. J. (2009). Food processing technology: principles and practice. Elsevier.

5 Sahay, K. M., & Singh, K. K. (1996). Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd.

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U17BTE0003	FOOD PRESERVATION TECHNOLOGY	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To explain the principles of food preservation and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To describe with the recent methods of minimal processing of foods
- To discuss the materials and types of packaging for foods

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Identify the causes of spoilage
CO2 Categorize high temperature processing techniques
CO3: Apply drying techniques for different foods
CO4: Compare various low temperature processing techniques
CO5: Examine various non-thermal methods of preservation
CO6: Analyze various packaging techniques

Pre-requisite Course:

1. U17BTE002 Food Process Engineering

CO/PO /PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M				M							S	
CO2	S	M	M										S	
CO3		M	M			S							S	
CO4	M				M								S	
CO5	S												S	
CO6		M											S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

FOOD AND ITS PRESERVATION **6 Hour**

General principles of preservation, classification of methods used for preservation, need and importance of preservation at domestic and large scale, Causes of food spoilage; Nature of harvested crop, plant and animal – moisture, pH and water activity of foods.

CANNING, RETORT PROCESSING, CONCENTRATION AND DRYING **12 Hour**

Signature of BOS chairman, BT

Types and classification of foods used for canning; spoilage of canned and bottled foods, storage of canned foods; Influence of canning on the quality of food; retort pouch processing. Drying –influence of drying on pigments and enzymes; Dehydration of fruits, vegetables, milk, animal products ; Case Study :Osmotic methods. Principles of preservation by use of acid, sugar and salt; High solid - high acid foods; jelly making, food concentrates. Pickling and curing and microbial fermentation.

PRESERVATION BY LOW TEMPERATURE **9 Hour**

Principles of storage using low temperature; Product storage; Effect of cold storage on quality, storage of grains; Principles of refrigerated gas storage of foods, Gas packed refrigerated dough, Sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers. Principles of food freezing: Freezing of raw and processed foods, freeze concentration, freeze drying, IQF.

NON-THERMAL METHODS **9 Hour**

Chemical preservatives, preservation by ionizing radiations, ultrasonication, high pressure, fermentation, curing, pickling, smoking, membrane technology; Hurdle technology, application of infra-red microwaves; Ohmic heating; control of water activity.

FOOD PACKAGING **9 Hour**

Basic packaging materials, types of packaging materials used for different kinds of foods, HACCP Introduction and Principles, Introduction to Food Labelling.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1 Hui, Y. H., & Evranuz, E. Ö. (Eds.). (2015). Handbook of vegetable preservation and processing. CRC press.

2. Gould, G. W. (2012). New methods of food preservation. Springer Science & Business Media.

3. Rahman, M. S. (2007). Food Preservation. In Handbook of Food Preservation, Second Edition (pp. 14-29). CRC press.

4. Subbulakshmi, G., and Shobha A. Udipi.(2006) .Food Processing and Preservation. New Age Publications.

5. Gould, G. W. (1996). Methods for preservation and extension of shelf life. International journal of food microbiology, 33(1), 51-64.

U17BTE0004	**CANCER BIOLOGY**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

Course Objectives:

- To learn about the fundamentals of carcinogenesis and role of oncogenes
- To understand the regulation of cell cycle in cancer and mechanism of cancer metastasis
- To know about the strategies for cancer diagnosis and therapy

Course Outcomes (COs):

After successful completion of this course, the students should be able to

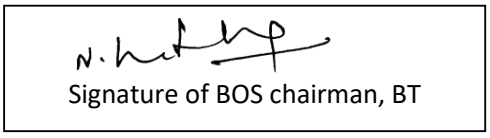
CO1: Comprehend role and function of genes in cell cycle regulation

CO2 Apply and evaluate mechanism of oncogenes and proto-oncogenes in cell cycle regulation in cancer

CO3: Attain the knowledge in the fundamentals of carcinogenesis and its role in cancer

CO4: Illustrate the mechanism of cancer metastasis and progression of cancer stage

CO5: Comprehend the basis of molecular diagnosis of cancer and cancer therapy



CO6: Apply techniques in the field of cancer diagnosis and forms of therapy

Prerequisite

U17BTI4203 Cell & Molecular Biology

U17BTI5201 Genetic engineering and genomics

CO/PO/PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S										S	
CO2	S												S	
CO3	S		S			S							S	
CO4	S		M	S		S							S	
CO5	S		S			S							S	
CO6	S		S	S		S							S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CELL CYCLE REGULATION **9 hour**

Regulation of cell cycle - *S. pombe*, *S. cerevesiae* and mammalian system; Types of mutations that cause changes in signal molecules; Effects on receptor; Tumor suppressor genes -p53 and Rb proteins; Modulation of cell cycle in cancer; Mechanism of action of telomerase. Interaction of cancer cells with normal cells. Role of antioxidants in preventing cancer

ONCOGENES AND PROTO ONCOGENES **9 hour**

Mechanism of oncogene and proto oncogene – epidermal growth factor (EGF), platelet derived growth factor (PDGF), transforming growth factor (TGF), src and myc; RAS cycle; Oncogenes – Identification and detection; Apoptosis – intrinsic and extrinsic pathways. Genetic rearrangements in progenitor cells

MECHANISM OF CARCINOGENESIS **9 hour**

Carcinogenesis – introduction and types; Chemical carcinogenesis – Direct acting and indirect acting carcinogens; Metabolism of carcinogens - CYP450 reductase mechanism; Mechanism of radiation carcinogenesis – ionizing and non-ionizing radiation; Retroviruses - RSV life cycle and its role in cancer; Identification of carcinogens- Long (rat or mice model) and short term bioassays (Bacteria and yeast culture).

CANCER METASTASIS **9 hour**

Metastasis – Introduction and cascade; Clinical significances and three step theory of invasion; Significance of proteases in basement membrane disruption; Properties of cancer cell; brain, oral, lung, uterus, breast & blood – etiology, diagnosis and treatment.

Case study – oral, breast and blood cancers

MOLECULAR DIAGNOSIS AND THERAPY **9 hour**

Cancer diagnosis– biochemical assays; Tumor markers; Molecular tools for early diagnosis of cancer; Prediction of aggressiveness of cancer; Different forms of therapy – stem cell therapy, Chemotherapy, Radiation therapy and Immunotherapy.

Signature of BOS chairman, BT

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

REFERENCES

1. Weinberg, R. (2013). The biology of cancer. Garland science.
2. Pelengaris, S., & Khan, M. (Eds.). (2013). The molecular biology of cancer: A bridge from bench to bedside. John Wiley & Sons.
3. Fauci, A. S. (Ed.). (2008). Harrison's principles of internal medicine (Vol. 2, pp. 1888-1889). New York: Mcgraw-hill.
4. Thomas, G. (2011). Medicinal chemistry: an introduction. John Wiley & Sons..
5. Tannock, I. F. (2005). The basic science of oncology. McGraw-Hill.
6. Lewin, B., & Lewin, B. (2004). genes VIII (No. Sirsi) i9780131439818). Upper Saddle River, NJ: Pearson Prentice Hall.

Web References:

1. http://www.cyclacel.com/research_science_cell-cycle.shtml
2. http://www.cancer.org/treatment/treatmentsandsideeffects/treatmenttypes/
3. http://www.cancer.gov/about-cancer/treatment/types

		L	T	P	J	C
U17BTE0005	**VACCINE TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**

Course Objectives:

- To describe the differences between conventional vaccines and purified antigen vaccines.
- To understand advancement of therapeutic vaccines preparation methods and technological applications
- To acquire fundamental knowledge related to regulatory issues, guidelines and environmental concerns with the use of recombinant vaccines

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Comprehend knowledge about the historical vaccine development and conventional vaccines in disease prevention

CO2: Classify and understand about different bacterial vaccine preparation methods

CO3: Acquire fundamental research knowledge to implement the production viral vaccines

CO4: Understand advancement of therapeutic vaccines and technological applications

CO5: Recognize the fundamental knowledge vaccine production through modern recombinant DNA and vaccine delivery methods

CO6: Understand the regulatory issues, guidelines and environmental concerns with the use of recombinant vaccines

Prerequisite

U17BTT6001 Biopharmaceutical Technology; U17BTT6204 Immunology

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CO/PO/PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	S	M	S	S	S						S	M
CO2	S		S		M	S	S							
CO3	S		S		M		S							
CO4	S		S		M		S							
CO5	S		S		S	M	M							
CO6	M		S				S						M	S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

INTRODUCTION TO VACCINATION **9 hour**

History of vaccine development, Conventional Vaccines, Purified antigen Vaccines. Role of WHO and UIP in disease prevention, Conventional strategies for vaccine development. Live, attenuated, subunit and killed vaccines

BACTERIAL VACCINES **9 hour**

Brief history of Fermentation culture; Technology related to monitoring, temperature, sterilization, environment, quality assurance and related areas. Production techniques - growing the microorganisms in maximum toxicity level, preservation techniques, production and testing of BCG, DPT,TT,

Case Study : A cellular pertussis vaccine and Meningococcal vaccine

VIRAL VACCINES **9 hour**

Primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation, application of cell culture technology in production of human and animal viral vaccines, Bioreactor technology, freeze drying.

Case study

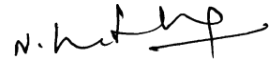
VACCINE BIOTECHNOLOGY AND DELIVERY METHODS **9 hour**

Vaccine production through recombinant DNA - Various approaches for Novel Vaccine production. Recombinant polypeptide Vaccines, DNA vaccines, Edible Vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines, plant-based vaccines, Strategies and Development (Vaccinia virus recombinants), Role and properties of adjuvants, types of adjuvant, Immunomodulators Innovative methods of delivery of immunogen through liposome's, microspheres, ISCOMS, Nasal immunization.

Case study**:** Nanoemulsion

GUIDELINES FOR THE MANAGEMENT **9 hour**

Regulatory issues Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines such as seed management Method of manufacture – in-process control, batch control, test on final products.



Signature of BOS chairman, BT

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

REFERENCES

1. Plotkin, S., Orenstein, W., Offit, P., & Edwards, K. M. (2018). Plotkin's vaccines. *Ljugman P. Cap*, *69*, 1381.
2. Fox, C. B. (2017). *Vaccine Adjuvants*. Humana Press,.
3. Ellis, R. W. (2001). *New vaccine technologies* (Vol. 26). Landes Bioscience.
4. Davies, G. (2010). *Vaccine Adjuvants*. Nova York: Humana Press.
5. Singh, M. (Ed.). (2007). *Vaccine adjuvants and delivery systems*. John Wiley & Sons.
6. Owen, J. A., Punt, J., & Stranford, S. A. (2013). *Kuby immunology* (p. 692). New York: WH Freeman.

U17BTE0006	MOLECULAR DIAGNOSTICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To learn about the diagnostic techniques related to pathogenic diseases and pre-natal testing.
- To understand the biomarkers for disease diagnosis and biochemical diagnostics.
- To explore the diagnostics tools available for cancer and genetic disorders.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Define the significance of molecular diagnostics and enlist the type of diseases and infections.

CO2 Evaluate the diagnostic tools available for identifying the infections caused by micro-organisms

CO3: Relate the biomarkers as diagnostic tools and infer the biochemical diagnostics for metabolic disorders.

CO4: Comprehend the techniques for the pre-natal testing of inherited genetic disorders.

CO5: Apply the methods available for the diagnosis of cancer.

CO6: Outline the genetic disorders and the tools employed for the detection of neo-natal diseases.

Pre-requisite Courses:

1. U17BTI5201 – Genetic Engineering and Genomics

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S			S							S	
CO2	S	M	S		S	S							S	
CO3	S	M	S		S	S							S	
CO4	S	M	S		S	S							S	
CO5	S	M	S		S	S							S	
CO6	S		S		S	S							S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

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Course Content

INTRODUCTION TO MOLECULAR DIAGNOSTICS **9 hour**

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.

Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites.

PATHOGEN DIAGNOSTIC TECHNIQUES **6 hour**

Diagnosis of DNA and RNA viruses. Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis. Study of helminthic diseases: *Fasciola hepatica* and *Ascaris lumbricoides*. Filariasis and Schistosomiasis

Case study: Diagnosis of Dengue virus

BIOMARKERS IN DISEASE DIAGNOSTICS AND BIOCHEMICAL DIAGNOSTICS 9 hour

FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.

Biochemical diagnostics: inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders

PRENATAL DIAGNOSIS **9 hour**

Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques -Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood. Diagnosis using protein and enzyme markers, monoclonal antibodies. DNA/RNA based diagnosis Hepatitis, CML-bcr/abl, HIV - CD 4 receptor. Microarray technology- genomic and cDNA arrays, application to diseases.

CANCER AND GENETIC DISORDERS DIAGNOSTICS **12 hour**

Methods available for the diagnosis of genetic diseases and metabolic disorders.

Cancer - Cancer cytogenetics. Spectral karyotyping. Genes in pedigree. Genetic Counselling.

Genetic disorders - Sickle cell anaemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex –linked inherited disorders.

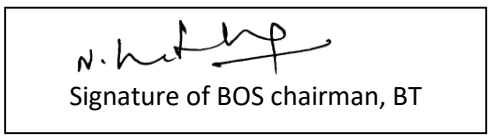
Neonatal and Prenatal disease diagnostics. Gender identification using amelogenin gene locus. Amplification of Y chromosome specific Short Tandem Repeats (Y-STR). Analysis of mitochondrial DNA for maternal inheritance. karyotype analysis. G-banding, in situ hybridization (FISH and on-FISH), and comparative genomic hybridization (CGH).

Case study: Immuno diagnosis of cancer

Theory: 45 hour **Tutorial: 0 hour** **Practical: 0 hour** **Project: 0 hour** **Total Hour: 45**

References:

1. Nader, R.(2018). *Teitz Textbook of Clinical Chemistry and Molecular Diagnostics.* 6th edition, Saunders.
2. George, P., Wilhelm, A., Philip, B.D. (2016). *Molecular Diagnostics*. 3rd edition. Academic Press.
3. Wayne W. G, Robert M. N, Frederick L. K. and Charles S. (2010) *In: Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory*, 2nd edition, Elsevier Science.
4. Betty A. F., Daniel F. S., Alice S. W. and Ernest A. T. (2007). *Bailey & Scott's Diagnostic Microbiology*, 12th edition, Mosby Inc.
5. David E. B, Edward R. A. and Carl A. B. (2007). *Fundamentals of Molecular Diagnostics.* 1st edition, Saunders Group.



Web References:

6. https://www.sciencedirect.com/topics/medicine-and-dentistry/molecular-diagnostics
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1214554/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4375750/

		L	T	P	J	C
U17BTE0007	**NANOBIOTECHNOLOGY**	**3**	**0**	**0**	**0**	**3**

Course Objectives:

- To develop the knowledge on nanomaterials synthesis and characterization and their applications

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Understand the synthesis processing of various nanomaterials
CO2: Apply and interpret the various characterization techniques for nanomaterials
CO3: Apply and evaluate the various nanomaterials applications in different field
CO4: Understand and apply the natural bionanomlecules for various biological applications
CO5: Understand and apply the nanobiochips, nanobiosensor and micro array for biological applications
CO6: Evaluate the nanomaterials in cancer diagnosis and treatment

Prerequisite: U17BBT3002 – Biomolecules and Genetics

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S				M								
CO2	S	S	M			S						M		
CO3	S		S									S	M	S
CO4	S		S	M								M		S
CO5	S	S										S		S
CO6	S													S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

INTRODUCTION TO NANOBIOTECHNOLOGY **9 hour**

Introduction to Nanotechnology and nanobiotechnology: Properties at nanoscale; overview of nanodevices and techniques; General synthesis methods of nanoscale materials; top down and bottom up approaches; Biological approach to self assembly.

CHARACTERIZATION TECHNIQUES **9 hour**

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X-ray diffraction technique; Scanning Electron Microscopy with EDX; Transmission Electron Microscopy, Zeta Potential, Particle size analyzer; Surface Analysis techniques;: AFM, SPM, STM, SNOM, ESCA, SIMS; Nanoindentation.

NANOMATERIALS AND APPLICATIONS **9 hour**

Inorganic nanoscale systems for biosystems: nanostructure materials of fullerenes, carbon nanotubes, quantum dots and wires, preparation, properties and applications; Nanopores: applications.

NANOMOLECULES IN BIOSYSTEMS **9 hour**

Nanomolecules in biosystems: Proteins, RNA and DNA nanoscale elements for delivery of materials into cells; DNA based artificial nanostructures; proteins as components in nanodevices; Tissue regeneration using anti-inflammatory nanofibres; Polymer nanofibers and applications; polymer nanocontainer; magnetosomes; bacteriorhodopsin: applications; S-layer proteins.

APPLICATION OF NANOBIOTECHNOLOGY **9 hour**

Nanoscale devices for drug delivery: micelles for drug delivery; targeting; bioimaging; microarray and genome chips; nanobiosensors and nanobiochips; Nanotechnology for cancer diagnosis and treatment; Case study: Nanomaterials on drug delivery.

Theory: 45 hour **Tutorial: 0 hour** **Practical: 0 hour** **Project: 0 hour** **Total Hour: 45**

REFERENCES

1. Niemeyer, C. M., and CA Mirkin, C. A., (2010); NanoBiotechnology II – More concepts, and applications. First edition, Wiley –VCH publications
2. Rosenthal, S.J. and Wright, D.W., (2010); Nanobiotechnology Protocols, First Edition, Humana Press
3. Oded shoseyov & Ilan Levy (2008); Nanobiotechnology – Bioinspired and materials of future. Humana press, New Jersey
4. Mirkin, C. A., & Niemeyer, C. M. (Eds.). (2007). Nanobiotechnology II: more concepts and applications. John Wiley & Sons.
5. Jain, K. K. (2006); NanoBiotechnology in molecular diagnostics –current technique and applications, First edition, Taylor and Francis

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1. http://www.understandingnano.com

		L	T	P	J	C
U17BTE0008	**NEUROBIOLOGY AND COGNITIVE SCIENCES**	**3**	**0**	**0**	**0**	**3**

Course Objectives:

- To learn about the neuroanatomy and neurophysiology
- To understand the concept of synaptic transmission and mechanism of action of neurotransmitters
- To gain insight into the mechanism of sensations and disorders related to nervous system.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Comprehend the central and peripheral nervous system, and describe the structure and functions of neurons and supporting cells

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CO2 Analyze the mechanism of action potential conduction and working of voltage dependent channels.

CO3: Illustrate the concept of synaptic transmission and mechanism of action of neurotransmitters.

CO4: Evaluate mechanism of sensations and skeletal muscle contraction.

CO5: Enumerate the mechanisms associated with motivation behaviors.

CO6: Summarize the various disorders of nervous system.

Pre-requisite Course:

1. U17BTI3204 Concepts in Biochemistry

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S			M								
CO2	S													
CO3	S					M							W	
CO4	S		M		S	S						S	W	
CO5	S		S			S							M	
CO6	S	S	S			S						S	S	

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

NEUROANATOMY **9 hour**

Classification of central and peripheral nervous system, Neurons: structure, types and functions – Neuronal membrane, cytoskeleton, axon, dendrites; Glial cells: types; Synapses: types and functions; Myelination; Blood Brain barrier; Neural Development; Cerebrospinal fluid: origin and composition; Spinal cord - functions.

NEUROPHYSIOLOGY **9 hour**

Resting and action potential: introduction; Properties and mechanism of action potential conduction; Voltage dependent channels: sodium and potassium channels; Principle of metabotropic receptors; Electrical transmission

NEUROPHARMACOLOGY **9 hour**

Synapse formation; Synaptic transmission: Principles of Chemical synaptic transmission.

Principles of synaptic integration; neurotransmitters and their mechanism of action: acetyl choline, serotonin, dopamine and γ-amino butyric acid (GABA); Peptide transmitters: mechanism of action; Nicotinic and muscarinic acetyl choline receptors; hypothalamic control of neuronal function

APPLIED NEUROBIOLOGY & MODERN DIAGNOSTIC TOOLS **9 hour**

Basic mechanisms of sensations: touch, pain, smell, taste; neurological mechanisms of vision and audition; skeletal muscle contraction (neuromuscular junction).

Imaging techniques to study Brain functions – EEG, MRI

Case study – Brain-Machine Interface

BEHAVIOURAL SCIENCE **9 hour**

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Basic mechanisms associated with motivation; Hypothalmus, homeostasis and motivated behavior; regulation of feeding, sleep, emotions. Molecular mechanisms of memory and leaning; Disorders associated with nervous system: Parkinson's disease, Alzheimer's disease, Schizoprenia, Epilepsy; Anxiety and mood disorders - Depression, Agrophobia.

Case study – Degenerative diseases of the nervous system

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1. Striedter, G. F. (2015). Neurobiology: a functional approach. Oxford University Press.
2. Squire, L., Berg, D., Bloom, F.E., du Lac, S., Ghosh, A., Spitzer, N.C (2012). Fundamental Neuroscience, 4th edition, UK: Academic Press.
3. Abel, L. & Sylvester, E.V (2008). Handbook of Neurochemistry and Molecular Neurobiology: Neurotransmitter systems, 3rd edition, Springer.
4. Bear, M., Connors, B., &Paradiso, M. (2006). *Neuroscience – Exploring the Brain*, 3rd edition, USA: Lippincott Williams & Wilkins
5. Mathews G G. (2000). *Neurobiology*: Molecules, cells and systems, 2nd edition, UK: Blackwell Science.

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1. https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-01-introduction-to-neuroscience-fall-2007/lecture-notes/
2. https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-01-neuroscience-and-behavior-fall-2003/study-materials/

U17BTE0009	MEMBRANE TECHNOLOGY	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To learn and apply the principles of membranes in the water treatment, bioprocess and food process industries

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Learn various transport models for the calculation of membrane fluxes and the extent of separation for various membrane systems

CO2 Identify the types of experimental data needed for the calculation of membrane parameters

CO3: Understand the pretreatment techniques for the membranes

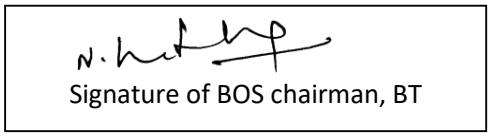
CO4: Select a membrane process and design components to carry out a specific separation

CO5: Comprehend advancements in membrane techniques to solve environmental problems

CO6: Design the membrane separation for bio and food processes

Prerequisite

1. U17BTT3003 Bioprocess Calculations
2. U17BTI5203 Heat and mass transport in Bioprocess



CO/PO/PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	S			S							M		S
CO2	M	S			S							M		S
CO3	M	S			S							M		S
CO4	M	S			S							M		S
CO5	M	S			S		M					M		S
CO6	M	S			S		M		M			M		S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

INTRODUCTION **9 hour**

Solid Liquid separation systems - Filtration -Theory of Membrane separation - Mass transport Characteristics - Cross Flow filtration - Types and choice of membranes, Plate and Frame, spiral wound and hollow fibre membranes - Liquid Membranes: Emulsion and supportive liquid membrane

THEORY AND PRINCIPLE **9 hour**

Microfiltration-Ultrafiltration-Nano Filtration -Reverse Osmosis -Electro dialysis-Pervaporation - Membrane Module/Element designs-Membrane System components-Design of Membrane systems

PRETREATMENT **9 hour**

Membrane Fouling -Pretreatment methods and strategies -monitoring of Pretreatment-Langlier Index, Silt Density Index, Chemical cleaning, Biofoulant control

HETEROGENEOUS REACTING SYSTEM MEMBRANES IN WATER TREATMENT **9 hour**

Introduction and Historical Perspective of Membrane Bioreactors (MBR), Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations

MEMBRANE IN BIO AND FOOD PROCESSES **9 hour**

Bioprocess: Hemodialysis-electrodialysis-Virus removal by ultrafiltration. Food process: membrane distillation, Pervaporation, membranes in dairy industry

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1. Ho, W., & Sirkar, K. (2012). *Membrane handbook*. Springer Science & Business Media.
2. Bungay, J. K. (2012). *Synthetic Membranes:: Science, Engineering and Applications* (Vol. 181). Springer Science & Business Media.
3. Mulder, J. (2012). *Basic principles of membrane technology*. Springer Science & Business Media.
4. Baker, R. W., & Updated by Staff. (2000). Membrane technology. *Kirk-Othmer Encyclopedia of Chemical Technology*.
5. Cheryan, M. (1998). *Ultrafiltration and microfiltration handbook*. CRC press.

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1. 1. http://nptel.ac.in/courses/103103032
2. 2. http://nptel.ac.in/courses/103103035

U17BTE0010	BIOENTREPRENEURSHIP	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To learn about the factors, attributes and indicators of bio-entrepreneurship.
- To learn the business strategies and technology transfer in biotech companies.
- To study the various concepts on creativity, innovation, product development and technology transfer

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: To learn about the factors, attributes and indicators of bio-entrepreneurship.

CO2 To learn business strategies and technology transfer in biotech companies.

CO3: Illustrate the components of biotechnology companies

CO4: To impart the knowledge on Creativity, Innovation and New product development.

CO5: To inculcate novel strategies on identifying market demands, establishing market niche.

Pre-requisite Course:-

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M			S		S			
CO2	S	S		M	S					M		M		
CO3	S	M	S							S				
CO4				S	S	M			M		M			
CO5	S	M		M										
CO6	S													

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

FUNDAMENTALS OF ENTREPRENEURSHIP **9 hour**

Entrepreneurship, Definition; Factors necessary for Entrepreneurship, Attributes in an Entrepreneur, Bio-entrepreneurship, Indicators of Bio-entrepreneurship Case study: Building of a Bio-entrepreneur.

FUNDING OPTIONS, FINANCIAL PLANNING AND INVESTMENT STRATEGIES 9 hour

Writing a business proposal, funding and establishing a biotech start-up, basics of trading, stocks and shares, risk management and diversification of risks.

COMPONENTS OF BIOTECH COMPANY AND BUSSINESS MODELS **9 hour**

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Paths for starting new biotech ventures, history of pioneering biotech companies, Key for success, Mission and Strategy, product selection for new biotech venture, evaluation of company's annual report (a case study).

INNOVATION AND TECHNOLOGY TRANSFER **9 hour**

Intellectual property in biotech - Licensing, Accessing University technology, Licensing of Biotechnological invention, Funding agencies in India.

MARKET RESEARCH AND PRODUCT DEVELOPMENT **9 hour**

Strategies to identify market demands, establishing market niche, competing in a crowded market place, adaptation to market needs and case study on Indian and global entrepreneurs.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

REFERENCES:

1. Navi R, 2015, Frugal Innovation: How to do more with less, The Economist.
2. Joel G and Andrew T, 2015, The Little Book That Still Beats the Market, Wiley Books.
3. Venter J.C, 2014, Life at the Speed of Light: From the Double Helix to the Dawn of Digital Life, Little Brown Book Group.
4. Branson R, 2009, Business Stripped Bare: Adventures of a Global Entrepreneur, Virgin Books.
5. Jogdand, S.N. 2007. Entrepreneurship and Business of Biotechnology, Himalaya Publishing Home,

U17BTE0011	INDUSTRIAL BIOSAFETY AND BIOETHICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To create awareness, practice of Industrial biosafety regulation and bioethics

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Describe various risk assessments and associated biosafety practices at industrial level.

CO2 Demonstrate and Classify Biosafety levels

CO3: Elucidate various biosafety guidelines, norms and regulations.

CO4: Assess GMO's and its regulation in terms of environmental release

CO5: Acquire knowledge on ethical issues, guideline and regulations.

CO6: Discuss environmental release of GMOs and their impact

Pre-requisite Course:

CO/PO/PSO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2	S	S			M		M	M					S	S
CO3		M			S		S	S						M
CO4		M			S		S	M						M
CO5		S			M							M		S
CO6	S	S											S	S

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Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

INDUSTRIAL BIOSAFETY **9 hour**

Introduction to Biosafety; Causes- classification, identification of hazards; issues handling; awareness of accidents at industrial level; types of accidents; first aid, precautionary measure;Clean room procedures- Classification specification; Personal protective equipment working with biohazards; Proper gowning and hygiene for clean room work; Behavioral requirements in a controlled environment; Basic methods for safe handling, transport, and storage of biological and chemical materials; Equipment related hazards; safe laboratory techniques; Contingency plan and emergency procedures.

LEVELS OF BIOSAFETY **12 hour**

Introduction to Biological safety cabinets; Horizontal & Vertical Laminar Air Flow Cabin; Fume hood; Primary and secondary containments; Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens); MSDS- Material Safety Data Sheet- Understanding, and infected animals (test animals).

FDA AND FPO BIOSAFETY GUIDELINES **6 hour**

FDA guideline and approval; FPO specification and guidelines for food products; GOI - Biosafety procedure, time frames and specification for Production and manufacturing industries- Case study

INTRODUCTION TO BIOETHICS **6 hour**

Definition of bioethics; Environmental release of GMOs- Risk analysis, Risk assessment, Risk management and Communication; Precaution before and after environmental release of GMO's – case study.

REGULATORY AFFAIRS **12 hour**

Overview of national regulation and international agreement on GMO; Cartagena protocol- articles; Ethical committee- administration channel; Role of NIH, IACUC,IBSC

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

References:

1. Deepa Goel and Ms.Shomini Parashar , (2013) IPR, Biosafety and Bioethics, Pearson Education publisher
2. Kumar S (2012) Biosafety issues in laboratory research. Biosafety 1:e116.
3. Sateesh, M. K. (2010) Bioethics and biosafety. IK International Pvt Ltd.
4. Singh. K, (2010), Intellectual Property Rights in Biotechnology, BCLI, New Delhi
5. Shaleesha A. Stanley (2007) Bioethics, Wisdom educational service, Chennai.
6. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASMPress, Washington.

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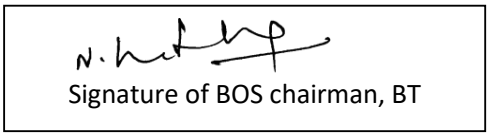
1. http://blink.ucsd.edu/safety/research-lab/biosafety/
2. http://ces.iisc.ernet.in/hpg/cesmg/iprdoc.html
3. https://www.fic.nih.gov/RESEARCHTOPICS/BIOETHICS/Pages/teachers-students.aspx
4. 4https://www.omicsonline.org/open-access/biosafety-issues-of-genetically-modified-organisms-2167-0331.1000e150.php?aid=27764&view=mobile
5. http://www.who.int/csr/resources/publications/biosafety/Biosafety



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U17BTE0012	BIOPROCESS DESIGN AND ECONOMICS	L	T	P	PJ	C
		3	0	0	0	3

Course Objectives:

To introduce about the various application of chemical engineering principles for development of new processes to produce these new chemicals, and development of marketable technology

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Able to apply and develop the flow sheets used in bioprocess industry

CO2 Apply and evaluate the capital cost for construction of a new plant or modifications to an existing chemical manufacturing plant

CO3: Apply and evaluate the manufacturing cost (operating cost)for production of bioproducts

CO4: Apply and evaluate the economic evaluation of the bioproducts

CO5: Understand the basics of techno-economical assessments for bioenergy systems

CO6: Understand the basics of life cycle assessments for the analysis of bioenergy system

Prerequisite: U17BTI5203 Heat and Mass Transport in Bioprocess

CO/PO Mapping

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

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO 1	PSO 2
CO1	S		M			S								S
CO2	S		M			S								S
CO3	S		M			S								S
CO4	S		M			S								S
CO5	S		M			S								S
CO6	S		M			S								S

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

DIAGRAMS FOR UNDERSTANDING CHEMICAL PROCESSES **9 hours**

Block Flow Diagrams (BFDs), Block Flow Process Diagram, Block Flow Plant Diagram, Process Flow Diagram (PFD), Process Topology, Stream Information, Equipment Information, Combining Topology, Stream Data, and Control Strategy to Give a PFD, Piping and Instrumentation Diagram (P&ID).

ESTIMATION OF CAPITAL COSTS **9 hours**

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Classifications of Capital Cost Estimates, Estimation of Purchased Equipment Costs, Estimating the Total Capital Cost of a Plant- problem solving.

ESTIMATION OF MANUFACTURING COSTS **9 hours**

Factors Affecting the Cost of Manufacturing a Chemical, Product, Cost of Operating Labor, Utility Costs, Background Information on Utilities, Calculation of Utility Cost, Raw Material Costs ,Yearly Costs and Stream Factors, Estimating Utility Costs from the PFD, Cost of Treating Liquid and Solid Waste Streams.
Case study: Evaluation of Cost of Manufacture for the Production of bioethanol.

ENGINEERING ECONOMIC ANALYSIS **9 hours**

Investments and the Time Value of Money. Different Types of Interest. Time Basis for Compound Interest Calculations. Cash Flow Diagrams. Inflation. Depreciation of Capital Investment. Taxation, Cash flow and profit.
Case studies: A Typical Cash Flow Diagram for a New Project. Profitability Criteria for Project Evaluation

TECHNO-ECONOMIC ASSESSMENT **5 hours**

Introduction to Techno-Economic analysis (TEA). Basic steps in TEA; Tools, Software & Data source for performing TEA – Tools available for performing TEA, Procedure for TEA using commercial software, Data source for performing TEA, Process optimization using TEA.

LIFE CYCLE ANALYSIS **4 hours**

Introduction to Life cycle analysis (LCA). Procedure for LCA: Goal and defining and scoping , life cycle Inventory, Life cycle Impact Assessment, Life cycle Interpretation. Tools available to perform LCA. Case studies: Life cycle assessment of bio-based products from agro wastes

Theory : 45 hours **Tutorial: 0 hours** **Practical: 0 hours** **Total: 45 Hours**

References

1. Bhattacharya B.C. (2018), i*ntroduction to chemical equipment design: mechanical aspects*. Chemical Engineering Education Development Centre, Indian Institute of Technology, 1976.
2. Max, S. P., Klaus, D. T., & Ronald, E. W. (2017). Plant design and economics for chemical engineers. *International edition*.
3. Li, Y. (2016). Bioenergy: Principles and Applications. John Wiley & Sons
4. Turton, R., Bailie, R. C., Whiting, W. B., & Shaeiwitz, J. A. (2008) 4/e, *Analysis, synthesis and design of chemical processes*. Pearson Education.
5. Peters, Max S., K.D. Timmerhaus and R.E. West, Plant Design and Economics for Chemical Engineers (2003) 5/e, McGraw-Hill International Editions (Chemical Engineering Series), New York, USA (2003).

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