I SEMESTER SYLLABI
COMMON FOR ALL BRANCHES

Applicable to the students admitted to

R-2021: CBCS

Academic year 2021-2022
onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE
An Autonomous Institution
#60, Avadi – Vel Tech Road, Vel Nagar,
Avadi, Tamil Nadu 600062

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	**HSMC**	Humanities & Social Science including Management Courses
2	**BSC**	Basic Science Courses
3	**ESC**	Engineering Science Courses
4	**PCC**	Professional Core Courses
5	**PEC**	Professional Elective Courses
6	**OEC**	Open Elective Courses
7	**PROJ**	Project Work
8	**EEC**	Employability Enhancement Courses
9	**MC**	Mandatory Courses

Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**25**

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Course code	21EN11T	Semester	I			
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)		L	T	P	C
Course Title	COMMUNICATIVE ENGLISH (COMMON FOR ALL BRANCHES)		3	0	0	3

COURSE OBJECTIVES:

- To exhibit the students of Engineering and Technology to develop their listening and to recall the pattern of listening.
- To facilitate the learners to develop speaking skills to convey their ideas and views in the real context.
- To develop their reading skills and grasp the central ideas of the text.
- To expose them to acquire writing technique with basic grammar.
- To motivate the students to use appropriate vocabulary in academic and categorize the inferences in writings.

PREREQUISITE:

- Foundation of language with Basic English Grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C101. 1	***Listen*** to different talks and lectures and understand them easily.	K1
C101. 2	***Communicate*** their thoughts confidently using communicative strategies	K2
C101. 3	***Read*** and grasp different genres of texts effortlessly	K2
C101. 4	***Write*** grammatically correct academic, business and technical texts	K3
C101. 5	***Apply*** the appropriate vocabulary to communicate efficiently in all forms of communication.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C101. 1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 2	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 3	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 4	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 5	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101. 6	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
C101	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I BASIC GRAMMAR I AND READING FOR INFORMATION 9

PRACTICAL

LISTENING: Listening to short dialogues with good accent

SPEAKING : Introducing oneself - Exchanging personal information

TUTORIAL

READING : Reading short comprehension passages- practice skimming and scanning for specific information

WRITING: Parts of speech - Sentence patterns – Tenses – 'wh'- questions - Yes/No questions -Countable and Uncountable nouns

VOCABULARY AND GRAMMAR: Affixation – word formation - Synonyms and Antonyms.

UNIT II BASIC GRAMMAR II AND SHARING INFORMATION 9

PRACTICAL

LISTENING : Listening to documentaries - inspiring speeches of great leaders and practicing opinion sharing

SPEAKING : Self-introduction - peer introduction - picture description - JAM

TUTORIAL

READING: Note-making- Critical reading finding key information in a given text - shifting facts from opinions and paraphrasing

WRITING: Autobiographical writing (writing about one's leisure time activities, hometown - favourite place and school life) - Biographical writing (place, people)

VOCABULARY AND GRAMMAR: Compound Words – Guessing meaning of words contexts - One Word substitutes – Pronouns- Adjectives – Adverbs – Imperatives - Direct and Indirect questions.

UNIT III BASIC GRAMMAR III AND FREE WRITING 9

PRACTICAL

LISTENING : News Bulletins - Ted talks - telephonic conversations

SPEAKING : functions of Language - giving reasons - talking about future plans - comparing and contrasting - making suggestions

TUTORIAL

READING: Current Affairs - newspaper reading /magazines - loud in the classroom

WRITING: Coherence and cohesion in writing- cause and effect - compare & contrast and narrative & analytical paragraphs.

VOCABULARY AND GRAMMAR: Discourse marker - Reference words - Process description - Conjunctions – Prepositions - Articles - Degrees of comparison.

UNIT IV BASIC GRAMMAR IV AND FREE WRITING 9

PRACTICAL

LISTENING : Listen to audio/ Conversation from BEC/IELTS /TOFEL.

SPEAKING : Interpersonal Skills: Role play/group discussion/debate/ conduct of meeting

TUTORIAL

READING: Reading different types of texts /genres/ for comprehension and pleasure – related with human values.

WRITING: Letter writing (informal letters) and formal letters – rejecting and accepting Letters - Personal emails and etiquette.

VOCABULARY AND GRAMMAR: Single Word substitutes - Use of abbreviations Acronyms - Cloze reading - interpreting visual materials - Jumbled sentences - Subject verb agreement - Modal verbs - Phrasal verbs.

UNIT V BASIC GRAMMAR V AND LANGUAGE DEVELOPMENT 9

PRACTICAL

LISTENING : Listen to official meetings to know about the project proposal.

SPEAKING : Discussing the project and the proposals in the group - Creative writing and speaking - Poster making and description - project proposals.

TUTORIAL

READING: Reading comparison and contrast text with the deeper level of meaning **WRITING :** Essay writing - different types of essays - dialogue writing

VOCABULARY AND GRAMMAR: Word association (connotations) - Lexical items (fixed / semi fixed expressions) - Clause - Direct and indirect speech - Correction of errors.

Total: 45 Periods

Extensive Reading:

Kalam , Abdul. The Wings of Fire , Universities Press, Hyderabad. 19

LEARNING RESOURCES:

TEXT BOOKS:

1. Board of Editors, Department of English, Anna University, Chennai. Using English:A Course Book for Undergraduate Engineers and Technologists, Orient Black Swan: Chennai,2017.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai,2011.

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma, Technical Communication: English Skills for Engineers. Oxford University Press, NewDelhi.2011.

2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006

3. Rizvi M, Ashraf. Effective Technical Communication. Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.

4. Rutherford, Andrea J. Basic Communication Skills for Technology. Pearson Edition (II Edition), NewDelhi, 2001.

5. Mandel, Steve. *Effective Presentation Skills*. New Delhi: Viva Books Pvt. Ltd., 2004.

6. Kilmet, Stephen. "The Resume and "The Computerized Resume." In Writing for Design Professionals.

7. Writing Cover Letters-Kilmet, Stephen. "Cover Letter, "and" Enclosures and Attachments." in Writing for Design Professionals New York.

Course code	21MA12T	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	MATRICES AND DIFFERENTIAL CALCULUS (COMMON FOR ALL BRANCHES)		4	0	0	4

COURSE OBJECTIVES:

- To apply advanced matrix knowledge to solve engineering problems
- To improve their ability in solving geometrical applications of differential calculus
- To familiarize with the application of differential equations

PREREQUISITE:

- Basic Mathematics skills at 12th level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C102.1	***Solve*** Engineering problems using matrices.	K3
C102.2	***Use*** various test to discuss the convergence of infinite series.	K2
C102.3	***Apply*** the geometrical concepts to solve differential calculus.	K4
C102.4	***Compute*** partial derivatives of functions of several variables.	K2
C102.5	***Apply in Engineering many physical initial*** and boundary value problems can be described by ODE.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C102.1	3	3	-	-	-	-	-	-	-	-	-	-
C102.2	3	2	-	-	-	-	-	-	-	-	-	-
C102.3	3	3	-	-	-	-	-	-	-	-	-	-
C102.4	3	2	-	-	-	-	-	-	-	-	-	-
C102.5	3	2	-	-	-	-	-	-	-	-	-	-
C102	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I MATRICES 12

Matrix operations, special types of matrices, matrices as linear transformations, linear independence, Orthogonalization, Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley – Hamilton theorem, Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformations- Nature of quadratic forms.

UNIT II INFINITE SERIES 12

Sequences of real numbers-Series-General properties of series-Comparison test- Integral test, D' Alemberts ratio test and Cauchy's root test- Power series, radius and interval of convergence of power series, Convergence of exponential, logarithmic and Binomial Series, Properties of uniformly convergence series

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 12

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

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 12

Limits and Continuity –Partial derivatives –Homogeneous Functions-Total derivative –Change of variables –Jacobian and properties –Taylor's series for functions of two variables –Maxima and minima of functions of two variables –Lagrange's method of undetermined multipliers.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

Second and Higher Order Equations, homogeneous and non-homogeneous linear equations and linear systems with constant coefficients, method of variation of parameters, method of undetermined coefficients, Equations reducible to linear equations with constant coefficients-Simultaneous linear equations with constant coefficients.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2015.

REFERENCES:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons. Singapore, 10thEdition, 2015.
2. M.K. Venkataraman, Engineering Mathematics- First Year, 2nd Edition, National Publishing., Chennai 2001.
3. T. Veerarajan, Engineering Mathematics-I, Tata McGraw Hill Publishing Co, New Delhi, 2017.

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Course code	21PH13T	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ENGINEERING PHYSICS I (COMMON FOR ALL BRANCHES)		3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of polarization, optical fiber and Lasers
- To familiar the knowledge of electromagnetic waves oscillations
- To understand the importance of quantum physics
- To cognize the basics of heat and thermodynamics
- To express the basics of crystal physics

PREREQUISITE:

- High School Maths and Physics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C103.1	***Utilize*** the concepts of polarization, optical fiber and Lasers for engineering applications	K3
C103.2	***Apply*** the knowledge of electromagnetic waves oscillations	K3
C103.3	***Understand*** the importance of quantum physics.	K2
C103.4	***Cognize*** the basics of heat and thermodynamics	K2
C103.5	***Express*** the basics of crystal physics	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C103.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C103.4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
C103.5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
C103	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I PHOTONICS 9

Polarization and Fiber Optics: Electromagnetic waves - Production and analysis of linearly, elliptic and circularly polarized light-Polaroid and applications of polarization. Fiber optics - principle of operation – numerical aperture - acceptance angle and applications of fiber optics.

Optical Sources: Characteristics of Lasers - Spontaneous and Stimulated Emission of Radiation - Population Inversion - Einstein's Coefficients and Relation between them - Applications of Lasers.

UNIT II WAVES AND OSCILLATION 9

Oscillatory motion: Differential equation of SHM- Velocity and acceleration- Restoring Force- Frequency response - phase response and resonance-Analogy with LCR circuits and oscillators- Energy and energy loss- Damped oscillations- Significance in control systems - vibration and vibration isolation.

Wave motion: Definition of a plane progressive wave- Attenuation of waves- Phase Velocity- Introduction to numerical methods for solution of wave equation- Importance of spherical and plane wave fronts.

UNIT III QUANTUM MECHANICS 9

Need for Quantum Physics-Historical overviews - Matter waves - De-Broglie's concept of matter waves - Properties of matter waves - Photo electric effect - Heisenberg's uncertainty principle – Statement - Interpretation and application - Schrödinger's time dependent and time independent equations - Operators - Eigen values and Eigen functions - Expectation values -Physical significance of wave function-Quantum superposition and entanglement for Qbits (quantitatively)

UNIT IV HEAT AND THERMODYNAMICS 9

Heat and internal energy - Specific heat and calorimetry - Latent Heat coefficient of linear thermal expansion - Methods of measurement of thermal expansion - Thermal expansion -Applications - The bimetallic strip - Differential equation of one-dimensional heat flow - Lee's disc apparatus for determination of thermal conductivity - Thermal Insulation- Heat dissipation and heat sinking of electronic devices-solid state refrigerators (qualitatively)

UNIT V CRYSTAL PHYSICS 9

Introduction of Crystallography - Space Lattice - Unit Cell - Lattice Parameters – Crystal Systems - Bravais Lattices - Miller Indices and its applications - Crystal Planes and Directions- Inter Planar Spacing of Orthogonal Crystal Systems - Atomic Radius - Co-ordination Number and Packing Factor of SC, BCC, FCC – Crystal growth –Solution growth -Structure determination by x-ray diffraction method (cubic structure).

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Richard Wolfson, "Essential University Physics", Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Gaur R K, Gupta S L, "Engineering Physics", DhanpatRai Publications, 2013.

REFERENCES:

1. Halliday D., Resnick R. and Walker J., “Fundamentals of Physics”, Wiley Publications,2008.
2. Avadhanulu M. N., “Engineering Physics”, S. Chand & Co., 2007.
3. Purcell E. M., “Electricity and Magnetism – Berkeley Physics Course”, Vol. 2, Tata McGraw-Hill, 2008.
4. Paul A. Tipler and Geene Mosca, “Physics for Scientists and Engineers”, W.H. Freeman and Company, New York, 2004.

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Course code	**21CY14T**	**Semester**	**I**			
Category	**BASIC SCIENCE COURSE (BSC)**		**L**	**T**	**P**	**C**
Course Title	**ENGINEERING CHEMISTRY (COMMON FOR ALL BRANCHES)**		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students conversant with water quality parameters and treatment techniques.
- To get the basic idea about the polymers, electrochemistry and corrosion.
- To deal with the information about various types of fuels and energy sources.

PREREQUISITE:

- Basic Chemistry Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C104.1	***Understand*** the water related problems and their treatment techniques.	K2
C104.2	***Explain*** the applications of polymers and reinforced plastics.	K2
C104.3	***Acquire*** knowledge on electrochemistry and corrosion.	K2
C104.4	***Summarize*** the types of fuels and its production process and calculate the CV values.	K2
C104.5	***Classify*** the non-conventional energy sources and its applications.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C104.1	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.2	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.4	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104.5	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
C104	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I WATER AND ITS TREATMENT 9

Introduction - characteristics - alkalinity - types and determination - hardness - types expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -boiler feed water-requirements-boiler troubles – scale & sludge -disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) -softening of hard water - external treatment process - demineralization and zeolite, internal treatment - boiler compounds (carbonate, phosphate, Calgon, sodium aluminate and colloidal conditioning methods) – desalination of brackish water –reverse osmosis.

UNIT II POLYMERS AND REINFORCED PLASTICS 9

Introduction - classification of polymers - Natural and synthetic - Thermoplastic and Thermosetting, Functionality - Degree of polymerization, Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index. Types – addition, condensation and Copolymerization – free radical, cationic and anionic polymerization mechanism - Preparation, properties and uses of PVC, Nylon- 6,6, Teflon and Epoxy resin. Plastics - Compounding of plastics – moulding methods – injection, extrusion and compression – Engineering plastics-applications-fibre-reinforced plastics (FRP) – carbon and glass– applications.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential-oxidation potential-reduction potential - measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes- factors- types: chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function Electroplating of Copper and electroless plating of nickel-Chemical conversion coatings-phosphate, chromate, chemical oxide, and anodized coatings.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum – refining- manufacture of synthetic petrol (Bergius process) – knocking - octane number- cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) – synthesis, advantages and commercial application of power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value –problems- ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Energy-Types- Non-renewable energy- Nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries - primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells - H_2-O_2 fuel cell.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai, Publishing Company (P) Ltd., New Delhi, 2015.
2. S.S Dara&S.S Umare, A Text book of Engineering Chemistry, S.Chand & Company Ltd., New Delhi, 2015.

REFERENCES:

1. S. Vairam,P. Kalyani and Suba Ramesh., Engineering Chemistry, Wiley India Pvt. Ltd, New Delhi, 2013.
2. B.K.Sharma, Engineering Chemistry, Krishna Prakasan Media (P) Ltd., Meerut, 2014.
3. Prasanta Rath, Engineering Chemistry, Cengage Learning India Pvt. Ltd, Delhi, 2015.
4. Shikha Agarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
5. V.R.Gowariker, N.V.Viswanathan, J.Sreedhar, Polymer Science, New Age International (P) Ltd., Publishers, New Delhi, 2011.

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Course code	21CS15IT	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON FOR ALL BRANCHES)		2	0	4	4

COURSE OBJECTIVES:

- To be familiar with the basics of algorithmic problem solving.
- To construct python programs with conditionals, loops and functions.
- To use python data structures-Lists, Tuples and Dictionaries.

PREREQUISITE:

- Basic Mathematics Skills and Computer Knowledge

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C105. 1	***Develop*** algorithmic solutions to simple computational problems	K3
C105. 2	***Construct*** simple Python programs for solving problems.	K3
C105. 3	***Build*** Python programs with conditionals and loops.	K3
C105. 4	***Demonstrate*** a Python program into functions.	K2
C105. 5	***Show*** compound data using Python lists, tuples, and dictionaries.	K2
C105. 6	***Read*** and write data from/to files in Python Programs.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	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
C105. 1	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 2	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 3	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 5	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105. 6	3	2	1	-	-	-	-	-	-	-	-	-	2	2
C105	3	2	1	-	-	-	-	-	-	-	-	-	2	2

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT- I ALGORITHMIC PROBLEM SOLVING AND BASICS OF PYTHON 8

Algorithms-building blocks of algorithms (statements, state, control flow, functions), simple Strategies for developing algorithms (iteration, recursion)-pseudo code- flow chart-programming language. Introduction to Python-Features of Python-Python Interpreter: Interactive and script mode- Values and types, variables, Keywords, Identifiers, operators, precedence of operators, expression, Comments.

UNIT-II CONTROL FLOW, FUNCTIONS 8

Conditional statements-Iterative statements, Functions: Built-in functions, user defined function-Function Arguments-Fruitful functions and void functions- local and global variable - function composition- recursion-Lambda Functions.

UNIT-III MODULES, PACKAGES, STRINGS 4

Modules-Packages-Strings-string operations, string functions and methods.

UNIT-IV LISTS, TUPLES, DICTIONARIES 5

Lists- list operations, list methods, list loop, mutability, aliasing, cloning lists-Tuples-Tuple assignment, Operations on Tuples, Tuple as return value- Dictionaries- operations and methods-Sets-Operations on sets.

UNIT-V FILES AND EXCEPTIONS 5

Files –Types of files, file operations, file methods, format operator-command line arguments-Errors and Exceptions, handling exceptions.

List of Experiments: **30 Periods**

1. Write a python program to demonstrate basic data types in python.
2. Write a python program using conditional statements.
3. Write a python program using Iterative statements.
4. Write a python program using built-in and user defined functions.
5. Write a python program using lambda functions and recursions.
6. Write a python program to demonstrate Strings and its Operations.
7. Write a python program to demonstrate lists, tuples and its operations.
8. Write a python program to demonstrate Sets and its operations.
9. Write a python program to demonstrate Dictionaries and its operations.
10. Write a python program to demonstrate Files and its Operations.

30 Periods

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Reema Thareja, “Python Programming using Problem Solving Approach”, OXFORD University Press, 2017.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016.

REFERENCES:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, “Programming and Problem Solving with Python”, Mc-Graw Hill Education, 2018.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016.
3. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1	Standalone desktops with Python [Open Source]	30 Nos

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Course code	21ME16T	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	ENGINEERING GRAPHICS (COMMON FOR ALL BRANCHES)		1	3	0	4

COURSE OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

PREREQUISITE:

- Engineering Drawing Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students are able to		
C106.1	***Familiarize*** with the fundamentals and standards of Engineering graphics.	K2
C106.2	***Develop*** freehand sketching of basic geometrical constructions and multiple views of objects.	K3
C106.3	***Draw*** orthographic projection of lines and plane surfaces.	K3
C106.4	***Construct*** projection of solids, Section and development of surfaces.	K3
C106.5	***Visualize*** isometric and perspective projections	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C106. 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C106. 2	3	3	-	-	-	-	-	-	-	-	-	1	1	-	-	-
C106. 3	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 4	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106. 5	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-
C106	3	3	2	-	-	1	-	1	-	1	-	1	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square, Triangle and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views– Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection– principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. Applications – Drawing interpretation and process planning, circuit design.

UNIT III PROJECTION OF SOLIDS 5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method, auxiliary plane method. Applications – Engineering design, automotive modelling, X-rays.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Applications – Design of piping, Fabrication, body building, defect analysis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones– combination of two solid objects in simple vertical positions – Perspective projection of simple solids–Prisms, pyramids and cylinders by visual ray method and vanishing point method. Applications–constructions, photography, animation and image processing.

Total: 90 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2010.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 51th Edition, 2019.

REFERENCES:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited,2015.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 3rd Edition, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to Semester End Examination on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. Students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

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Course code	21BS17P	Semester	I			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	PHYSICS AND CHEMISTRY LABORATORY (COMMON FOR ALL BRANCHES)		0	0	4	2

COURSE OBJECTIVES:

- To test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To encourage the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

PREREQUISITE:

- Basic measurement skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C107.1	***Estimate*** the various water quality parameters like alkalinity, hardness (total, temporary, & permanent), dissolved oxygen content, and chloride content.	K2
C107.2	***Investigate*** the metals and ions present in any given sample using various analytical techniques.	K2
C107.3	***Analyze*** the properties such as conductance of solutions, and redox potentials.	K2
C107.4	***Determine*** various moduli of elasticity and also various thermal and optical properties of materials.	K2
C107.5	***Determine*** the velocity of ultrasonic waves, band gap determination and viscosity of liquids.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C107.1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107.5	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
C107	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

PHYSICS LABORATORY
LIST OF EXPERIMENTS
(Any SIX Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Lee's disc Determination of thermal conductivity of a bad conductor
4. Laser- Determination of the wave length of the laser using grating, Estimation of laser parameters
5. Optical fibre -Determination of Numerical Aperture and acceptance angle
6. Ultrasonic interferometer - determination of the velocity of sound and compressibility of Liquids
7. Determination of Band gap of a semiconductor
8. Spectrometer- Determination of wavelength using gating

Total: 30 Periods

REFERENCES:

1. Physics Practicals, Department of Physics, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College 2021
2. Wilson J.D. and Hernandez C.A., "Physics Laboratory Experiments", Houghton Mifflin Company, New York 2005

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	Torsional Pendulum, stop clock, suspension metallic wire: two different thickness, two identical cylindrical mass, screw gauge, wooden scale	5
2.	Uniform bending: 1-meter wooden scale, two-knife edges, travelling microscope, two weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
3.	Non-uniform bending: 1 meter wooden scale, two-knife edges, travelling microscope, weight hanger with slotted weights, screw gauge, Vernier calliper, pin	5
4.	Diode laser (green or red), fiber optic cable, movable arrangement with a screen for measuring spot size (zig), meter scale, stand	5
5.	He-Ne/Diode laser (red), Green diode laser, Grating, Screen, Iron stand (3 Nos), 1m wooden scale, thread.	5
6.	Ultrasonic interferometer apparatus with high frequency wave generator, cell, micrometer, PZ crystal, water or other liquids	5
7.	450 inclined glass plate set-up, two optically plane glass plates, sodium vapour lamp, travelling microscope, thin wire/thin strip of paper	5
8.	Post office box, 5V power supply, thermometer, galvanometer, semiconductor (thermistor), variable temperature bath set-up (oil, temperature controller, vessel, hot plate.	5

CHEMISTRY LABORATORY
LIST OF EXPERIMENTS
(Any SIX Experiments)

1. Determination of permanent, total and temporary hardness of water sample.
2. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
3. Determination of DO Content of water sample by Wrinkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given HCl using pH meter.
6. Estimation of Fe^{2+} by Potentiometric titration.
7. Determination of molecular weight of PVA using Ostwald viscometer.
8. Estimation of Iron content in water sample using spectrophotometer (1,10 – Phenanthroline/thiocyanate method).
9. Conductometric titrations of strong acid Vs strong base.
10. Determination of strength of acid in a mixture using conductivity meter.
11. Corrosion experiment-weight loss method.
12. Estimation of sodium and potassium present in water using flame photometer.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Jeffery G.H., Bassett J., Mendham J. and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
2. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.
3. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook ofpractical organic chemistry", LBS Singapore (1994).

Lab Requirements

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	PH meter	10 nos
2.	Conductivity meter	10 nos
3.	Potentiometer	10 nos
4.	Flame photometer	2 nos
5.	Electronic Balance (Four digit)	1 no
6.	Hot Air Oven	1 no
7.	Spectrophotometer	2 nos
8.	Magnetic stirrer	2 nos

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Course code	21ME18P	Semester	I			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	ENGINEERING PRACTICES LABORATORY (COMMON FOR ALL BRANCHES)		0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

PREREQUISITE:

- Basic knowledge of engineering skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
At the end of the course students will be able to		
C108. 1	Demonstrate on Smithy operations, Foundry operations models and machine assembly practice of centrifugal pump and air-conditioner	K2
C108. 2	Experiment with pipe connections and plumbing works	K3
C108. 3	Make use of welding equipment to join the structures.	K3
C108. 4	Explain carpentry components, for the joint used in roofs, doors, windows and furniture.	K5
C108. 5	Develop sheet metal models, fitting models and do basic machining operations	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C108. 1	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 2	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 3	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 4	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108. 5	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-
C108	3	-	-	-	-	2	2	-	2	1	1	2	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

I CIVIL ENGINEERING PRACTICE 12

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers and elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:
   Basic pipe connections-Mixed pipe material connection-Pipe connections with different joining components
e) Demonstration of plumbing requirements of high-rise buildings

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise:
   Wood work, joints by sawing, Planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning
b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending:
b) Model making – Trays and funnels.
c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump
b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
b) Foundry operations like mould preparation for gear and step cone pulley.
c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total: 30 Periods

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 14

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.

6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments – Resistor, colour coding

measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.

2. Study of logic gates AND, OR, EX-OR and NOT.

3. Generation of Clock Signal.

4. Soldering practice – Components Devices and Circuits – Using general purpose

PCB.

5. Measurement of ripple factor of HWR and FWR.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Chapman, W.A.J. Workshop Technology, Edward Arnold, 2001.

REFERENCES:

1. Raghuwanshi B.S., Workshop Technology Vol. I & II, DhanpathRai & Sons.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2 Edn, Scitech publishers.
3. John K.C., Mechanical Workshop Practice. 2nd Edn. PHI 2010.
4. JeyapoovanT. and Pranitha S., Engineering Practices Lab Manual, 3rd Edn. Vikas Pub.2008

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Required Numbers (for batch of 30 students)
Part I: Civil Engineering Practices		
(a)	**Plumbing Work:**	
1)	Pipe Vice	15 Nos.
2)	Die Holder with Die set	15 Nos.
(b)	**Wood Work**	
1)	Tri Square	15 Nos.
2)	Hand Saw	15 Nos.
3)	Carpentry bench wise	15 Nos.
4)	Firmer Chisel	15 Nos.
5)	Motrin Chisel	15 Nos.
6)	Iron Jack	15 Nos.
7)	Mallet	15 Nos.
8)	Bench hold fastens	15 Nos.
9)	Wooden Bench Hook	15 Nos.
10)	Wood Cutting Machine	2 Nos.
Part II: Mechanical Engineering Practices		
(a)	**Welding Work:**	
1)	Arc welding unit	5 Nos.
2)	Gas welding unit	2 Nos.
(b)	**Basic Machining Work:**	
1)	Lathe Machines	5 Nos.
2)	Drilling Machines	5 Nos.
(c)	**Assembly Work:**	
1)	Centrifugal pump	2 Nos.
2)	Air-conditioner unit	2 Nos.
3)	Household mixer	2 Nos.
(d)	**Sheet Metal Work:**	
1)	Steel rule	2 Nos.
2)	Bend snips	5 Nos.
3)	Straight snips	5 Nos.
4)	Scriber	5 Nos.
5)	Divider	5 Nos.
6)	Trammel	5 Nos.
7)	Prick Punches	5 Nos.
8)	Centre punches	5 Nos.
9)	Pliers	5 Nos.
10)	Ball pean hammer	5 Nos.
11)	Raising hammer	5 Nos.
12)	Riverting hammer	5 Nos.
13)	Square free hammer	5 Nos.
14)	Anvil	3 Nos.
15)	Swage block	3 Nos.
16)	Wige gauges	2 Nos.
(e)	**Foundry Work**	
1)	Cope and Drag Box	5 Nos.
2)	Pattern	5 Nos.
3)	Solid pattern	5 Nos.
4)	Split pattern	5 Nos.
5)	Runner	5 Nos.

6)	Riser	5 Nos.
7)	Sprue	5 Nos.
8)	Sand reamer	5 Nos.
9)	Trowel	5 Nos.
PART-III Electrical Practices		
1)	Assorted electrical components for house wiring	15 sets
2)	Electrical measuring instruments	10 sets
3)	Study purpose items: Iron box, fan and regulator, emergency lamp	One each
4)	Megger (250V/500V)	1 No.
5)	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 Nos 2 Nos
PART-IV Electronics Practices		
1)	Soldering guns	10 No.
2)	Assorted electronic components for making circuits	50 No.
3)	Small PCBs	10 No.
4)	Multi Meters	10 No.
5)	Study purpose items: Telephone, FM radio, low-voltage power supply	2 each

CURRICULUM AND
II SEMESTER SYLLABI

Applicable to the students admitted to

B.TECH-BIOTECHNOLOGY

R-2021: CBCS

Academic year 2021-2022
onwards

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R-2021: CBCS CURRICULA

II SEMESTER SYLLABI

LIST OF ABBREVIATIONS

S. No.	Abbreviations	Detailed Description
1	**HSMC**	Humanities & Social Science including Management Courses
2	**BSC**	Basic Science Courses
3	**ESC**	Engineering Science Courses
4	**PCC**	Professional Core Courses
5	**PEC**	Professional Elective Courses
6	**OEC**	Open Elective Courses
7	**PROJ**	Project Work
8	**EEC**	Employability Enhancement Courses
9	**MC**	Mandatory Courses

Category Based Credit Split-Up – Semester Wise

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	Project /EEC	MC	Total Credit
1	3	12	10	-	-	-	-	-	**25**
2	3	7	8	5	-	-	-	-	**23**
3	-	4	-	16	-	-	-	0	**20**
4	-	4	-	16	-	-	1	0	**21**
5	-	-	-	18	3	3	-	-	**24**
6	-	-	-	12	3	3	2	-	**20**
7	3	-	-	9	6	-	3	-	**21**
8	-	-	-	-	6	-	6	-	**12**
Total Credits	**9** (5.42%)	**24** (14.46%)	**24** (14.46%)	**72** (43.37%)	**18** (10.84%)	**6** (3.61%)	**13** (7.83%)	**0** (0%)	**166**

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B.Tech. - Biotechnology Curriculum (R2021)

SEMESTER I										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN11T	Communicative English	HSMC	40	60	100	3	0	0	3
2	21MA12T	Matrices and Differential Calculus	BSC	40	60	100	3	1	0	4
3	21PH13T	Engineering Physics I	BSC	40	60	100	3	0	0	3
4	21CY14T	Engineering Chemistry	BSC	40	60	100	3	0	0	3
5	21CS15IT	Problem Solving and Python Programming	ESC	40	60	100	2	0	4	4
6	21ME16T	Engineering Graphics	ESC	40	60	100	4	0	0	4
PRACTICAL										
7	21BS17P	Physics and Chemistry Laboratory	BSC	40	60	100	0	0	4	2
8	21ME18P	Engineering Practices Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**25**

SEMESTER II										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21EN21T	Technical English	HSMC	40	60	100	3	0	0	3
2	21MA22T	Vector Calculus and Complex Integration	BSC	40	60	100	3	1	0	4
3	21BT23T	Anatomy and Human Physiology	BSC	40	60	100	3	0	0	3
4	21EE24T	Basic Electrical, Electronics and Instrumentation Engineering	ESC	40	60	100	3	0	0	3
5	21BT25T	Chemistry of Biomolecules	PCC	40	60	100	3	0	0	3
6	21IT26T	Programming in C	ESC	40	60	100	3	0	0	3
PRACTICAL										
7	21BT27P	Biochemistry Laboratory	PCC	40	60	100	0	0	4	2
8	21IT28P	Programming in C Laboratory	ESC	40	60	100	0	0	4	2
TOTAL										**23**

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SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT31T	Applied Microbiology	PCC	40	60	100	3	0	0	3
2	21BT32T	Process Calculations for Biotechnologist	PCC	40	60	100	3	0	0	3
3	21BT33T	Bioorganic chemistry	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21BT35T	Cell Biology	PCC	40	60	100	3	0	0	3
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21BT37P	Applied Microbiology Laboratory	PCC	40	60	100	0	0	4	2
8	21BT38P	Cell Biology Laboratory	PCC	40	60	100	0	0	4	2
TOTAL										**20**

SEMESTER IV										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT41T	Research Methodology and Biostatistics	BSC	40	60	100	3	1	0	4
2	21BT42T	Fluid Mechanics and Heat Transfer Operations for Biotechnologist	PCC	40	60	100	3	0	0	3
3	21BT43T	Applied Thermodynamics for Biotechnologists	PCC	40	60	100	3	0	0	3
4	21BT44T	Principles and Techniques of Molecular Biology	PCC	40	60	100	3	0	0	3
5	21BT45T	Basics of Industrial Biotechnology	PCC	40	60	100	3	0	0	3
6	21MC02T	Environmental Sciences	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21BT47P	Chemical Engineering Laboratory for Biotechnologists	PCC	40	60	100	0	0	4	2
8	21BT48P	Molecular Biology Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project – I	EEC	40	60	100	0	0	2	1
TOTAL										**21**

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SEMESTER V										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT51T	Bioprocess Engineering	PCC	40	60	100	3	0	0	3
2	21BT52T	Mass Transfer Operations	ESC	40	60	100	3	0	0	3
3	21BT53IT	Analytical Techniques in Biotechnology	PCC	40	60	100	2	0	4	4
4	21BT54T	Principles of Genetic Engineering	PCC	40	60	100	3	1	0	4
5	-	Professional Elective I	PEC	40	60	100	3	0	0	3
6	-	Open Elective I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21BT57P	Bioprocess Laboratory	PCC	40	60	100	0	0	4	2
8	21BT58P	Genetic Engineering Laboratory	PCC	40	60	100	0	0	4	2
TOTAL										**24**

SEMESTER VI										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT61T	Protein Engineering	PCC	40	60	100	3	1	0	4
2	21BT62T	Applied Chemical Reaction Engineering	PCC	40	60	100	3	0	0	3
3	21BT63T	Principles of Immunology	PCC	40	60	100	3	0	0	3
4	-	Professional Elective II	PEC	40	60	100	3	0	0	3
5	-	Open Elective II	OEC	40	60	100	3	0	0	3
PRACTICAL										
6	21BT66P	Principles of Immunology Laboratory	PCC	40	60	100	0	0	4	2
7	21BT67P	Internship	EEC	100	-	100	0	0	0	1
8	21BT68P	Mini Project – II	EEC	40	60	100	0	0	2	1
TOTAL										**20**

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SEMESTER VII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT71T	Total Quality Management	HSMC	40	60	100	3	0	0	3
2	21BT72T	Principles of Bioseparation Processes	PCC	40	60	100	3	0	0	3
3	21BT73T	Computational Biology	PCC	40	60	100	2	0	4	4
4	-	Professional Elective III	PEC	40	60	100	3	0	0	3
5	-	Professional Elective IV	PEC	40	60	100	3	0	0	3
PRACTICAL										
6	21BT76P	Principles of Bio separation Processes Laboratory	PCC	40	60	100	0	0	4	2
7	21BT77P	Project Work – Phase I	PROJ	40	60	100	0	0	4	2
8	21BT78P	Technical Seminar	EEC	100	-	100	0	0	2	1
TOTAL										**21**

SEMESTER VIII										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	-	Professional Elective V	PEC	40	60	100	3	0	0	3
2	-	Professional Elective VI	PEC	40	60	100	3	0	0	3
PRACTICAL										
3	21BT83P	Project Work – Phase II	PROJ	40	60	100	0	0	12	6
TOTAL										**12**

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List of Professional Elective Courses

S. No.	Course Code	Engineering Stream Courses
PROFESSIONAL ELECTIVE I		
1	21BT551PT	Frontiers in Biomedicine
2	21BT552PT	Fundamentals of Nano Science
3	21BT553PT	Green and Renewable energy
4	21BT554PT	Bioethics and IPR
5	21BT555PT	Enzyme Technology
PROFESSIONAL ELECTIVE II		
6	21BT641PT	Molecular Pathogenesis of Infectious Diseases
7	21BT642PT	Bio-inspired AI
8	21BT643PT	Principles of Food Processing
9	21BT644PT	Creativity, Innovation and New Product Development
10	21BT645PT	Animal Biotechnology
PROFESSIONAL ELECTIVE III		
11	21BT741PT	Process Instrumentation Dynamics and control
12	21BT742PT	Cancer Biology
13	21BT743PT	Stem Cell Technology
14	21BT744PT	Medical Biotechnology
15	21BT745PT	Bio business Start Policy and Human Rights
PROFESSIONAL ELECTIVE IV		
16	21BT751PT	Clinical Nutrition
17	21BT752PT	Marine Bioprospecting and Pharmacology
18	21BT753PT	Tissue Engineering
19	21BT754PT	Bioproduct Planning and Strategy
20	21BT755PT	Forensic Biotechnology
PROFESSIONAL ELECTIVE V		
21	21BT811PT	Lifestyle Diseases and Clinical Trials
22	21BT812PT	Bioconjugate Technology and Applications
23	21BT813PT	Bioprocess Equipment's and Plant Design
24	21BT814PT	Clinical Data Management
25	21BT815PT	Agricultural Biotechnology
PROFESSIONAL ELECTIVE VI		
26	21BT821PT	Biopharmaceutical Technology
27	21BT822PT	Neurobiology and Cognitive Sciences
28	21BT823PT	Bioentrepreneurship
29	21BT824PT	Biosafety and Hazard Management
30	21BT825PT	Plant Biotechnology

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OPEN ELECTIVE I

S. No.	Course Code	Course Title
1	21BT01OT	Basics of Environmental Biotechnology
2	21BT02OT	Introduction to Biofuels and Bioenergy
3	21BT03OT	Lifestyle Diseases: A Biotechnological Approach
4	21BT04OT	Biology for Engineers

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Course code	21EN21T	Semester	II			
Category	HUMANITIES & SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)		L	T	P	C
Course Title	TECHNICAL ENGLISH (Common for all Branches)		3	0	0	3

COURSE OBJECTIVES:

- To make the students of engineering and technology to enhance their ability on reading and comprehencing the different texts
- To improve their creative and critical thinking so as to use in demanding contexts
- To equip the learners with the skills of writing convincing job Applications and effective reports
- To develop their speaking skills to make technical presentations and participate in group discussions
- To facilitate them to hone their soft skills

PREREQUISITE:

- Technical writing and basic English grammar.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C201. 1	***Read*** and understand general and technical texts	K2
C201. 2	***Apply*** creative and critical thinking and communicate their ideas efficiently	K2
C201. 3	***Participate*** in group discussions and deliver short speeches effectively	K3
C201. 4	***Write*** effectively and persuasively in academic and workplace contexts	K3
C201. 5	***Experiment with*** the future challenges confidently and successfully	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
C201. 1	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 2	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 3	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 4	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201. 5	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-
C201	-	-	-	-	-	-	-	-	1	3	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I TECHNICALWRITING AND VISUAL CONVERSION 9

PRACTICAL

LISTENING : Listening to pronunciation of longer words.

SPEAKING : Making out meaning of pictorial and graphical representations.

TUTORIAL

READING : Understanding logic and sequencing in reading inferring the exact meaning of text

WRITING : Extended Definition- Writing Instructions, Checklists & Recommendations- Reading short technical text from Journal.

VOCABULARY: Technical vocabulary- Regular and Irregular verbs.

UNIT- II TECHNICAL WRITING AND GUIDELINES PREPARATION 9

PRACTICAL

LISTENING : Comprehensive listening - Listening to telephonic conversations – short and long conversations from different domains, listening to various pre-recorded conversations and speeches.

SPEAKING : Delivering short speeches in the class.

TUTORIAL

READING : Technical reading on innovations and innovators.

WRITING : Conditional clauses, Numerical adjectives, Process Description

VOCABULARY: Collocation, Verbal Analogies.

UNIT-III TECHNICAL PROCESS WRITING 9

PRACTICAL

LISTENING : Listening to documentaries and making notes.

SPEAKING : Basic speaking practice based on BEC, IELTs, and TOFEL.

TUTORIAL

READING : longer text both general and technical –practice in speed reading

WRITING : Purpose statements, words are used as nouns and verbs- describing a process – use of sequence word - Interpretation of Graphs and Charts.

VOCABULARY: Sequence words –Misspelled words -Embedded sentences.

UNIT- IV TECHNICAL WRITING AND BUSINESS LETTERS 9

PRACTICAL

LISTENING : listening to native accents.

SPEAKING : Group Discussions - Process, Skills, Guidelines, Evaluation, Oral Presentation - Planning, Preparing, Organizing and Presenting.

TUTORIAL

READING : Reading for detailed comprehension.

WRITING : Cause and effect, impersonal passive voice, idioms and phrases, - Letter writing, job application, business correspondence (letters) – calling for quotations, placing order,complaint letters, preparing a memo, notice and e-mail itinerary.

VOCABULARY: clauses and If conditionals.

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UNIT-V TECHNICAL WRITING AND REPORT WRITING 9

PRACTICAL

LISTENING : TED /ink talks

SPEAKING : Starting a Career — vision statement, preparing logo and tagline, making short term and long-term goals, setting plans.

TUTORIAL

READING : Reading and understanding technical articles.

WRITING : Degrees of comparison, editing, Email etiquette, Mispronounced words – Report writing survey, feasibility, industrial visit, reporting various incidents and accidents, Minutes of meeting.

VOCABULARY: Reported speech.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Department of English, Anna University, Chennai. Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Black Swan Publications, Chennai, 2011.

REFERENCE BOOKS:

1. Rizvi, M. Ashraf, “Effective Technical Communication”, Tata McGraw— Hill,2006.
2. Ibbotson, Mark, “Cambridge English for Engineering”, Cambridge University Reference Press, 2008
3. Richard Johnson-Sheehan, “Technical Communication Today”4th EditionBooks Longman Publishing Group, 2011.
4. Richard Johnson-Sheehan, “Technical Communication Today”4th EditionBooks Longman Publishing Group, 2011
5. Porter, Patricia A., and Margaret Grant, “Communicating Effectively in English: Ora1 Communication for Non-Native Speakers”, 2nd Edition, Wadsworth, 1992.
6. Gopalaswamy, Ramesh & Ramesh Mahadevan. ACE of Soft Skills: Attitude, Communication and Etiquette for Success, New Delhi: Pearson, 2010.

Extensive Reading:

Wells, H G. The Time Machine, Peacock, India, 2008.

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Course code	21MA22T	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	VECTOR CALCULUS AND COMPLEX INTEGRATION (Common for all Branches)		3	1	0	4

COURSE OBJECTIVES:

- To improve their ability in vector calculus
- To expose to the ideas of analytic functions
- To solve differential equation using the concept of Laplace Transform.

PREREQUISITE:

- Mathematics skills at Sem-I level

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C202.1	***Apply*** the vector calculus concepts to solve engineering problems.	K3
C202.2	***Apply*** the concept of mapping to solve Linear equation.	K3
C202.3	***Apply*** the complex integration problem ideas to solve engineering problems.	K3
C202.4	***Understand*** the concepts of multiple integrals.	K2
C202.5	***Apply*** the concepts of Laplace transformation to solve Differential Equations.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C202.1	3	2	-	-	-	-	-	-	-	-	-	-
C202.2	3	2	-	-	-	-	-	-	-	-	-	-
C202.3	3	2	-	-	-	-	-	-	-	-	-	-
C202.4	2	2	-	-	-	-	-	-	-	-	-	-
C202.5	3	2	-	-	-	-	-	-	-	-	-	-
C202	3	2	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 4**

UNIT I VECTOR CALCULUS 12

Gradient, divergence, curl – Solenoidal and irrotational fields – Vector identities– Directional derivatives – Line, surface and volume integrals –Green's, Gauss divergence and Stoke's theorems (without proof) .

UNIT II ANALYTIC FUNCTIONS 12

Limit of a complex functions-Derivative of f(z)-Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate – Milne-Thomson's method – Conformal mappings: 1/z, az , az+b and bilinear transformation.

UNIT III COMPLEX INTEGRATION 12

Line integral – Cauchy's integral theorem (statements only) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only) – Singularities – Poles and Residues – Cauchy's residue theorem (statement only) – Contour integration – Unit circle and semicircular contour.

UNIT IV MULTIPLE INTEGRALS 12

Double integration in Cartesian and polar coordinates – Change of order of integration – Area as double integral – Triple integration in Cartesian coordinates – Conversion from Cartesian to polar – Volume as a double and Triple Integral.

UNIT V LAPLACE TRANSFORMS 12

Definition-Conditions for existence- Transforms of elementary functions – Properties of Laplace Transform-Transforms of periodic functions – Transforms of derivatives and integrals– Inverse transforms – Convolution theorem– Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only- Unit step function and Unit impulse function [simple problems only]

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher **Engineering Mathematics**, Khanna Publishers, New Delhi, 42nd Edition, 2012.

REFERENCES:

1. E. Kreyszig, **Advanced Engineering Mathematics**, John Wiley & Sons. Singapore, 10thEdition, 2012.
2. M.K. Venkataraman, Engineering **Mathematics: Vol I and II**, National Publishing., Chennai 2001.
3. T. Veerarajan, **Engineering Mathematics**, Tata McGraw Hill Publishing Co, New Delhi, 2004.

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Course code	21BT23T	Semester	II			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	ANATOMY AND HUMAN PHYSIOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To define the basic concepts relating to cell, blood components and joints
- To understand the structure and functions of the various types of systems in the human body.
- To demonstrate the importance of anatomical features and physiology of human systems

PREREQUISITE:

- Fundamentals of the Chemistry and Biology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C203.1	Comprehend the basic concepts in human anatomy and physiology along with body fluids	K2
C203.2	Recognize the breathing mechanism, human body mechanics, bones and joints involved in movement	K2
C203.3	Perceive the concepts about circulatory pathways	K2
C203.4	Ability to understand the basic physiology of endocrine, human neural system and its conduction of nerve impulse	K2
C203.5	Conceive the mechanism about kidney function	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C203.1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C203.2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C203.3	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C203.4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C203.5	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C203	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I BASICS OF ANATOMY AND PHYSIOLOGY 9

Introduction to Human anatomy and physiology, Structure of human cell – Four primary tissues, organs and organ systems – Physiology of homeostasis. Osteology and joints- Muscles, Body fluids- Composition and functions of blood - Plasma proteins- Red blood cells, White blood cells and platelets - Blood groups and blood clotting.

UNIT-II SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS 9

Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration

UNIT- III CARDIOVASCULAR AND LYMPHATIC SYSTEMS 9

Cardiovascular: Components of Blood and functions.- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure. Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels

UNIT-IV NERVOUS AND ENDOCRINE SYSTEMS 9

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland.

UNIT-V DIGESTIVE AND URINARY SYSTEMS 9

Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publishers. 2014
2. Elaine.N. Marieb, “Essential of Human Anatomy and Physiology”, Eight Edition, Pearson Education, New Delhi, 2007

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013.

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Course code	21EE24T	Semester	II			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	BASIC ELECTRICAL, ELECRONICS AND INSTRUMENTATION ENGINEERING Common for (CSE, IT, AI&DS, BIOTECH, CIVIL, MECH, CSE(AI&ML))		3	0	0	3

COURSE OBJECTIVES:

- The course is intended to introduce the students to basic theorems and laws in DC and AC circuits.
- This course aims at giving adequate exposure to students on the principles of electrical machines.
- The course will enable the students to acquire knowledge on fundamentals and applications of various electronic devices and measuring instruments.

PREREQUISITE:

- Engineering Physics, Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C204.1	***Impart*** knowledge on electrical circuit components, laws and theorems.	K2
C204.2	***Analyze*** the behavior of ac circuits components in power system	K3
C204.3	***Illustrate*** the working of various ac machines, dc machines and special machines along with its characteristics.	K2
C204.4	***Infer*** and ***relate*** the working and applications of various electronics devices and circuits.	K2
C204.5	***Categorize*** the specific instruments for electrical measurements.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
C204.1	3	2	-	-	-	-	-	-	2	-	1	1
C204.2	3	2	-	-	-	-	-	-	2	-	1	1
C204.3	3	2	-	-	-	-	-	-	2	-	1	1
C204.4	3	2	-	-	-	-	-	-	-	-	1	1
C204.5	3	2	-	-	-	-	-	-	2	-	1	1
C204	3	2	-	-	-	-	-	-	2	-	1	1

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT I DC CIRCUITS 9

Basic circuit components (R, L & C) - Ohms Law - Kirchoff's Law – voltage and current division -source transformation-steady state solution of DC circuits - Nodal analysis, Mesh analysis-Thevenin's Theorem, Norton's Theorem, Maximum Power transfer -Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits – waveforms and RMS value – power and power factor, Analysis of single-phase ac circuits consisting of RL and RLC combinations -Resonance- Balanced and Unbalanced three-phase circuits-Star and Delta connections.

UNIT III ELECTRICAL MACHINES 9

Principles of operation and characteristics of DC machines, Construction and operation of Single-Phase transformer – Three phase transformer connections – Autotransformer. Construction and types of Single phase and Three phase Induction motor, Construction and working principle of Alternator, Stepper motors – Brushless DC Motors.

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials – Silicon & Germanium - PN Junction diodes – Structure, Operation and Characteristics – Display devices-LED, Laser diodes – Zener diode - Bipolar Junction Transistor – Characteristics and applications –Amplifiers - Basics, types and applications, Oscillators-Basics, types and its applications—D/A and A/D converters.

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive Thermoelectric, piezoelectric, photoelectric, Hall effect. Types and principle of indicating Instruments – Multimeters, Wattmeter, instrument transformers (CT and PT), Oscilloscopes.

TOTAL: 45 PERIODS

LEARNING RESOURCES:

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, ―Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint ,2016
2. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013
3. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.

REFERENCES:

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016
4. David A. Bell, "Electronic devices and circuits", Oxford University higher education,5th edition2008.
5. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006.

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Course code	21BT25T	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMISTRY OF BIOMOLECULES		3	0	0	3

COURSE OBJECTIVES:

- To comprehend the fundamental chemical principles that govern biological systems
- To Understand the regulation of biological/biochemical processes
- To Relate biomolecules and their metabolic pathways with metabolic disorders

PREREQUISITE:

- Fundamentals of the Chemistry and Biology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C205.1	***Understand*** the role of chemical and biological basis in life	K2
C205.2	***Explain*** the core concepts in biological metabolism and enzymatic structure and function.	K2
C205.3	***Illustrate*** the role of Biomolecules in Homeostasis	K2
C205.4	***Relate*** the structure, function and reactions of Biomolecules	K3
C205.5	***Analyze*** complications related to Metabolic disorders	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C205.1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C205.2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C205.3	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C205.4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C205.5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-
C205	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I INTRODUCTION TO BIOMOLECULES 05

Role of carbon, Types of functional groups, Chemical nature of water, pH and biological buffers, Biomolecules

UNIT-II CARBOHYDRATES 12

Introduction: Monosaccharides: Structure, Function, and its Reaction, Polysaccharides: Structure and Function; Homopolysaccharides – Sucrose, Lactose, Maltose, Heteropolysaccharides – Glycoprotein, Proteoglycans and Glycolipids, Glycosaminoglycans. **Metabolism, Regulation and Bioenergetics**: Glucose Metabolism – (Glycolysis, TCA cycle, Oxidative Phosphorylation), Gluconeogenesis, Glycogenesis, Glycogenolysis, Hexose Mono-Phosphate and Glyoxalate Shunt, Calculation of ATP – Glucose, **Biochemical Diseases**: Diabetes and Hunter syndrome

UNIT- III LIPIDS 12

Introduction: Classification, Structure, Function and its Reaction; Saponifiable Lipids – Fats and Waxes, Phospholipids, Sphingolipids and Glycolipids; Non Saponifiable Lipids – Steroids, Cholesterol and Eicosanoids. **Metabolism, Regulation and Bioenergetics**: Oxidation of Fatty Acids – Palmitic Acid and Propionic Acid, Alpha and Omega Oxidations, Fatty Acid Synthesis, Calculation of ATP – Palmitic Acid and Stearic Acid, **Biochemical Diseases**: Hypercholesterolemia and Tay-Sachs disease

UNIT-IV PROTEINS 09

Introduction: Amino Acids, Peptides, Proteins, measurement, Protein structure Hierarchy, Protein Folding, glycoproteins, lipoproteins. **Metabolism, Regulation and Bioenergetics**: Synthesis of Amino Acids – Glutamate, Serine, Aspartate, Alanine, Tryptophan, Thyrosine, Phenyl Alanine and Histidine, Urea Cycle. **Biochemical Diseases**: Maple syrup urine disease and Phenylketonuria

UNIT-V NUCLEIC ACIDS 07

Introduction: Purine and Pyrimidine, RNA and its types, DNA and its types, Watson and Crick Model, Chargaff's Rule. **Metabolism and Regulation**: Synthesis of Nucleic Acid (Denovo and Salvage Pathway), Degradation using Exo and Endonucleases. **Biochemical Diseases**: Hyperuricemia and Gout

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry. CBS publishers and distributors.
2. Victor W.R., David A.B., Botham K.M., Kennelly P.J., Weil P.A., Harper's illustrated biochemistry, 31st edition, New York: Mcgraw-Hill Education, 2018.
3. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.

REFERENCES:

1. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.
2. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., 2000.

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VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

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Course code	21IT26T	Semester	II			
Category	ENGINEERING SCIENCE COURSE(ESC)		L	T	P	C
Course Title	PROGRAMMING IN C (Common for CSE, IT, ECE, BIOTECH, CHEM, CSE (AI&ML))		3	0	0	3

COURSE OBJECTIVES:

- To learn Introduction of Algorithm and Basic Structure of C Programming.
- To gain knowledge on Implementation of Arrays and Strings concept in C Programming.
- To understand the Basic functions and Pointer declaration in C Programming.
- To apply the concepts of Structures and Unions in an example program.
- To write a sample C program to implement file handling and accessing Graphic Library function.

PREREQUISITE:

- Basic Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C206.1	***Explain*** the data types, syntax and control structures for solving different problems.	K2
C206.2	***Apply*** the concepts of Arrays, Strings in 'C' language for user defined problems	K3
C206.3	***Make use of*** functions and concepts of pointers in 'C' language	K3
C206.4	***Organize*** data using structures and unions in 'C' Programs.	K3
C206. 5	***Develop*** and implement applications using File handling Process and Graphics.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C206.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C206.2	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206.3	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206.4	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206. 5	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
C206	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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SYLLABUS **No. of Credits: 3**

UNIT-I INTRODUCTION TO PROGRAMMING 9

Basic Organization of a Computer - Introduction to Algorithm, Pseudo code, Flow Chart. Structure of 'C' program, compilation and linking processes - C Tokens: Keywords, Data Types, Constants, Variables - Declaration –Operator: precedence and associativity -Expressions - Input/Output statements -Assignment statements – Decision making statements Switch statement - Looping Statements-Bitwise operations- pre-processor-Syntax and Logical Errors in compilation solving simple scientific and statistical problems.

UNIT-II ARRAYS AND STRINGS 9

Arrays: Declaration, Initialization - One dimensional array: Assigning an array to another array – Equating an array with another array –Two dimensional Arrays: Declaration – usage of two-dimensional arrays – reading, storing and accessing elements in two dimensional arrays –String operations: Initialization of Strings – string library functions - command line arguments – Searching and Sorting of Strings.

UNIT-III FUNCTIONS AND POINTERS 9

Introduction to functions: Classification of functions – function definition – function call –function with inputs and outputs - recursive function –example programs: copy one string to another string using recursion, binary search using recursion -Pointer Fundamentals: Pointer Declaration – Passing Pointers to a Function- Operations on pointers: Pointer Arithmetic - Pointer comparisons -Array of pointer: Pointers and one-dimensional arrays- Pointers and multi-dimensional arrays.

UNIT-IV STRUCTURES AND UNIONS 9

Introduction to Structures: Defining structures - initializing structures -Array of Structures – Nested structures - Introduction to union Creating and using union variables - memory allocation of union – example programs: Store and display N employees information using Union- Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays.

UNIT-V FILE HANDLING AND GRAPHICS 9

Files: Introductions - Data hierarchy - Types of file processing- Sequential access: Reading data from sequential access file - Updating sequential access file - Random access: Reading data from random access file - Writing data randomly to random access file –C Graphics: libraries and functions – 2D shapes – 3D shapes – Examples.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Sumitabha Das, "Computer Fundamentals & C Programming", McGraw Hill, 2018.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Yashavant Kanetkar" Let usC", 15thedition.

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REFERENCES:

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 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.

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VEL TECH HIGH TECH

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Course code	21BT27P	Semester	II			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	BIOCHEMISTRY LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To carry out qualitative and quantitative estimation of biomolecules.
- To relate the laboratory analysis with biological fluids.
- To understand the regulation of biochemical processes.

PREREQUISITE:

- Fundamentals of the Chemistry and Biology Laboratory

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C207.1	***Outline the*** awareness of the hazardous chemicals and safety precautions in case of emergency.	K2
C207.2	***Experiment with*** the principles behind the qualitative and Quantitative estimation of biomolecules.	K3
C207.3	Analyze the biomolecules in the body fluids.	K4
C207.4	***Examine*** the various biomolecules to relate the biochemical parameters with clinical aspects	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C207.1	2	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
C207.2	3	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
C207.3	3	3	2	-	-	-	-	-	1	-	-	-	2	-	-	-
C207.4	3	3	2	-	-	-	-	-	1	-	-	-	2	-	-	-
C207	3	2	1	-	-	-	-	-	1	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

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List of Experiment **No. of Credits: 2**

1. Guidelines and Safety Awareness in Life Science Laboratories
2. Unit Conversions and Buffer Preparation
3. Study of Colorimeter and Beer's-Lambert's Law
4. Qualitative Estimation of Carbohydrates
5. Quantitative Estimation of Total Sugar by Anthrone Method
6. Quantitative Estimation of Reducing Sugar by DNSA Method
7. Extraction of Lipids and analysis by TLC
8. Qualitative Estimation of Proteins and Nucleic Acid
9. Quantitative Estimation of Protein by Biuret and Lowry's Methods
10. Estimation of Creatinine from Urine
11. Acid hydrolysis and action of salivary amylase on starch
12. Hydrolysis of Starch and Estimation of Glucose and Glucose Oxidase and Peroxidase (God- Pod) Method

LEARNING RESOURCES:

TEXT BOOKS:

1. Jayaraman J., Laboratory Manual in Biochemistry, 2nd Edition, New Age International Private Limited, January 2011.
2. Gupta R.C and Bhargavan S, "Practical Biochemistry", CBS Publishers and Distributors, 1985.

REFERENCES:

1. Hofmann, A., & Clokie, S. (Eds.). (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge: Cambridge University Press. doi:10.1017/9781316677056

Sl. No.	Description of Equipment		Required numbers (For batch of 30 students)
1.	UV- Spectrophotometer		01
2.	Colorimeter		04
3.	Water Bath		02
4.	Glassware's	Test tubes	50
		Pipettes	10
		Burettes	10
5.	Pre-coated TLC Plates		10

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VEL TECH HIGH TECH

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Course code	21IT28P	Semester	II			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	PROGRAMMING IN C LABORATORY (Common for CSE, IT, ECE, BIOTECH, CHEM, CSE(AI&ML))		0	0	3	2

COURSE OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures
- To develop applications in C using file processing, Graphics

PREREQUISITE:

- Basic Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C208.1	***Utilize*** decision making and looping statements for problem solving.	K3
C208.2	***Apply*** the concepts of Arrays and String to solve problem statements.	K3
C208.3	***Examine*** the dynamic behaviour of memory by the use of pointers.	K4
C208.4	***Develop*** simple applications using Structures and unions.	K3
C208.5	***Design*** and develop simple applications using File Processing and Graphics.	K6

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	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
C208.1	3	2	1	-	-	1	-	-	1	-	1	1	1	2
C208.2	3	2	1	-	-	1	-	-	1	-	1	1	2	1
C208.3	3	3	2	1	-	1	-	-	1	-	1	1	2	1
C208.4	3	2	1	-	-	1	-	-	1	-	1	1	2	1
C208.5	3	3	3	3	2	1	-	-	1	-	1	1	2	1
C208	3	2	2	3	2	1	-	-	1	-	1	1	2	1

Note: 1: Slight, 2: Moderate, 3: Substantial

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LIST OF EXPERIMENT **No. of Credits: 4**

1. a) Write a C program to perform input / output of all basic data types.

   b) Write a C program using decision making construct.

   c) Write a program that finds if a given number, is a prime number.

2. a) Write a program to find whether the given year is a leap year or not?
   (Hint: not every Centurion year is a leap. For example, 1700, 1800 and 1900 is not a leap year)
   b) Write a program using looping statements.

   c) Write a program to use swapping operations.

3. a) Write a C program for print pyramids and patterns.

   b) Write a C program to generate Fibonacci series.

4. a) Write a C program to shut down or turn off the computer.

   b) Write a C program to perform sorting operations.

5. Write a program using one dimensional and two-dimensional arrays.

6. From a given paragraph perform the following using built-in functions:
   a) Count total number of vowels and consonants.
   b) Capitalize the first word of each sentence.
   c) Replace a given word with another word.

7. Write a program using user defined functions and recursive functions.

8. Write a C program using pointers functions.

9. Write a program using structures and unions.

10. Write a program using text files and binary files.

11. Write a program using string functions.

12. Write a program using dynamic memory allocation.

Total: 60 Periods

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LEARNING RESOURCES:

TEXT BOOKS:

1. Sumitabha Das, “Computer Fundamentals & C Programming”, McGraw Hill, 2018.
2. ReemaThareja, “Programming in c”, Oxford University Press, Second Edition, 2016
3. Yashavant P. Kanetkar, “Let Us C”, Sixteenth Edition, BPB Publications, 2018.

REFERENCES:

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 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.

Sl. No.	Description of Equipment	Required numbers (For batch of 30 students)
1.	Systems with Linux Operating System with GNU compiler[Open Source]	30

3rd SEMESTER
CURRICULUM & SYLLABI

Applicable to the students admitted to

B.TECH-BIOTECHNOLOGY

R-2021: CBCS

Academic year 2021-2022

Onwards

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

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#60, Avadi – Vel Tech Road, Vel Nagar,

Avadi, Tamil Nadu 600062

VEL TECH HIGH TECH

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B.Tech. – BIOTECHNOLOGY

R-2021: CBCS CURRICULUM

SEMESTER III										
S. No.	Course Code	Course Title	Category	CIE Marks	SEE Marks	Total marks	Credits			
							L	T	P	C
THEORY										
1	21BT31T	Applied Microbiology	PCC	40	60	100	3	0	0	3
2	21BT32T	Process Calculations for Biotechnologist	PCC	40	60	100	3	0	0	3
3	21BT33T	Bioorganic chemistry	PCC	40	60	100	3	0	0	3
4	21MA34T	Series, Transforms and Partial Differential Equations	BSC	40	60	100	3	1	0	4
5	21BT35T	Cell Biology	PCC	40	60	100	3	0	0	3
6	21MC01T	Constitution of India	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21BT37P	Applied Microbiology Laboratory	PCC	40	60	100	0	0	4	2
8	21BT38P	Cell Biology Laboratory	PCC	40	60	100	0	0	4	2
TOTAL										**20**

Dean Academics **Principal**

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Course code	**21BT31T**	**Semester**	**III**			
Category	**PROFESSIONAL CORE COURSE (PCC)**		**L**	**T**	**P**	**C**
Course Title	**APPLIED MICROBIOLOGY**		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Build knowledge in isolation, identification, cultivation, multiplication and preservation of microorganisms
- To demonstrate the expertise in handling and controlling of microorganisms in labs as well as in various industries
- To illustrate the microbial knowledge in day to day life

PREREQUISITE:

- Fundamentals of Biology and Biochemistry

COURSE OUTCOMES:

CO. No.	**Course Outcomes**	**Blooms level**
On successful completion of this Course, students will be able to		
C301.1	***Understand*** the chronology and types of microorganisms	K2
C301.2	***Outline*** the basics of culturing and isolation techniques	K2
C301.3	***Summarize*** the various types of microorganisms and its controls	K2
C301.4	***Relate*** between microorganisms and humans, their basic applications	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C301.1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
C301.2	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
C301.3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
C301.4	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I MICROBIAL EVOLUTION AND IDENTIFICATIONS 9

History and evolution of microbiology (classification and nomenclature of Microorganisms), Structural organization and multiplication – Eukaryotes and Prokaryotes, Microscopic Techniques-light and electron microscopy; Microbial staining techniques gram staining, acid fast, capsular staining, flagellar staining.

UNIT II GROWTH AND METABOLISM 12

Microbes growth Environment; Basic requirements for growth- Natural- In laboratory; Methods to cultivate and isolate microorganism; growth phases and growth curves - Chemostat, Turbidostat; Techniques for measurements of growth and enumeration, Batch culture, continuous culture and synchronous growth; factors affecting growth, Filamentous growth and measurement., Mathematics of growth-generation time; Respiratory metabolisms of microorganism – aerobic and anaerobic paths of energy production, specific growth rate Microbial metabolism: Entner– Doudoroff pathway. Fermentative pathways – organisms, substrates, intermediates and end products.

UNIT III CONFORMATION AND INHABITATION OF MICROBES 9

Biochemical test for identification (citrate utilization, catalase, coagulase, IMViC), Physical and chemical control of microorganisms; Disinfection, antiseptics and fumigation; Determination of phenol coefficient of disinfectant. Sources of microorganisms - Microbial Type Collection Centres in India and abroad, clinically important microorganisms.

UNIT IV MICROORGANISMS IN HEALTH AND DISEASE 6

Beneficiary Microorganisms- Probiotics and Prebiotics, Gut microorganism, Disease causing Microorganisms- Bacteria, Virus, Fungi, Protozoa. Therapeutic microorganisms.

UNIT V MICROORGANISM AND THE WORLD 9

Metabolites Types; **Food Microbiology**- Beneficiary- Preservatives; **Agriculture Microbiology**- beneficiary microbes, biogas; **Industry related**- Antibiotics and Commercial products; Aquatic microorganisms, bioremediation, **Energy Microbiology** - MFC, Biosensors.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition 1993, Fifth Edition New Delhi, India.
2. Talaron K, Talaron A, Casita, PelczarAnd Reid. Foundations In Microbiology, W.C.Brown Publishers, 1993**.**
3. Prescott LM, Harley JP, Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

REFERENCES:

1. Dr.R.C.Dubey and Dr.D.K.Maheshwari A Textbook of Microbiology,S. Chand. S.Chand and company 2010.

Course code	21BT32T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PROCESS CALCULATIONS FOR BIOTECHNOLOGIST		3	0	0	3

COURSE OBJECTIVES:

- To imbibe the knowledge to the students in the area of Bio-Chemical Engineering with emphasis in process calculations
- To deal with laws of conservation of mass and energy
- To perform calculations pertaining to processes and operations associated with Biotechnology

PREREQUISITE:

- Fundamentals of Physics, Chemistry and Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C302. 1	***Solve*** the basic chemical and biochemical engineering problems	K3
C302. 2	***Analyze*** the importance of ideal and actual gas equations in various industrial processes	K4
C302. 3	***Apply*** the material balance concepts in various industrial processes	K3
C302. 4	***Make use of*** the energy balance concepts in various industrial processes	K3
C302. 5	***Develop*** different combustion equation and solve using basic principles of thermochemistry	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C302. 1	3	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C302. 2	3	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
C302. 3	3	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C302. 4	3	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C302. 5	3	1	-	-	-	-	-	-	-	-	-	-	1	2	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I BASIC CHEMICAL CALCULATIONS 9

Systems of units – fundamental and derived quantities, Dimension, Dimensional Homogeneity and Dimensional Analysis, limitations and significance, unit conversion from one system to the other – composition of mixtures and solutions –Basic Calculations: mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.

UNIT II IDEAL AND ACTUAL GAS EQUATIONS 9

Ideal and actual gas equations, Vander Waals, compressibility factor equations, gas mixtures – vapour pressure, partial pressures, partial volumes – Air-water vapour systems, Humidification and dehumidification, Humidity chart, pH of solutions, Vapour pressure and applications of psychrometric chart.

UNIT III MATERIAL BALANCE 9

Basics of unit operations and unit processes involved in biotechnology industries and its applications. Material balance concept – overall & component – material balance equation for Evaporation, Absorber without reaction, Distillation (Binary system), Extraction, Drying, Crystallization, Mixing and Fermentation, Recycle, Purge and Bypass illustration.

UNIT IV ENERGY BALANCE 9

Fundamentals of energy balance calculations–Concepts of heat capacity, latent heat, sensible heat, vapour pressure and internal energy – energy balance with and without phase change in heat exchanger, Application of energy balance in Bioprocesses.

UNIT V FUELS AND COMBUSTION 9

Types of biofuels – solid, liquid & gaseous fuels – Ultimate and proximate analysis, Calculation of calorific value of fuels, Determination of composition by or sat analysis of products of combustion of solid, liquid and gas fuels – calculations of excess air from or sat techniques – problems on combustion process.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Bhatt B.I & SB Thakore, Stoichiometry - Fifth edition Tata McGraw Hill 2012.
2. K V Narayanan and B Lakshmi kutty, Stoichiometry and Process calculations –PHI 2015.
3. Geankoplis C.J. “Transport process & Separation process Principles 4th edition-PHI 2006.

REFERENCES:

1. McCabe W.L & J.C.Sonith & P.Harriot “Unit operations of chemical Engineering” 6thEdn McGraw Hill2001
2. Robert W.Fox, Alan T.McDonald & Philip J.Pritchard “Introduction to Fluid Mechanics” 6thedn John Wiley & Sons2003.
3. Himmelblau D.M “Basic principles & Calculations in Chemical Engineering” 6thedn PHI 2006.

Course code	21BT33T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	BIOORGANIC CHEMISTRY		3	0	0	3

COURSE OBJECTIVES:

- To describe in detail about the elements of atom, charges and their bonding rule.
- To know the various kinetic properties and types of reaction mechanisms.
- To understand the possible bio-organic reactions involved in biosynthesis.

PREREQUISITE:

- Fundamentals of Physics, Chemistry and Biochemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C303. 1	***Understand*** the elements of atom, charges and their bonding rule in detail.	K2
C303. 2	***Summarize*** the possible bio-organic reactions involved in biosynthesis.	K2
C303. 3	***Relate*** the various kinetic properties, types of reaction mechanisms and role of catalyst.	K2
C303. 4	***Apply*** the bioorganic reactions for profiling DNA and Protein.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C303. 1	2	-	-	-	-	-	1	-	-	-	-	2	2	2	-	-
C303. 2	2	1	-	-	-	-	1	-	-	-	-	2	2	2	-	-
C303. 3	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-	-
C303. 4	3	2	1	-	-	-	-	-	-	-	-	2	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO BONDING, ISOMERISIM AND STEREOCHEMISTRY 12

Atoms, Electrons and orbitals, Covalent Bonds, Octet rule, Polar covalant Bonds, Electronegativity, Isomerism –Types, Fischer, Sawhorse and Newmann projection, E and Z nomenclature.cis and trans isomerism, IUPAC nomenclature, sp^3 hybridization, optical activity, D-L and R-S notations, conformational analysis of ethane, butane, cyclohexane and peptide bond, Resonance effects, S_N1 and S_N2 reactions, E1 and E2 reaction.

UNIT II ENZYMES: STRUCTURE, STEREOCHEMISTRY AND MECHANISM 6

Enzymes and its classification, Stereospecific enzymatic reactions - fumarase catalysed reactions - NAD dependent oxidation and reduction reactions - chiral methyl group. The dehydrogenases - the proteases - lysozyme-ribonucleases.

UNIT III CATALYSIS 9

Reactivity ‑ Coenzymes ‑ Proton transfer ‑ metal ions ‑ Intra molecular reactions ‑ Covalent catalysis‑ Catalysis by organized aggregates and phases. Inclusion complexation.

UNIT IV KINETICS AND MECHANISM 9

Kinetic method ‑ Rate law and mechanism ‑ Transition states- Intermediates ‑ Trapping of intermediates ‑ Microscopic reversibility ‑ Kinetic and thermodynamic reversibility ‑ Isotopes for detecting intermediates. Primary and secondary isotopes ‑ the Arrhenius equation Eyring equation - ΔG, ΔS, ΔH, Thermodynamics of coupled reactions.

UNIT V BIOORGANIC REACTIONS 9

Timing of Bond formation and fission ‑ Acyl group transfer ‑ C-C bond formation and fission ‑ Catalysis of proton transfer reactions ‑ Transfer of hydride ion ‑ Alkyl group. Transfer ‑ Terpenebiosynthesis‑ Merrifield state peptide synthesis ‑ Sanger method for peptide and DNA sequencing.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Carey, Francis A.” Organic Chemistry”. VIIth Edition, Tata MCGraw Hill, 2009.
2. Page, M.I. and Andrew Williams “Organic and Bio-organic Mechanisms”. Pearson, 2010.

REFERENCES:

1. Morrison R. T., and Boyd R. N., “Organic Chemistry”, Pearson Education (Singapore) Pvt Ltd., New Delhi, 2002.
2. Michael B. Smith, “March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure”, Wiley, 8th Edition, 2020.

VEL TECH HIGH TECH

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Course code	21MA34T	Semester	III			
Category	BASIC SCIENCE COURSE(BSC)		L	T	P	C
CourseTitle	SERIES,TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to Mechanical, Civil, Chemical & Biotechnology)		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To develop Z transform techniques for discrete time systems.

PREREQUISITE:

- Mathematics skills at Sem-II level

COURSE OUTCOMES:

CO. No	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C304.1	***Understand*** how to solve the given standard partial differential equations.	K2
C304.2	***Solve*** differential equations using Fourier series analysis which plays a vital role in engineering applications.	K3
C304.3	***Appreciate*** the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.	K2
C304.4	***Understand*** the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.	K2
C304.5	***Use*** the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C304.1	3	3	-	-	-	-	-	-	-	-	-	-
C304.2	3	2	-	-	-	-	-	-	-	-	-	-
C304.3	3	2	-	-	-	-	-	-	-	-	-	-
C304.4	3	2	-	-	-	-	-	-	-	-	-	-
C304.5	3	3	-	-	-	-	-	-	-	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction-Formation of partial differential equations Solutions of a partial differential equation-Linear Equations of the first order– Nonlinear equations of the first order Charpit's method Linear partial Differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Introduction - Euler's Formulae - Conditions for a Fourier Expansion-Functions having points of discontinuity-Change of interval – Odd and even functions–Half range sine series–Half range cosine series–Parseval's Formula-Complex form of Fourier series–Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Introduction - Method of separation of variables–Vibrations of a stretched string-Wave equation [Fourier Series Method Only]– One dimensional equation of heat conduction–Steady state solution of two-dimensional equation of heat conduction - Laplace's equation in polar coordinates.

UNIT IV FOURIER TRANSFORMS 12

Introduction-Statement of Fourier integral theorem–Fourier transforms – Properties of Fourier transforms–Convolution theorem–Parseval's identity for Fourier transform-Relation between Fourier and Laplace transforms.

UNIT V TRANSFORMS AND DIFFERENCE EQUATIONS 12

Introduction – Definition of Z-transforms – Some standard Z-transforms–Damping rule-Some standard results-Shifting to the right and left – Multiplication by n-Initial and Final value theorem –Inverse Z-transform (using partial fraction and residues) – Convolution theorem–Convergence of Z-transforms-Evaluation of inverse Z-transforms [using partial and residue method only]-Application of difference equations.

Total:60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Erwin Kreyszig,"Advanced Engineering Mathematics ",10th Edition, John Wiley, India, 2016.
2. B.V.Ramana, "Higher Engineering Mathematics", McGrawHill Education Pvt. Ltd, New Delhi, 2016.
3. Wylie, R.C.and Barrett,L.C.,"Advanced Engineering Mathematics",Tata McGraw Hill Education Pvt. Ltd, 6th Edition, NewDelhi, 2012.

Course code	21BT35T	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CELL BIOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To acquire fundamental knowledge and perform translational research in cell biology
- To understand the cellular communication and signaling mechanisms
- To learn the cellular transport mechanisms and analytical techniques

PREREQUISITE:

- Biochemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C305. 1	***Understand*** the structural and functional units of a cell	K2
C305. 2	***Describe*** the various transport phenomena in cells	K2
C305. 3	***Explain*** the molecular interactions between the cells.	K2
C305. 4	***Relate*** the receptor and ligand interaction to aid cellular transduction	K2
C305. 5	***Analyze*** the cellular mechanisms using various techniques involved in Cell Biology	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C305. 1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C305. 2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C305. 3	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C305. 4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-
C305. 5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I CELL MEMBRANE, ORGANELLES AND MEMBRANE PROTEIN 10

Prokaryotic and Eukaryotic cells - Overview. Lipid bilayer: Composition, structure and properties of membrane lipids. Significance of membrane fluidity and asymmetry. Lipid rafts and its significance. Structure and functions of cell organelles, Cytoskeleton. Membrane proteins: Peripheral and Transmembrane proteins. Membrane dynamics: flip-flop, rotational and lateral diffusion. Techniques to assess membrane dynamics: Hybrid cells, FRAP and FLIP techniques. Cell-Cell junctions.

UNIT II CELL CYCLE AND REGULATION 7

Cell cycle, Cell Division - Mitosis, Meiosis, Molecules controlling cell cycle, Role of Ras and Raf in oncogenesis and apoptosis.

UNIT III MEMBRANE TRANSPORT 10

Basics of membrane transport: Size, solubility and electrochemical gradient of solutes across membrane. Kinetics of passive vs. facilitated diffusion. Transport proteins: Uniporters, Symporters, Antiporters, Aquaporins, ATP driven pumps and its types, Ion-channels – voltage and ligand gated. Role of ion-channels and ATP pumps in nerve conduction. Principles of Patch-Clamp experiment to study ion-channels activity.

UNIT IV CELL SIGNALLING 8

Extracellular Cell Signalling, Cell Signalling Types - Autocrine, paracrine and endocrine, Receptor Mediated Cell Signalling – Types and Classes, Secondary Messengers - cAMP, cGMP, IP_3, DAG and Ca^{2+}

UNIT V TECHNIQUES IN CELL BIOLOGY 10

Cell fractionation: Extraction, Homogenization and Centrifugation techniques. Microscopy and cell architecture: Fixation, sectioning and staining techniques for microscopic studies – Light microsope, fluorescent/confocal microscope, Electron microscopes – SEM, TEM and cryo EM. Cell isolation: Fluorescence Activated Cell Sorter (FACS) and Magnetic separation/MACS. Cell viability studies: Using tetrazolium salts, LDH release, Tryphan blue exclusion.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Lodish H, BerkA,MatsudairaP,Kaiser CA, Krieger M, Schot MP, Zipursky L, Darnell J., Molecular Cell Biology, 8th Edition, 2016.
2. Arnold Berk , Chris A. Kaiser , Harvey Lodish , Angelika Amon, HiddePloegh, Anthony Bretscher, Monty Krieger, Kelsey C. Martin. 2016. Molecular Cell Biology, 8th edition, W.H. Freeman. USA.
3. Rastogi, S.C. “Cell Biology” IIndEdition, New Age International, 2002.

REFERENCES:

1. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll and John Doebley. 2010.Introduction to Genetic Analysis. 10th edition. W.H. Freeman. USAVoet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., 1995.
2. Campbell, N.A., J.B. Recee and E.J. Simon “Essential Biology”, VIIrd Edition, Pearson International, 2007.

Course code	21MC01T	Semester	III			
Category	MANDATORY COURSE (MC)		L	T	P	C
Course Title	CONSTITUTION OF INDIA		2	0	0	0

COURSE OBJECTIVES:

- To understand the importance of constitution.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court, controller and auditor general of India and election commission of India.

PREREQUISITE:

- Civic Knowledge.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Understand*** historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration	K2
C001.2	***Understand*** the directive principle of state policy, and strengthening of the constitutional institutions.	K2
C001.3	***Analyze*** the role of Governor and Chief Minister, role of state election commission, the decentralization of powers.	K2
C001.4	***Understand*** the Public Election Process.	K2
C001.5	***Know*** the Special Provisions for Various category of People.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C001.1	-	-	-	-	-	3	-	2	-	-	-	1	-	-	-
C001.2	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.3	-	-	-	-	-	2	-	2	-	-	-	1	-	-	-
C001.4	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-
C001.5	-	-	-	-	-	1	-	2	-	-	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 0**

UNIT I INTRODUCTION TO INDIAN CONSTITUTION 6

The Necessity of the Constitution, The Societies before and after the Constitution adoption. **Introduction to the Indian constitution,** The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India.

UNIT II FUNDAMENTAL RIGHTS AND DIRECTIVE PRINCIPLES 6

Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building. Directive Principles of State Policy (Art. 36-51).

UNIT III UNION EXECUTIVE AND STATE EXECUTIVE 6

Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Parliamentary Terminologies**.** Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts.

UNIT IV ELECTIONS, AMENDMENTS AND EMERGENCY PROVISIONS 6

Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments Important Constitutional Amendments. Emergency Provisions, types of Emergencies and its consequences.

UNIT V DIRECTIVE PRINCIPLES & FUNDAMENTAL DUTIES 6

Fundamental Duties (Art. 51A), Basic Features of Constitution & Constitutional **special provisions:** Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Total: 30 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. N. Shukla, Constitution of India, Eastern Book Agency, 2014.
2. P. Jain, Indian Constitutional Law, Lexis Nexis, 2013.
3. M. Seervai, Constitutional Law of India, Universal Law Publishing Co., Reprint 2013.

REFERENCES:

1. Glanville Austin, Indian Constitution – cornerstone of the Nations, Oxford University Press, 1999.
2. M. Bakshi, The Constitution of India, Universal Law Publishing Co., 2014.
3. D. Basu, Shorter Constitution of India (14th Ed. 2008, reprint 2010).

Course code	21BT37P	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	APPLIED MICROBIOLOGY LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To learn and experiment various culturing techniques and microbial growth estimation

PREREQUISITE:

- Fundamentals of Biology and chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C307.1	***Understand*** about basic lab techniques and culture medium	K2
C307.2	***Experiment with*** Culturing of microorganisms and ***Build*** Medium Preparation.	K3
C307.3	***Examine*** the microorganisms by ***v***arious Staining Procedure and ***Classify*** them through biochemical test.	K4
C307.4	***Inference*** the growth of microorganisms in various conditions	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C307.1	2	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-
C307.2	3	2	1	-	-	-	-	-	1	-	-	-	1	-	-	-
C307.3	3	3	1	-	-	-	-	-	1	-	-	-	1	-	-	-
C307.4	3	3	-	-	-	-	-	-	1	-	-	-	1	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

List of Experiment **No. of Credits: 2**

1. Sterilization Techniques
2. Preparation of Broth and agar
3. Microbial Culture Techniques
4. Preservation techniques
5. Microscopy and Staining
6. Microorganism Growth Curve
7. Enumeration of microorganisms
8. Effect of different environmental condition on microorganisms
9. Antibiotic Sensitive Assay
10. Effect of disinfectants on microorganisms
11. Biochemical methods to identify Microorganism
12. Isolation of microorganisms from waste water

LEARNING RESOURCES:

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual, 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology 4thEdition, Churchill Livingstone, 1996.

REFERENCES:

1. R.C. Dubey and D. K. Maheshwari, "Practical Microbiology", SChand (India), 2002.

LIST OF EQUIPMENT REQUIRED

S. No.	Description of Equipment		Required numbers (For a batch of 30 students)
1.	Autoclave		01
2.	Hot Air Oven		01
3.	Incubators		02
4.	Light Microscopes		04
5.	Incubator Shaker		01
6.	Colorimeter		02
7.	Lamina Flow Chamber		02
8.	Glassware	Test tubes	50
		Pipettes	10
		Petri-plates	30
9	Media and Chemicals		As Required

Course code	21BT38P	Semester	III			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CELL BIOLOGY LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To learn the various techniques for morphology, identification and propagation of cells

PREREQUISITE:

- Biochemistry Laboratory

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C308.1	***Outline the*** awareness on the sterilization techniques and microscopy handling	K2
C308.2	***Experiment with*** differential staining in order to understand the internal components of a cell	K3
C308.3	***Demonstrate*** the ability to propagate cells and perform cell division	K2
C308.4	***Distinguish*** the viable cells from dead cells using cell viability assays.	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C308.1	2	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
C308.2	3	2	1	-	-	-	-	-	1	-	-	-	2	-	-	-
C308.3	2	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
C308.4	3	3	1	-	-	-	-	-	1	-	-	-	2	-	-	-

Note: 1: Slight, 2: Moderate, 3: Substantial

LIST OF EXPERIMENT **NO OF CREDITS: 2**

1. Principles of sterilization and handling of microscopes.
2. Studying the diversity of cells using permanent slides.
3. Differentiate plant cells from animal cells using a staining procedure.
4. Stain and differentiate gram positive and gram negative bacteria.
5. Stain and differentiate nucleated and non-nucleated blood cells.
6. Staining method to identify blood parasites.
7. Cell lysis through Osmosis and Tonicity.
8. Peripheral Blood Mononuclear Cell Separation from Blood.
9. Growing root tips of *Allium cepa* and study different stages of Mitosis.
10. Study of Meiotic Cell Division using permanent slides.
11. Thin Layer Chromatography.
12. Cell Viability: Tryphan Blue Assay.

LEARNING RESOURCES:

TEXT BOOKS:

1. Rickwood, D. and J.R. Harris “Cell Biology: Essential Techniques”, Johnwiley,1996.
2. Davis, J.M. “Basic Cell Culture: A Practical Approach”, IRL,1994.

REFERENCES:

1. Roitt, I., Brostoff, J. and Male, D. “Immunology”, 6th Edition, Mosby, 2001.

LIST OF EQUIPMENT REQUIRED

S. No.	Description of Equipment		Required numbers (For a batch of 30 students)
1.	Autoclave		01
2.	Hot Air Oven		01
3.	Incubators		02
4.	Light Microscopes		04
5.	Incubator Shaker		01
6.	Colorimeter		02
7.	Lamina Flow Chamber		02
8.	Glassware	Test tubes	50
		Pipettes	10
9.	Chemicals		As Required

IV & V SEMESTER
CURRICULUM AND SYLLABI

Applicable to the students admitted to

B. TECH BIOTECHNOLOGY

R-2021: CBCS

Academic year 2021-2022
onwards

VEL TECH HIGH TECH

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B.Tech.-Biotechnology (R2021)

SEMESTER IV										
S. No.	**Course code**	**Course title**	**Category**	**CIE Marks**	**SEE Marks**	**Total Marks**	**Credits**			
							L	**T**	**P**	**C**
THEORY										
1	21BT41T	Research Methodology and Biostatistics	BSC	40	60	100	3	1	0	4
2	21BT42T	Fluid Mechanics and Heat Transfer Operations for Biotechnologist	PCC	40	60	100	3	0	0	3
3	21BT43T	Applied Thermodynamics for Biotechnologists	PCC	40	60	100	3	0	0	3
4	21BT44T	Principles and Techniques of Molecular Biology	PCC	40	60	100	3	0	0	3
5	21BT45T	Basics of Industrial Biotechnology	PCC	40	60	100	3	0	0	3
6	21MC02T	Environmental Sciences	MC	40	60	100	2	0	0	0
PRACTICAL										
7	21BT47P	Chemical Engineering Laboratory for Biotechnologists	PCC	40	60	100	0	0	4	2
8	21BT48P	Molecular Biology Laboratory	PCC	40	60	100	0	0	4	2
9	21EE01P	Mini Project – I	EEC	40	60	100	0	0	2	1
TOTAL										**21**

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Course code	21BT41T	Semester	IV			
Category	BASIC SCIENCE COURSE (BSC)		L	T	P	C
Course Title	RESEARCH METHODOLOGY AND BIOSTATISTICS		3	1	0	4

COURSE OBJECTIVES:

- To create an awareness on research methods and data collection techniques.
- To prepare the students to present their research in journals and periodicals.
- To understand the basic concepts of biostatistics and its role in research.
- To implement the statistical tools in research.

PREREQUISITE:

- Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C401.1	***Document*** and present research findings in various scientific forums	K3
C401.2	***Analyze*** and present the research data.	K3
C401.3	***Interpret*** research findings using various statistical tools and techniques	K3
C401.4	***Define*** and apply a research problem statement	K3
C401.5	***Identify*** research gaps through literature survey	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C401.1	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
C401.2	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
C401.3	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
C401.4	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
C401.5	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I CLASSIFICATION AND PRESENTATION OF DATA 9+3

Biostatistics – Definition and Scope – Collection of Data (Primary and Secondary). Variable – Discrete and Continuous. Presentation of Data – Classification and Types of Classification, Tabulation - Types of Tables. Diagrams and Graphs – Bar Diagram (Simple and Multiple), Pie Diagram , Frequency Diagram : Histograms , Frequency Polygon, Frequency Curve , Ogives, Line Graphs, Characteristics of Frequency Distribution.

UNIT II STATISTICAL RESEARCH TOOLS AND TECHNIQUES 9+3

Measures of Central Tendency – Mean, Median, Mode – Weighted Arithmetic Mean (Individual, Discrete, and Continuous) - Measures of Dispersion – Range , Mean Deviation, Standard Deviation and Standard Error-Correlation and Its Types, Regression and Regression Equations and Regression Lines. Samples – Principle and Sampling Methods. Test of Significance – Large and Small Sample Test – Test for Proportions – ANOVA, Student's T Test, F Test and Chi Square Test.

UNIT III RESEARCH PROBLEM AND EXPERIMENTATION 9+3

Types of Research (Descriptive/Analytical, Applied /Fundamental, Qualitative/Quantitative, Conceptual / Empirical)-Defining a Research Problem statement– Development of Research Plan -Basic Principles – Informal and Formal Experimental Design -Data Collection Techniques - Hypothesis – Null and Alternate Hypothesis, Testing the Hypothesis

UNIT IV LITERATURE REVIEW AND INFORMATION RESOURCES 9+3

Literature Review- Importance in Defining a Problem, Identifying gap- Sources of Information – Primary and Secondary Sources. Library Books, Journals, Periodicals, Reference Sources, Abstracting and Indexing Sources, Reviews, Monographs- Internet – Search Engines, Online Libraries (Scopus, Medline, PubMed, Science Directs), E-Books, E-Encyclopedia, Institutional Websites.

UNIT V SCIENTIFIC DOCUMENTATION AND PRESENTATION 9+3

Scientific Writing – Characteristics. Logical Format for Writing Thesis and Papers. Essential Features of Abstract, Introduction, Review of Literature, Materials, Methods and Discussion. Effective Illustration – Table and Figures. Reference Styles – Project Proposal Writing, ResearchReport Writing (Research Articles, Oral Communications)- Presentation Techniques – Assignment, Seminar, Debate, Workshop, Colloquium, Conference-Computer Aided Techniquesfor Data Presentation, Data Analysis, And Statistical Techniques

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Biostatistical Analysis 5th Edition (2008), J.H. Zar. Publisher – Pearson Education Inc. and Dorling Kindersley Publishing Inc.
2. Research Methodology Methods and Statistical Techniques (2018), Santhosh Gupta. PublisherDD.

REFERENCES:

1. Research Methodology for Biological Sciences (2006), N. Gurumani. MJP Publishers- TamilNadu Book House.
2. Introduction to Biostatistics (2004), N. Gurumani. MJP Publishers Research
3. Methodology: Methods and Techniques (2004), C.R. Kothari. Publisher – New Age International

Course code	21BT42T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	FLUID MECHANICS AND HEAT TRANSFER OPERATIONS FOR BIOTECHNOLOGIST		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the fundamental principles and concepts of fluidmechanics in fluid flow and fluid flowing over immersed solids
- Learn the concepts involved in heat transfer by conduction, convection and radiation heattransfer.

PREREQUISITE:

- Basics of Stoichiometry.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C402.1	***Explain*** the theoretical concepts of Fluid Properties & Fluid Mechanics	K3
C402.2	***Demonstrate*** the capability to analyse the Flow of Fluid through Packing and its industrial applications.	K4
C402.3	***Understand*** the concept of Conduction Heat Transfer in various heat exchange process in the industry.	K3
C402.4	***Learn*** basic Convection Heat Transfer and condensation process	K3
C402.5	***Correlate*** Radiation Heat Transfer & Heat Transfer Equipment in biotechnology	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C402.1	3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
C402.2	3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
C402.3	3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
C402.4	3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
C402.5	3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I FLUID PROPERTIES AND FLUID MECHANICS 9

Fluid definition- compressible, in compressible fluids – coefficient of isothermal compressibility, Density, specific gravity, specific weight, surface tension, vapour pressure, viscosity. Rheology of fluids. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Types of Pressure measurement devices, Fluid Dynamics – equation of continuity – Bernoulli's equation – Flow Measurement Device Types.

UNIT II FLOW OF FLUID THROUGH PACKINGS 9

Fluidization, Fluid transport Industrial application of fluid flow through packing-characterise of packed bed-Bed surface area-void fraction-Laminar flow through packed bed and turbulent flow pressure drop experienced by the fluid-equations and application problems. Heat Transfer from wall surfaces, Fluidization Phenomena-Industrial application - minimum fluidization velocities. Industrial pipes and fittings- Fluid moving machinery-pumps centrifugal, Reciprocating-gear, Peristaltic pumps, Introduction togas moving machinery-Fans, blowers, compressors. Dimensional analysis for flow parameters by Rayleigh's method, Buckingham Pi theorem.

UNIT III CONDUCTION HEAT TRANSFER 9

Heat transfer phenomena-thermodynamics & heat transfer. Heat conduction – Fourier's Law – steady state conduction in plexor and radial systems – Resistance concept – series and resistance in conduction –and parallel resistance in conduction – unsteady state conduction – lumped capacity model – extended surfaces (Fins) –combined conduction & convection – 2-dimensional conduction.

UNIT IV CONVECTION HEAT TRANSFER 8

Forced and natural convection – Dimensional analysis, Dimensional numbers, Convection heat transfer coefficient, LMTD for parallel and counter flow exchanger. Correlations for flow over plate, through tubes, over spheres and cylinders. Agitated systems, Packed columns, condensation phenomena, Film and drop wise condensation over tubes. Boiling phenomena, and overall heat transfer coefficients and solving related problems.

UNIT V RADIATION HEAT TRANSFER AND EQUIPMENTS 10

Electromagnetic waves, energy of radiation, Planck's Equation-Blackbody, Radiation exchange. Kirchhoff's law, Stefen-Boltemann equation of radiant energy – Wien's law, Radiation exchange between surfaces – black, gray bodies, view factors-sample problems. Concept of overall heat transfer coefficient by radiation. Types of Heat Exchangers, LMTD Concepts and Design of heat exchangers. Types of Evaporators, Design of Evaporators, Application of Heat exchangers and Evaporators in Biotechnology Industries.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Bansal RK. A Textbook of Fluid Mechanics and Hydraulic Machines (in SI Units). Laxmi Publications, Ltd.; 2005.
2. Geankoplis. C.J ”Transport Process & separation Process Principles” IV edition PrenticeHall of India 2015.
3. P. K. Nag “Heat & Mass Transfer”, Tata McGraw Hill III Edition 2011.

REFERENCES:

1. Frank Kreith, Raj M. Manglik and Mark S. Bohn “Principles of Heat Transfer” VIIedition Cenage Learning Inc 2018.
2. Mc Cabe, W.L., Smith, J.C. and Harriot, P., ‘Unit Operations in Chemical Engineering’,VII edition., McGraw-Hill, 2017.

Course code	21BT43T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn about basic concepts of classical and statistical thermodynamics

PREREQUISITE:

- Fundamentals of Physics, Chemistry and Mathematics

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C403.1	***Explain*** the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.	K3
C403.2	***Demonstrate*** the capability to analyse the energy conversion performance in a variety of modern applications in biological systems.	K4
C403.3	***Design*** and carry out bioprocess engineering experiments, and analyse and interpret fundamental data to do the design and operation of bioprocesses.	K3
C403.4	***Describe*** the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and productformation.	K3
C403.5	***Apply*** their knowledge in the field of biochemical engineering from the principles of thermodynamics.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C403.1	3	2	2	1	-	-	-	-	-	-	-	-	1	1	-	-
C403.2	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-	-
C403.3	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
C403.4	3	2	2	1	-	-	-		-	-	-	-	1	2	-	-
C403.5	3	2	2	1	1	-	-		-	-	-	-	-	1	2	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties;estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications. Application of thermodynamics concepts – Calorimeter, refrigerator, compressor and nozzles.

UNIT II SOLUTION THERMODYNAMICS 9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid- liquid equilibria and solid-solid equilibria. Phase diagrams for binary solutions.

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversionand yields for single.

UNIT V BIOCHEMICAL THERMODYNAMICS 9

Thermodynamics of open system – biological system. Concept of pH and ionization. Ligand binding. Membrane transport (Gibbs Donnan equation). Energy coupling reactions (ATP and NADH). Energetic of metabolic pathways (Glucose metabolism, Photosynthesis). Thermodynamic feasibility analysis of metabolic pathways. Protein stability

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VI Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
3. Christiana D. Smolke, "The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

REFERENCES:

1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley, 1989.
2. Donald T Hayne, "Biological Thermodynamics", Cambridge University press, New York, 2001.

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE-New Delhi, Affiliated to Anna University, Chennai

Accredited by NBA, New Delhi & Accredited by NAAC with "A" Grade & CGPA of 3.27

Course code	21BT44T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PRINCIPLES AND TECHNIQUES OF MOLECULAR BIOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the cell and molecular biology of both Prokaryotes and Eukaryotes.
- To Acquire basic fundamental knowledge and explore skills in molecular biology
- To emphasize the molecular mechanism of DNA replication, repair, transcription,protein synthesis and gene regulation in various organisms.

PREREQUISITE:

- Fundamentals of Biochemistry and Cell Biology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C404.1	***Describe*** the basic structure and biochemistry of nucleic acids and protein	K2
C404.2	***State*** the principle of central dogma and DNA replication in prokaryotes and eukaryotes	K2
C404.3	***Infer*** the various types of RNA and explain the DNA transcription and the posttranscriptional modification.	K2
C404.4	***Outline*** the genetic code and prokaryotic and eukaryotic protein synthesis	K2
C404.5	***Understand*** about the gene organization in prokaryotes and eukaryotes and related mechanisms	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C404.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C404.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C404.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C404.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C404.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	3

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I GENETIC MATERIAL 9

Introduction to nucleic acids: Nucleic acids as genetic material, Primary and secondary structure of DNA: Conformational variants of double helical DNA, Tertiary structure of DNA: DNA supercoiling, Hogsteen base pairing, Triple helix, Quadruple helix, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Reversible denaturation and hyperchromic effect.

UNIT II DNA REPLICATION AND REPAIR 9

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson& Stahl experiment, bi–directional DNA replication, Geometry of replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. θ replication, D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III TRANSCRIPTION 9

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.

UNIT IV TRANSLATION 9

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its importance.

UNIT V REGULATION OF GENE EXPRESSION 9

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

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

REFERENCES:

1. Tropp, Burton E. “Molecular Biology: Genes to Proteins”. IIIrd Edition. Jones and Bartlett, 2008.
2. Glick , B.R. and J.J. Pasternak. “Molecular Biotechnology: Principles and Applications ofRecombinant DNA” 4th Edition. ASM, 2010.

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

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Course code	21BT45T	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	BASICS OF INDUSTRIAL BIOTECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on industrial fermentation technology.
- To make the students aware of the overall industrial bioprocess that helps them tomanipulate the process to the requirement of industrial needs.
- To prepare students for the bulk production of commercially important primary, secondary metabolites and biotechnological products.

PREREQUISITE:

- Microbiology and Biochemistry

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C405.1	***Understand*** the fundamentals of fermentation technology	K2
C405.2	***Interpret*** the techniques for the production of primary metabolites	K2
C405.3	***Illustrate*** the techniques for the production of secondary metabolites	K2
C405.4	***Summarize*** the production of enzymes and other bio products	K2
C405.5	***Outline*** the process for the production of modern biotechnological products	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C405.1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C405.2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C405.3	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C405.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C405.5	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Fermentation- Fermentation principles & Product recovery for Bacterial, fungal and yeast; Biochemistry of fermentation; Types of media Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting- block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES 9

Primary Metabolites- Production of commercially important primary metabolites like organic acids- (Citric acid, Lactic acid, Acetic acid, Itaconic acid), amino acids (Glutamic acid, Phenyalanine, Asparticacid) and alcohols; Biosynthetic pathways and Feedback Mechanisms.

UNIT III PRODUCTION OF SECONDARY METABOLITES 9

Fermentation Design, Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics (Penicillin, Cephalosporin, Erythromycin), Vitamins (Vit B12, Riboflavin) ,β- Carotene, Alkaloids and Steroids; Biosynthetic Pathways and Feedback Mechanisms.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 9

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Bio preservatives, Biopolymers, Biofuel, Biogas. Cheese, Beer, SCP & Mushroom culture, Bioremediation, Economic Aspects.

UNIT V PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS 9

Production of recombinant proteins : Monoclonal antibodies, Human Growth Factor, Insulin, Tumor Suppressor Proteins - therapeutic and diagnostic applications; vaccines.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Patel, AH- Industrial Microbiology. 2nd edition, Trinity press Lakshmi publication (P) Ltd.,2017.
2. Satyanarayana, U. ―Biotechnology‖ Books & Allied (P) Ltd., 2005.
3. Ratledge, Colin and Bjorn Kristiansen ―Basic Biotechnology‖ IInd Edition Cambridge University Press, 2001
4. Dubey, R.C. ―A Textbook of Biotechnology‖ S.Chand& Co. Ltd., 2006.

REFERENCES:

1. Casida, L.E. ―Industrial Microbiology‖, New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, ―Industrial Microbiology‖, Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, ―Biotechnology: A Textbook of Industrial Microbiology‖, IInd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, ―Comprehensive Biotechnology‖, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. Stanbury, P.F., A. Whitaker and S.J. Hall ―Principles of Fermentation Technology‖, IInd Edition, Butterworth –Heinemann (an imprint of Elsevier), 1995.

Course code	21MC02T	Semester	IV			
Category	MANDATORY COURSE (MC)		L	T	P	C
Course Title	ENVIRONMENTAL SCIENCES (Common for All Branches except Chemical)		2	0	0	0

COURSE OBJECTIVES:

- To study the nature, interrelationship between living organism and environment, biodiversity, natural resources, pollution control and waste management.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To appreciate the importance of environment by assessing its impact on the human world.

PREREQUISITE:

- Basic awareness on environment.

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C002.1	***Illustrate*** the interrelationship between living organism and environment.	K2
C002.2	***Relate*** Public awareness, environmental pollution and its problem.	K2
C002.3	***Classify*** the dynamic processes and the features of natural resources.	K2
C002.4	***Measure*** the development and improvement in standard of living.	K2
C002.5	***Summarize*** the knowledge about human health and welfare.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C002.1	1	-	-	-	-	-	1	-	-	-	-	-
C002.2	2	-	-	-	-	-	1	-	-	-	-	-
C002.3	1	-	-	-	-	-	1	-	-	-	-	-
C002.4	1	-	-	-	-	-	2	1	-	-	-	1
C002.5	1	-	-	-	-	-	1	1	-	-	-	1

Note: 1: Slight, 2: Moderate, 3: Substantial

SYLLABUS **No. of Credits: 0**

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

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

UNIT II NATURAL RESOURCES 10

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

UNIT III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

From unsustainable to sustainable development- Equitable use of resources for sustainable lifestyles – urban problems related to energy –water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of nongovernmental organization- environmental ethics: Issues and possible solutions –principles of green chemistry–climate change, global warming, acid rain, ozone layer depletion, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water(Prevention

and control of Pollution) act – Wildlife protection act – Forest conservation act – environmental impact assessment- enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 7

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – women and child welfare – HIV/AIDS –SARS- Covid-19- role of information technology in environment and human health – Case studies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2014.
2. Anubha Kaushik, and Kaushik, C. P., Environmental Science and Engineering, New Age International Publishers, 6thEdition, 2019.

REFERENCES:

1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, 2nd Edition, University Grants Commission, Universities Press, 2013.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Pearson Education, 2004.
3. Tyler Miller, G., and Scott E. Spoolman, Environmental Science, Cengage Learning India Pvt, Ltd, Delhi, 2014.

Course code	21BT47P	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	CHEMICAL ENGINEERING LABORATORY FOR BIOTECHNOLOGISTS		0	0	4	2

COURSE OBJECTIVES:

- To provide basic understanding of chemical engineering principles and operations
- Course will enable the students to apply the principles in other chemical engineering andbiotechnology subjects offered in higher semesters.

PREREQUISITE:

- Chemistry and Process Calculation

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C407.1	***Apply*** the basic principles of chemical engineering	K3
C407.2	***Relate*** the material balance and energy balance in unit operations, unit process of chemical engineering and biotechnology	K3
C407.3	***Analyze*** the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives	K3
C407.4	***Explore*** the design and working principles of fluid moving machinery and transport phenomena	K3
C407.5	***Investigate*** the design and working principles of mass transfer and heat transfer	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C407.1	3	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C407.2	3	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C407.3	3	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C407.4	3	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C407.5	3	2	2	1	-	-	-	-	-	-	-	-	2	1	-	-

Note: 1: Slight; 2: Moderate; 3: Substantial

List of Experiment **No. of Credits: 2**

1. Flow measurement in Orifice meter
2. Flow measurement in Venturimeter
3. Flow measurement in Rotameter
4. Pressure drop in flow through pipes
5. Pressure drop in flow through packed column
6. Pressure drop in flow through fluidized beds
7. Characteristics of centrifugal pump
8. Filtration through plate and frame filter press
9. Filtration in leaf filter
10. Heat transfer characteristics in heat exchanger
11. Simple and Steam distillation
12. Leaching

LEARNING RESOURCES:

TEXT BOOKS:

1. McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. McGrawHill. 1993.
2. Binay K.Dutta, Heat transfer: Principles and applications, PHI learning Pvt. Ltd., New Delhi,1st edition, 2006.

REFERENCES:

1. Geankoplis C.J. Transport Processes and Unit Operations. Prentice Hall India.2002.
2. Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green,Marylee Z. Southard, Imprint: McGraw-Hill Education.

VEL TECH HIGH TECH

Dr. RANGARAJAN Dr. SAKUNTHALA ENGINEERING COLLEGE

An Autonomous Institution

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Course code	21BT48P	Semester	IV			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	MOLECULAR BIOLOGY LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- Provide hands-on experience in performing basic molecular biology techniques.
- Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the studentsto take up specialized project in Molecular biology and will be a pre-requisite for research work.

PREREQUISITE:

- Fundamentals of the Biochemistry and Biology Laboratory

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C408.1	***Demonstrate*** the principles under pinning important techniques in molecular biology.	K3
C408.2	***Isolate*** DNA from prokaryotic and eukaryotic organisms	K3
C408.3	***Apply*** the principles in transformation of genetic material	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C408.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C408.2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
C408.3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-

Note: 1: Slight; 2: Moderate; 3: Substantial

List of Experiment **No. of Credits: 2**

`

1. Agarose Gel Electrophoresis
2. Isolation of microbial DNA
3. Isolation of DNA from Banana/Strawberry using Household Chemicals
4. Isolation of genomic DNA from plant cell
5. Isolation of genomic DNA from Animal cell
6. Isolation of RNA
7. Quantification of DNA (UV/ Vis) and analysis of purity
8. Restriction enzyme digestion and Ligation
9. competent cells preparation
10. Transformation
11. Selection of recombinants – Antibiotic sensitivity assay
12. Plating of λ phage

LEARNING RESOURCES:

TEXT BOOKS:

1. Robert J. Slater., Experiments in Molecular Biology, Springer Nature, 1986.

REFERENCES:

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor, 2006.

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Course code	21EE01P	Semester	IV			
Category	EMPLOYABILITY ENHANCEMENT COURSE (EEC)		L	T	P	C
Course Title	MINI PROJECT – I		0	0	2	1

COURSE OBJECTIVE:

- To introduce project-based learning

PREREQUISITE:

- All Core Courses

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Evaluate*** specific problem statements for ill-defined real-life problems with reasonable assumptions and constraints.	K5
C001.2	***Perform*** literature search and / or patent search in the area of interest	K3
C001.3	***Conduct*** experiments / design and analysis / solution iterations anddocument the results/ Perform error analysis	K4
C001.4	***Synthesize*** the results and arrive at scientific conclusions / products / solution	K4
C001.5	***Document*** the results in the form of technical report / presentation	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C001.1	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2
C001.2	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2
C001.3	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2
C001.4	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2
C001.5	3	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2

Note: 1: Slight; 2: Moderate; 3: Substantial

DOMAINS

Students are advised to carryout the projects in the following domains, but not limited with

- Biochemistry
- Bio-organic Chemistry
- Cell Biology
- Microbiology
- Marine Biology
- Industrial Biotechnology
- Plant Science
- System Biology
- Natural Products

Total: 30 Periods

ONLINE RESOURCES:

1. https://swayam.gov.in/nc_details/NPTEL
2. https://www.sciencedirect.com/
3. https://www.ncbi.nlm.nih.gov/
4. https://www.ncbi.nlm.nih.gov/pmc/
5. https://mtccindia.res.in/
6. https://www.atcc.org/

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B.Tech.-Biotechnology (R2021)

SEMESTER V										
S.No	Course code	Course title	Category	CIE Marks	SEE Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	21BT51T	Bioprocess Engineering	PCC	40	60	100	3	0	0	3
2	21BT52T	Mass Transfer Operations	ESC	40	60	100	3	0	0	3
3	21BT53IT	Analytical Techniques in Biotechnology	PCC	40	60	100	2	0	4	4
4	21BT54T	Principles of Genetic Engineering	PCC	40	60	100	3	1	0	4
5	-	Professional Elective I	PEC	40	60	100	3	0	0	3
6	-	Open Elective I	OEC	40	60	100	3	0	0	3
PRACTICAL										
7	21BT57P	Bioprocess Laboratory	PCC	40	60	100	0	0	4	2
8	21BT58P	Genetic Engineering Laboratory	PCC	40	60	100	0	0	4	2
									TOTAL	**24**

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Course code	21BT51T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	BIOPROCESS ENGINEERING		3	0	0	3

COURSE OBJECTIVES:

- To provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for production of biochemical products using biochemical processes.

PREREQUISITE:

- Microbiology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C501.1	***Select*** appropriate bioreactor configurations and operation modes based on nature of bioproducts and other process criteria	K3
C501.2	***Illustrate*** the design of a bioreactor and scale-up process.	K3
C501.3	***Integrate*** research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology	K3
C501.4	***Use*** the modeling and simulation of bioprocesses in reducingthe cost and to enhance the quality of products and systems.	K3
C501.5	***Apply*** bioprocess technology in recombinant cell cultivation	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C501.1	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
C501.2	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
C501.3	3	2	1	-	-	-	-	-	-	-	-	-	3	3	-	-
C501.4	3	2	1	-	-	-	-	-	-	-	-	-	3	3	1	1
C501.5	3	2	1	-	-	-	-	-	-	-	-	-	3	3	1	1

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I CONFIGURATION OF BIOREACTORS 9

Introduction – Ideal Reactor, Chemostat, Fed batch cultivation – Fixed Volume and Quasi-Steady State, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, Packed bed reactor, Airlift reactor, Fluidized bed reactor, Bubble column reactors

UNIT II BIOREACTOR SCALE – UP 9

Oxygen mass transfer in bioreactors – microbial oxygen demands, Methods for the determination of mass transfer coefficients, Factors affecting kLa, Mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS 9

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors.

UNIT IV MODELLING AND SIMULATION IN BIOPROCESSES 9

Structured models – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism using ISIM.

UNIT V RECOMBINANT CELL CULTIVATION 9

Different host vector system for recombinant cell cultivation, strategies and advantages, E. coli, yeast Pichiapastoris / Saccharomyces cereviseae, Insect cell cultivation, Animal cell cultivation, Plant cell cultivation, Reactor considerations in the above system

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering, Basic Concept, 2nd Edition Prentice Hall PTR, 2002
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications
3. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer Verlag.
2. James M. Lee, Biochemical Engineering, PHI, USA.

Course code	21BT52T	Semester	V			
Category	ENGINEERING SCIENCE COURSE (ESC)		L	T	P	C
Course Title	MASS TRANSFER OPERATIONS		3	0	0	3

COURSE OBJECTIVES:

- The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in phase changes for product separation
- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of bio separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of bioproducts.

PREREQUISITE:

- Basic Physics, Chemistry, Process Calculation and Mathematics Skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C502.1	***Classify*** and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process	K3
C502.2	***Analyze*** the importance of gas – liquid operations (absorbers and strippers) in various industrial processes	K3
C502.3	***Investigate*** the simultaneous phase equilibrium material balance concepts in various industrial separation (distillation) processes	K3
C502.4	***Make*** use of the mechanism behinds for liquid–liquid (extraction) and solid–liquid (leaching) separation process for bioproduct purification	K3
C502.5	***Design*** and construction with operating principles for drying and adsorption process for bioproduct purification with industrial applications	K4

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C502.1	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
C502.2	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
C502.3	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
C502.4	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
C502.5	3	2	2	1	-	-	-	-	-	-	-	-	1	2	-	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I DIFFUSION AND MASS TRANSFER **9**

Molecular diffusion in fluids and solids, Inter-phase Mass Transfer, Mass Transfer coefficients, analogies in transport phenomenon, Application of Mass Transfer operation in biotechnology industry.

UNIT II GAS LIQUID OPERATIONS **9**

Principles of gas-liquid absorption, single component absorption, types of absorption and its packing, design of absorption column, HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS **9**

Vapor-Liquid equilibria, types of distillation process – Simple, Steam, Azeotropic, Extractive, batch and continuous distillation, McCABE THIELE & PONCHON-SAVARIT Principles, HETP, HTU and NTU concepts, Basic Calculation.

UNIT IV EXTRACTION OPERATIONS **9**

Liquid-Liquid equilibria, extraction Principles, various stages of extraction process, types of extraction, Industrial extraction equipments. Solid-liquid equilibria, Leaching Principles, Industrial leaching equipments, Basic Calculation.

UNIT V SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Batch, fixed and Moving bed adsorption; Drying-Mechanism-Drying curves- Time of Drying; types of drying process, Industrial drying equipments, Basic Calculation.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Treybal R.E. Mass Transfer Operations. IIIrd edition. Mcgraw Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations. IIIrd edition, Prentice Hall of India, 2002.

REFERENCES:

1. McCabe W.L & J.C.Sonith &P. Harriot “Unit operations of chemical Engineering” 6thEdn McGrawHill2001.
2. Coulson and Richardson’s Chemical Engineering. Vol I & II, Asian Books Pvt Ltd, 1998.

Course code	21BT53IT	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY		2	0	4	4

COURSE OBJECTIVES:

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence,NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biologicalproducts.
- To have practical hands on experience on analytical instruments

PREREQUISITE:

- Fundamentals of Physics, Chemistry and Biology.

COURSE OUTCOMES:

CO.NO	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C503.1	***Understand*** fundamental knowledge about spectrometry, Properties of electromagnetic radiation and components of optical instruments	K2
C503.2	***Interpret*** the theory of absorbance, molecular spectroscopy and its application	K2
C503.3	***Discuss*** about Mass spectrometer and the environmental impacts of NMR	K2
C503.4	***Characterize*** and separate different biological samples using basic chromatographic methods	K3
C503.5	***Demonstrate*** the mechanism of electrochemical cells, surface microscopy, and acquire knowledge about Instrument for potentiometric studies and its application	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Co. No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C503.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	1	-
C503.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	1	-
C503.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	1	-
C503.4	3	2	1	1	-	-	-	-	-	-	-	-	2	2	1	-
C503.5	3	2	1	1	-	-	-	-	-	-	-	-	2	2	1	-

Note:- 1: Slight; 2: Moderate; 3 Substantial

SYLLABUS **No. of Credits: 4**

UNIT I INTRODUCTION TO SPECTROMETRY 6

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 6

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications

UNIT III MAGNETIC RESONANCE SPECTROSCOPY & MASS SPECTROMETRY 6

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 6

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography-principlesof GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 6

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

Total: 30 Periods

List of Experiment

1. Precision and validity in an experiment using absorption spectroscopy .
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorbtivity and stoichiometry of the using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids using varied concentration.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO4-- by Nephelometry.
8. Estimation of Al3+ by Flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using Column Chromatography.
12. Chromatography analysis using Size Exclusion Chromatography.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis".CengageLearning , 2007.
2. Fifield F.W.,Principles and Practice of Analytical Chemistry. Blackwell, Scientific Publishers,2016
3. Ewubg G. W. "Instrumental Methods of Chemical Analysis" 5th Edition, Mc Graw Hill 1985

REFERENCES:

1. Sharma, B.K. "Instrumental Methods of Chemical Analysis: Analytical Chemistry", KrishnaPrakashan Media (P) Ltd, 2014
2. Haven, Mary C., etal., "Laboratory Instrumentation ". 4th Edition, Wiley India Pvt Ltd, 2010
3. Philopose P.M.Analytical Biotechnology. Domihant Publishers & distributors, New Delhi,2016.

APPARATUS REQUIRED

Equipment Need for 30 Students	
Colorimeter	3
Glasswares, Chemical, Media	as required

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Course code	21BT54T	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	PRINCIPLES OF GENETIC ENGINEERING		4	0	0	4

COURSE OBJECTIVES:

- To explain the techniques involved in cloning genes for the production of recombinant proteins
- To explicate the fundamentals of r DNA technology on construction of vectors and DNA libraries
- To describe the principle involved in whole genome sequencing and mapping.
- To make students understand the application of genetic engineering in various fields.

PREREQUISITE:

- Molecular biology and Biochemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C504.1	***Understand*** the cloning of commercially important genes and production of recombinant proteins	K2
C504.2	***Construct*** and screening of DNA libraries	K3
C504.3	***Learn*** to design DNA sequence using amplification techniques	K3
C504.4	***Evaluate*** the methods for sequencing genomic materials	K3
C504.5	***Infer*** the applications of genetic engineering in biotechnology	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C504.1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C504.2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C504.3	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C504.4	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	1
C504.5	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	1

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 4**

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 12

Overview of recombinant DNA technology. Manipulation of DNA – Restriction and Modification enzymes, DNA polymerase, DNA ligase, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA into host cells and selection methods.

UNIT II Construction of DNA Libraries 12

Construction of genomic and cDNA libraries- hairpin and loop strategies, Limitations in cDNA library constructions Artificial chromosomes– BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antibodies.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 12

Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Polymerase chain reaction: Principle and steps in PCR, Types of PCR- Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR–SYBR green assay, Taqman assay, Molecular beacons, Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES 12

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies, Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V APPLICATIONS OF GENETIC ENGINEERING 12

Gene therapy- ex vivo and in vivo, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System, CRISPR-Cas. Genetic engineering in medicine - recombinant therapeutics, antibiotics and vaccines, Genetic engineering in agriculture – bio pesticides and herbicides.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Primrose SB and R. Twyman "Principles of Gene Manipulation & Geneomics BlackwellScience Publications, 2006.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, ThirdEdition (Blackwell Publishing), 2003.

REFERENCES:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology "Greene Publishing Associates, NY, 1988.
2. Genomes 3 by T A Brown Third Edition (Garland Science Publishing), 2007.

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Course code	21BT551PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	FRONTIERS OF BIOMEDICINE		3	0	0	3

COURSE OBJECTIVES:

- To provide students with sound foundation in the mathematical, scientific andengineering fundamentals necessary
- To formulate, analyze and solve engineering problems and to prepare them for graduate studies and for successful careers in healthcare sector

PREREQUISITE:

- Biochemistry, Microbiology and Cell Biology

COURSEOUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5501.1	***Understand*** the fundamental concepts of bio medicine	K2
C5501.2	***Comprehend*** the methods, technologies utilized in the field of immunology	K2
C5501.3	***Define*** the concept of biomaterials and the techniques used	K2
C5501.4	***Learn*** the various tools and techniques used in biomedical field	K2
C5501.5	***Explain*** the various sources of biomedicine and study the role of nano technology.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C5501.1	2	1	-	1	-	-	-	-	-	-	-	-	-	2	-	-
C5501.2	2	1	-	1	-	-	-	-	-	-	-	-	-	2	-	-
C5501.3	2	1	-	1	-	-	-	-	-	-	-	-	-	2	-	-
C5501.4	2	1	-	1	-	-	-	-	-	-	-	-	-	2	-	-
C5501.5	2	1	-	1	-	-	-	-	-	-	-	-	-	2	-	-

Note:- 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO BIOMEDICINE 9

Biomedical science – Early development of biomedical system – Development of the biomedical science as profession – Role of IBMS in 21st century – Education and training for Biomedical scientist – Professional societies.

UNIT II TECHNIQUES USED IN IMMUNOLOGY 9

Haematology and Transfusion science - Clinical biochemistry - Histopathology and Cytopathology - Medical microbial - Evaluation of a new diagnostic test - Sensitivity and specificity of an assay.

UNIT III BIOMATERIALS 9

Materials in Medicine: From Prosthetics to regeneration - Biomaterials: Types, properties and their Applications - Tissue/ Biomaterial Interactions - Techniques for Guiding Tissue Repair & Regeneration.

UNIT IV BIOMEDICAL SYSTEMS 9

Foundations for Systems Biomedicine - Genomic Technologies - Proteomic Technologies - Software Tools - Challenges - Applications of Immunologic Modeling to Drug Discovery.

UNIT V SOURCES OF BIOMEDICINE 9

Medicines derived through Food, Terrestrial and Marine Sources, Role of Nano-Technology in drug deliver, Probiotics and Prebiotics Future of Biomedicine

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Pitt, S. J., & Cunningham, J. (2009). An introduction to biomedical science in professional and clinical practice. John Wiley & Sons.
2. Enderle, J., & Bronzino, J. (Eds.). (2012). Introduction to biomedical engineering. Academic press.
3. Biomedical Engineering: Concepts, Methodologies, Tools, and Applications. (2017). United States: IGI Global.

REFERENCES:

1. Liu, E. T., & Lauffenburger, D. A. (Eds.). (2009). Systems biomedicine: Concepts andperspectives. Academic Press.
2. Baker, B. J. (Ed.). (2015). Marine biomedicine: from beach to bedside. CRC Press.
3. Pokorski, M. (Ed.). (2015). Environmental Biomedicine. Springer InternationalPublishing.

VEL TECH HIGH TECH

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Course code	21BT552PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	FUNDAMENTALS OF NANO SCIENCE		3	0	0	3

COURSE OBJECTIVES:

- To learn about basics of nanomaterial science, preparation method, types and applications.

PREREQUISITE:

- Physics and Chemistry

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5502.1	***Understand*** the basics of nanomaterials	K2
C5502.2	***Describe*** the preparation of nanomaterials	K2
C5502.3	***Explain*** the various techniques involved in the preparation of Nano-materials	K2
C5502.4	***Comprehend*** the different techniques involved in the characterization of nano-materials	K2
C5502.5	***Learn*** the diversified applications of Nano-materials	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C5502.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C5502.2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C5502.3	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C5502.4	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C5502.5	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
C5502.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION 8

Nanoscale Science and Technology-Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X- ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nano computer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties andApplications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory,Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

VEL TECH HIGH TECH

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Course code	21BT553PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	GREEN AND RENEWABLE ENERGY		3	0	0	3

COURSE OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

PREREQUISITE:

- Environmental Sciences

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5503.1	***Understand*** the physics of solar radiation	K2
C5503.2	***Classify*** the solar energy collectors and methodologies of storing solar energy	K2
C5503.3	***Acquire*** knowledge in applying solar energy in a useful way	K2
C5503.4	***Explain*** wind energy and biomass with its economic aspects	K2
C5503.5	***Learn*** the various types of green energy sources like biogas and other biofuels	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C5503.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5503.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5503.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5503.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5503.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 8

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY AND GEOTHERMAL 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria; Geo-thermal Resources, types of wells, methods of harnessing the energy, potential in India.

UNIT V BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion – Biomass gasifier – Types of biomass gasifiers – Cogeneration – Carbonization – Pyrolysis – Biodiesel production – Ethanol production – Biogas and Bio-hydrogen Production.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House,2004
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi,2003
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I,New Delhi, 2010

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Course code	21BT554PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	BIOETHICS AND IPR		3	0	0	3

COURSE OBJECTIVES:

- To provide fundamental ethical in advanced clinical trial management
- To understand about project management in clinical trials
- To manage quality assurance and governance
- To create awareness about Intellectual Property Rights and engineering ethics

PREREQUISITE:

- Basic sciences and Environmental sciences

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5504.1	***Acquire*** knowledge in all aspect of clinical trials	K2
C5504.2	***Learn*** the regulations pertaining to clinical trials	K2
C5504.3	***Explain*** project management and ethics in clinical trials	K2
C5504.4	***Understand*** the data protection and management	K2
C5504.5	***Comprehend*** the importance of intellectual property rights	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C5504.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5504.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5504.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5504.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C5504.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO CLINICAL TRIALS 9

Fundamentals of clinical trials; Basic statistics for clinical trials; Clinical trials in practice; Reporting and reviewing clinical trials; Legislation and good clinical practice - overview of the European directives and legislation governing clinical trials in the 21stcentury; International perspectives; Principles of the International Committee on Harmonization (ICH)-GCP.

UNIT II REGULATIONS OF CLINICAL TRIALS 9

Drug development and trial planning - pre-study requirements for clinical trials; Regulatory approvals for clinical trials; Consort statement; Trial responsibilities and protocols - roles and responsibilities of investigators, sponsors and others; Requirements of clinical trials protocols; Legislative requirements for investigational medicinal products.

UNIT III MANAGEMENT AND ETHICS OF CLINICAL TRIALS 9

Project management in clinical trials - principles of project management; Application in clinical trial management; Risk assessment; Research ethics and Bioethics - Principles of research ethics; Ethical issues in clinical trials; Use of humans in Scientific Experiments; Ethical committee system including ahistorical overview; the informed consent; Introduction to ethical codes and conduct; Introduction to animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulation regarding use of animals in research.

UNIT IV INFORMED CONSENT 9

Consent and data protection- the principles of informed consent; Consent processes; Data protection; Legislation and its application; Data management – Introduction to trial master files and essential documents; Data management.

UNIT V INTELLECTUAL PROPERTY RIGHTS 9

Intellectual Property Rights (IPR) – Discrimination. Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology, Case studies on basmati rice, turmeric and neem.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, NewYork, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Learning, Wadworth Publisher & co, 2013.
3. Matthews D and Zech H, “Research Handbook on Intellectual Property and the LifeSciences”, Edward Elgar Publishing, 2017.

REFERENCES:

1. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, 4th Edition,2011.
2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, 7th Edition, 2011.

VEL TECH HIGH TECH

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Course code	21BT555PT	Semester	V			
Category	PROFESSIONAL ELECTIVE COURSE (PEC)		L	T	P	C
Course Title	ENZYME TECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning kinetics with the usage of enzymes

PREREQUISITE:

- Basic Industrial Biotechnology, Bioprocess Principles

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C5505.1	***Explain*** the concept of enzymatic reactions in biological systems.	K2
C5505.2	***Identify*** the theoretical and practical aspects of enzyme kinetics in bioprocess applications.	K2
C5505.3	***Learn*** the various immobilization techniques to improve enzyme stability.	K2
C5505.4	***Understand*** suitable techniques for production and purification of enzymes.	K2
C5505.5	***Describe*** the enzymatic reaction mechanism and design artificial enzymes.	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C5505.1	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1	-
C5505.2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1	-
C5505.3	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1	-
C5505.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1	-
C5505.5	2	1	-	-	-	-	-	-	-	-	-	-	3	2	1	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes - Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Ligases, Nomenclature of enzyme, Mechanisms of enzyme action – Specificity, Factors affecting enzyme activity, Concept of active site, Enzyme substrate complex formation, Lock and Key Hypothesis - Induced Fit Hypothesis, Non Productive Hypothesis, Substrate strained Hypothesis, Collision theory and Transition state theory.

UNIT II KINETICS OF ENZYME ACTION 13

Kinetics of single substrate reactions- Michelis-Menten Equation, Briggs- Haldmann Equation, Estimation of Michelis-Menten parameters, Reciprocal plot, Eadie-Hofstee plot, Hans Wolf Plot, Eisenthal Carnish Bowdan Plot, Multi-substrate reactions - Mechanisms and kinetics , Turnover number Integral form of Michelis-Menten Equation, Types of inhibition – Reversible and Irreversible Inhibitors, Competitive, Uncompetitive and Non Competitive Inhibitions, Models for substrate and product inhibition, Allosteric regulation of enzyme, Monod Changeux Wyman model, pH and Temperature effect on enzymes

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 7

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 8

Methods of Enzyme Production, Extraction and Purification of Enzymes, Methods of characterization of enzymes, Development of enzymatic assays – Enzyme units, Enzyme activity, Specific activity, Rate of a reaction, Percentage of purity, Continuous and Discontinuous assay, Factors to control in assay.

UNIT V BIOTRANSFORMATION 8

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions – Aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger – Enzymes in organic synthesis –esters, amide, peptide – Modified and Artificial Enzymes – Catalytic antibodies.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Jens. N, John. V and Gunnar. L, “Bioreaction engineering principles”, 2nd Edition, KulwerAcademic, 2002
2. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, 2nd Edition, Marcel DekkerInc. 2002.
3. Shuler. M, Kargi. M., and Delisa. M, “Bioprocess Engineering: Basic Concepts”, 3rd revised, Pearson Education, 2017

REFERENCES:

1. Anton Moser, “Bioprocess Technology: Kinetics and Reactors”, Springer Verlag 2011.
2. Tapobrate Panda, “Bioreactors: Analysis and Design”, Tata McGraw Hill, 2011.

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Course code	21BT01OT	Semester	V			
Category	OPEN ELECTIVE COURSE (OEC)		L	T	P	C
Course Title	BASICS OF ENVIRONMENTAL BIOTECHNOLOGY		3	0	0	3

COURSE OBJECTIVES:

- To provide the importance of microbial diversity and of molecular approaches inenvironmental microbiology and biotechnology
- This course will train students encompassing different biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewableenergy and water recycling.

PREREQUISITE:

- Basic principles and emerging technologies utilized in area of environmental biotechnology.

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C001.1	***Explain*** the basic concepts and methodologies used in environmental biotechnology	K2
C001.2	***Comprehend*** the methods, technologies utilized in the field of waste management	K2
C001.3	***Understand*** the concept of bioremediation and techniques involved	K2
C001.4	***Learn*** the technologies adopted in producing various value added products	K2
C001.5	***Describe*** the recent biotechnological advancements in environmental monitoring	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C001.1	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	2
C001.2	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	2
C001.3	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	2
C001.4	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	2
C001.5	2	1	-	-	-	1	2	-	-	-	-	-	-	-	-	2

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I CONCEPT OF ENVIRONMENTAL BIOTECHNOLOGY 9

Definition – Concept and scope – Application of biotechnology – Role of microbial systems – Principles – Characteristics - Genetically engineered organisms – Merits and demerits – Bio tools for environmental monitoring – Role of biotechnology in environmental protection.

UNIT II BIOTECHNOLOGY AND POLLUTION ABATEMENT 9

Biotechnology of wastewater treatment - Bioreactors, Microbial system in waste water stabilization, Biofilms immobilization technology in waste water treatment Microbial metabolism and growth kinetics – oil degradation – bio decolourization – Reed bed technology – Rhizosphere engineering - Biofiltration and Bioindicators.

UNIT III ROLE OF BIOTECHNOLOGY IN BIOREMEDIATION 9

Soil pollution - Bioremediation – Principles, Biodegradation of agro chemicals and other organic compounds – Biotransformation of xenobiotic compound - Role of GEMS in degradation of xenobiotics; Bioscrubbers – Biomining of metals - Biopulping.

UNIT IV BIOTECHNOLOGY AND VALUE ADDITION 9

Bio processes in waste treatment - Production of value added products from waste – Single Cell Protein (SCP), ethanol, methane and hydrogen, amino acids, vitamins - Enzyme production from wastes – Biodegradable plastics - Environmental implications - Biotechnology of Microbial composting - Biofertilizers - Biopesticides.

UNIT V ENVIRONMENTAL MONITORING 9

Bioindicators – Biomarkers – Biosensors – Biomonitoring – Polluted environment – Short and long term monitoring of remediated sites

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Chatterji. A.K., 2003. Introduction to Environmental Biotechnology. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Miller Jr. G.T., 2004. Environmental Science. Tenth Edition. Thompson Brook/Cole. UnitedStates.

REFERENCES:

1. Kumar H.D, 1998. A text book on biotechnology. II Edition Affiliated East West PressPvt. Ltd., New Delhi.

Course code	21BT02OT	Semester	V			
Category	OPEN ELECTIVE COURSE (OEC)		L	T	P	C
Course Title	INTRODUCTION TO BIOFUELS AND BIOENERGY		3	0	0	3

COURSE OBJECTIVES:

- The course aims to develop skills of the students in the area of fuels with an emphasis on renewable feedstock's for use in sustainable society
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To begin the concept of biofuels production and develop skills of the students in the area of bioenergy with emphasis on eco-friendly options or Swachh Bharat mission

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PREREQUISITE:

- Basic chemistry and Environmental science skills

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C002.1	***Describe*** the resources used in the production of biofuels	K2
C002.2	***Explain*** the physical and chemical properties of the biodiesel	K2
C002.3	***Understand*** the technologies involved in biofuel conversion and their environmental attributes	K2
C002.4	***Illustrate*** the construction of biorefineries for alternate biofuel production	K2
C002.5	***Learn*** the Economic, Social and Ecological Impacts of Bioenergy at Global Levels	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C002.1	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C002.2	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C002.3	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C002.4	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-
C002.5	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO BIOENERGY 9

Introduction to Bioenergy, Bioenergy Products, Co-Products & By-Products, Current and Emerging Challenges to Bioenergy Development, bioenergy feedstock production, Generation of biofuels, Development of biological conversion technologies, technical aspects of bioenergy generation.

UNIT II BIODIESEL 9

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Transesterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number. quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel and their combustion properties.

UNIT III BIOETHANOL, BIOHYDROGEN AND BIOGASES 9

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification chemical and enzymatic. Production of biomethane and biohydrogen.

UNIT IV BIOREFINERIES 9

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

UNIT V COMMUNITY ECONOMIC DEVELOPMENT 9

Introduction to Community Issues in Bioenergy Development, Energy security and supply, Environmental sustainability of biofuels, Economic, Social and Ecological Impacts of Bioenergy at Local, National and Global Levels, water quality, and community engagement processes to assist communities in understanding the implications of bio-based alternative energy, Roles for Extension Educators.

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Luque, R, Campelo, J, and Clark, J, “Handbook of biofuels production”, Woodhead Publishing Limited, 2011.
2. Sunggyu Lee and Y. T. Shah. “Biofuels and Bioenergy Processes and Technologies” CRC Press Taylor & Francis Group, 2013.

REFERENCES:

1. Eckert C. A. and Trinh C T. “Biotechnology for Biofuel Production and Optimization”, Elsevier, 2016.
2. Moheimani, N. R, Boer M. P. M. K, Parisa A, and Bahri, “Biofuel and Biorefinery Technologies”, Springer, 2015.

VEL TECH HIGH TECH

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Course code	21BT03OT	Semester	V			
Category	OPEN ELECTIVE COURSE (OEC)		L	T	P	C
Course Title	LIFESTYLE DISEASES: A BIOTECHNOLOGICAL APPROACH		3	0	0	3

COURSE OBJECTIVES:

- To obtain knowledge and understanding of health, nutrition and other life style andassociated diseases
- To develop own thinking, opinions and attitudes to global health issues.

PREREQUISITE:

- Biology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C003.1	***Understand*** the overview of lifestyle diseases and its types	K2
C003.2	***Classify*** cancer , types and its management	K2
C003.3	***Outline*** the cardiovascular diseases and its prevention methods	K2
C003.4	***Illustrate*** the lifestyle changes that leads to Diabetes and obesity	K2
C003.5	***Describe*** the respiratory diseases and its management	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C003.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
C003.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
C003.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
C003.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
C003.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1

Note: - 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO LIFESTYLE DISEASES 9

Lifestyle diseases – Definition; Basic biochemistry; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER 9

Cancer: Introduction, Metastasis, Types - Lung cancer, Mouth cancer, Skin cancer, cervical cancer, Carcinoma esophagus; causes Tobacco usage, Diagnosis – Biomarkers, Treatment, Prevention- Dietary, Medication, Screening.

UNIT III CARDIOVASCULAR DISEASES 9

Coronary atherosclerosis – Coronary artery disease; Myocardial infraction-definition, Diagnosis; Causes -Fat and lipids, Alcohol abuse –Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9

Types of Diabetes mellitus; Blood glucose regulation; Glycated hemoglobin characteristics-polyuria, polydipsia, polyphagia; Complications of diabetes – Pediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. R. Kumar & Meenal Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003.
2. Gary Eggar et al, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017.

REFERENCES:

1. James M.R, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013.
2. Akira Miyazaki et al, “New Frontiers in Lifestyle-Related Disease”, Springer, 2008.

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Course code	21BT04OT	Semester	V			
Category	OPEN ELECTIVE COURSE (OEC)		L	T	P	C
Course Title	BIOLOGY FOR ENGINEERS		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of biology and biomolecules present in cell, their structure andfunction in the living organism.
- To give brief introduction to human physiology, which is essential for bioengineeringfield.
- To describe the hereditary units in living organisms and explain their process of information transfer
- To make students understand the application of biology in our daily life using differenttechnology to design biotechnological products

PREREQUISITE:

- Biology

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C004.1	***Define*** the cells, its structure and function and to classify living organisms	K2
C004.2	***Understand*** about biomolecules its structure and function and their role in living organism	K2
C004.3	***Outline*** the human physiology and its different system	K2
C004.4	***Illustrate*** the genes and genetic materials in living organisms	K2
C004.5	***Infer*** the applications of biology in different biotechnological fields	K2

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
C004.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	1
C004.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	1
C004.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	1
C004.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	1
C004.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	1

Note:- 1: Slight; 2: Moderate; 3: Substantial

SYLLABUS **No. of Credits: 3**

UNIT I INTRODUCTION TO BASIC BIOLOGY **9**

Cell: What is a Cell, Cell theory, Cell shapes, structure of a Cell, Cell cycle chromosomes The Plant Cell and animal Cell, protoplasm, prokaryotic and eukaryotic Cell, Plant Tissue and Animal tissue. Brief introduction to five kingdoms of classification.

UNIT II INTRODUCTION TO BIO-MOLECULES **9**

Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types. Enzymes and their application in Industry. Large scale production of enzymes by Fermentation.

UNIT III HUMAN PHYSIOLOGY **9**

Nutrition (Classes of nutrients or food substances), Digestive systems, Respiratory system (two kinds of respiration – aerobic and anaerobic) Respiratory organs, respiratory cycle. Excretory system

UNIT IV GENES AND INTRODUCTION TO rDNA TECHNOLOGY **9**

Prokaryotic gene and Eukaryotic gene structure, gene replication, Transcription and Translationin Prokaryote and Eukaryote and synthesis of protein in Eukaryotes. Recombinant DNA technology and cloning introduction.

UNIT V APPLICATION OF BIOLOGY **9**

Brief introduction to Production of vaccines, Enzymes, antibodies, cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels, and Biosensors. What is Tissue engineering? And its application, transgenic plants and animals, Bio engineering (production ofartificial limbs, joints and other parts of body).

Total: 45 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. Cell and Molecular Biology, S C Rastogi, , New age International (p) limited publishers,second edition.
2. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A globalapproach”, Pearson Education Ltd, 2018.
3. T Johnson, Biology for Engineers, CRC press, 2011 Molecular Biology and Biotechnology2nd ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.

REFERENCES:

1. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012 Principles of Biochemistry. 2nd ed. 1993. A.L. Lehninger, D.L.Nelson.M.Cox. Paniama Publications. PP. 1090.
2. Harper’s biochemistry. 1988. R.K. Murray. D.K. Granner, P.A. Mayes. Printice Hall International.
3. De Robertis EDP & EMF De Robertis. 2001. Cell and Molecular biology. Lippincott Williams &Wilkins. Bombay.

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Course code	21BT57P	Semester	V			
Category	PROFESSIONAL CORE COURSE (PCC)		L	T	P	C
Course Title	BIOPROCESS LABORATORY		0	0	4	2

COURSE OBJECTIVES:

- To educate the students on the effect of various parameters on enzyme activity.
- To impart the knowledge on enzyme inhibition kinetics.
- To apply the concept of various enzyme immobilization techniques.

PREREQUISITE:

- Fundamentals of the microbiology, biochemistry and process calculation.

COURSE OUTCOMES:

CO. No.	Course Outcome	Blooms level
On successful completion of this Course, students will be able to		
C507.1	***Demonstrate*** the parameters involved in enzyme kinetic.	K3
C507.2	***Evaluate*** the various parameters involved in growth kinetics.	K3
C507.3	***Apply*** the principles for the growth of microorganisms.	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C507.1	3	3	2	1	-	-	-	-	-	-	-	-	3	2	-	-
C507.2	3	3	2	1	-	-	-	-	-	-	-	-	3	2	-	-
C507.3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	-	-

Note: 1: Slight; 2: Moderate; 3: Substantial

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List of Experiment **No. of Credits: 2**

1. Enzyme kinetics – Determination of Michaelis Menten parameters.
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics.
3. Enzyme activity – Effect of pH.
4. Enzyme inhibition kinetics.
5. Enzyme immobilization – Gel entrapment.
6. Enzyme immobilization – Crosslinking.
7. Enzymatic conversion in Packed bed Column/Fluidized bed Column.
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, YieldCoefficient.
9. Growth of yeast – Estimation of Biomass, Calculation of Specific Growth Rate, YieldCoefficient.
10. Medium optimization – Plackett Burman Design.
11. Estimation of kLa – Dynamic Gassing-out method.
12. Estimation of kLa – Sulphite Oxidation Method.

Total: 60 Periods

LEARNING RESOURCES:

TEXT BOOKS:

1. RBailey and Ollis, ― Biochemical Engineering Fundamentals‖, McGraw Hill (2nd Ed.),1986.
2. Shuler and Kargi, ― Bioprocess Engineering ―, Prentice Hall,1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

REFERENCES:

1. Anton Moser, ―Bioprocess Technology, Kinetics and Reactors, Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGrawHill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors, Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

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`Course code	21BT58P	Semester	V			
Category	**PROFESSIONAL CORE COURSE (PCC)**		**L**	**T**	**P**	**C**
Course Title	**GENETIC ENGINEERING LABORATORY**		**0**	**0**	**4**	**2**

COURSE OBJECTIVES:

- To provide hands-on experience in performing basic recombinant DNA techniques
- To learn about the identification and characterization of gene and protein
- To introduce students to the theory behind each techniques of Genetic engineering

PREREQUISITE:

- Molecular biology

COURSE OUTCOMES:

CO. No.	Course Outcomes	Blooms level
On successful completion of this Course, students will be able to		
C508.1	***Experiment*** the basic techniques of DNA isolation and manipulation	K3
C508.2	***Demonstrate*** clearly about the gene amplification and methods foranalysis of DNA	K3
C508.3	***Apply*** the principles of Genetic engineering in analysis of gene expression	K3

COURSE OUTCOMES MAPPING WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C508.1	3	2	1	-	-	-	-	-	-	-	-	-	-	3	3	-
C508.2	3	2	1	-	-	-	-	-	-	-	-	-	-	3	3	-
C508.3	3	2	1	-	-	-	-	-	-	-	-	-	-	3	3	-

Note: 1: Slight; 2: Moderate; 3: Substantial

List of Experiment **No. of Credits: 2**

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1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Restriction Digestion
4. Ligation of DNA in to expression vectors
5. Transformation & Selection of recombinants- Blue white screening assay
6. Optimization of time of inducer for recombinant protein expression
7. Protein profiling by SDS- PAGE
8. Western blotting
9. Southern blotting
10. Hybridization with anti-sera
11. PCR amplification of genes
12. Colony lysate PCR.

LEARNING RESOURCES:

TEXT BOOKS:

1. Primrose SB and R. Twyman "Principles of Gene Manipulation & Geneomics BlackwellScience Publications, 2006.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, ThirdEdition (Blackwell Publishing), 2003.

REFERENCES:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering ", Blackwell Science Publications, 1993.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology", Greene Publishing Associates, NY, 1988.
3. Berger Sl, Kimmer AR, "Methods in Enzymology", Vol 152, Academic Press, 1987.

List of Professional Elective Courses

S. No.	Course Code	Engineering Stream Courses
PROFESSIONAL ELECTIVE I		
1	21BT551PT	Frontiers in Biomedicine
2	21BT552PT	Fundamentals of Nano Science
3	21BT553PT	Green and Renewable energy
4	21BT554PT	Bioethics and IPR
5	21BT555PT	Enzyme Technology
PROFESSIONAL ELECTIVE II		
6	21BT641PT	Molecular Pathogenesis of Infectious Diseases
7	21BT642PT	Bio-inspired AI
8	21BT643PT	Principles of Food Processing
9	21BT644PT	Creativity, Innovation and New Product Development
10	21BT645PT	Animal Biotechnology
PROFESSIONAL ELECTIVE III		
11	21BT741PT	Process Instrumentation Dynamics and control
12	21BT742PT	Cancer Biology
13	21BT743PT	Stem Cell Technology
14	21BT744PT	Medical Biotechnology
15	21BT745PT	Bio business Start Policy and Human Rights
PROFESSIONAL ELECTIVE IV		
16	21BT751PT	Clinical Nutrition
17	21BT752PT	Marine Bioprospecting and Pharmacology
18	21BT753PT	Tissue Engineering
19	21BT754PT	Bioproduct Planning and Strategy
20	21BT755PT	Forensic Biotechnology
PROFESSIONAL ELECTIVE V		
21	21BT811PT	Lifestyle Diseases and Clinical Trials
22	21BT812PT	Bioconjugate Technology and Applications
23	21BT813PT	Bioprocess Equipment’s and Plant Design
24	21BT814PT	Clinical Data Management
25	21BT815PT	Agricultural Biotechnology
PROFESSIONAL ELECTIVE VI		
26	21BT821PT	Biopharmaceutical Technology
27	21BT822PT	Neurobiology and Cognitive Sciences
28	21BT823PT	Bioentrepreneurship
29	21BT824PT	Biosafety and Hazard Management
30	21BT825PT	Plant Biotechnology

OPEN ELECTIVE I

S. No.	Course Code	Course Title
1	21BT01OT	Basics of Environmental Biotechnology
2	21BT02OT	Introduction to Biofuels and Bioenergy
3	21BT03OT	Lifestyle Diseases: A Biotechnological Approach
4	21BT04OT	Biology for Engineers