Scheme of Instruction and Syllabi of

B.E. / B.TECH. I & II SEMESTERS

FOR

BIOTECHNOLOGY (R22) Ay 2022-2023

SCHEME OF INSTRUCTIONS & SYLLABUS OF I & II SEMESTERS FOR

B.TECH. – BIOTECHNOLOGY

(AS PER AICTE MODEL CURRICULUM)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Kokapet Village, Gandipet Mandal, Hyderabad- 500 075. Telangana

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Head
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of I Semester of B.Tech. – Biotechnology as per AICTE Model Curriculum 2022-23

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction			Credits
			Hours per Week			
			L	T	P/D	
THEORY						
1	22MTC03/ 22BTC01	Mathematics-I/ Basics of Biology-I	3	1	0	4
2	22CYC01	Chemistry	3	0	0	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3
4	22CSC01	Problem Solving and Programming	2	1	0	3
PRACTICAL						
5	22CYC02	Chemistry Lab	0	0	3	1.5
6	22MBC02	Community Engagement	0	0	3	1.5
7	22CSC02	Problem Solving and Programming Lab	0	0	3	1.5
8	22MEC37	Robotics & Drones Lab	0	2	2	3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	1
TOTAL			**10**	**5**	**13**	**21.5**

L:Lecture **T:Tutorial** **D:Drawing**

P:Practical **CIE-Continuous Internal Evaluation** **SEE-Semester End Examination**

Dept. of Bio-Technology
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With effect from Academic Year 2022-23

22MTC03

Mathematics-I

(Biotech- BiPC Stream)

Instruction:	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To discuss elementary transformations of trigonometric functions.
2. To explain basics of limit and continuity of the functions.
3. To explain differentiation of the basic functions
4. To discuss matrix methods to solve system of linear equations.
5. To discuss the exact roots of Cubic and Bi-quadratic equations.

Course Out Comes:

Upon completing this course, students will be able to:

1. Calculate the elementary transformations of trigonometric functions.
2. Evaluate the limit and Continuity of the functions
3. Calculate the differentiation of functions.
4. Apply the matrix methods to solve the system of linear equations.
5. Solve the Cubic and Bi-quadratic equations.

UNIT-I

Trigonometry: Review of basics of Trigonometry, Compound angles and multiple and sub multiple angles, Transformations-sum and product rules, Hyperbolic and Inverse Hyperbolic functions.

UNIT-II

Function Limits and Continuity: Function sinx, cosx, e^x, logx intervals and neighborhoods, limits and concept of limit, standard limits and related problems

UNIT-III

Differentiation: Derivatives of a function, Elementary properties. Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic and inverse Hyperbolic functions, Methods of differentiation, second and higher order derivatives.

UNIT-IV

Matrices: Types of matrices, multiplication of matrices, scalar multiplication, Inverse of matrix- determinant, singular, non-singular, minor, cofactors, adjoint, Rank-Echelon form, consistency and inconsistency Solutions of simultaneous linear equations.

UNIT-V:

Theory of Equations: Relation between roots and the co-efficient in an equation, solution of the equation when two or more of its roots are connected by certain relations.

Text Books:

1. Shanti Narayan and Mittal P.K. ," Differential Calculus" , 30th edition, S Chand Publishers, 2005.
2. A.R.Vasistha, "Matrices", 43rd edition, Krishna's Educational Publishers, 2014.
3. Hall and Knight, "Higher Algebra", Arihant Publications, 2016.

Suggested Reading:

1. N P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi Publishers, 2017.
2. Joseph Edwards, "Differential Calculus For Beginners", Arihant Publishers,2016.
3. Kanti B.Datta, "Mathematical Methods of Science and Engineering", Cengage Learning India Publishers, 2012.

With effect from the Academic Year 2022-23

22BTC01

BASICS OF BIOLOGY - I

(for MPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	4

Course Objectives:

1. To give understanding of fundamentals of origin of life and various theories of evolution.
2. To give an insight of plant cell and its organelles
3. To provide a knowledge on classification of plants and their propagation mode.
4. To impart theoretical knowledge on various physiological aspects of plants
5. To give the students an understanding of knowledge on microbes and their economic importance.

Course Outcomes:

At the end of the course student will be able to

1. Explain the theories behind the origin of life and evolution studies (BL2).
2. Describe the structure and functions of plant cell and its organelles (BL2)
3. Relate the plants based on the habit and habitat and mechanism of seed development in plants (BL2).
4. Describe the basic physiological processes in plants and various methods of crop improvement (BL2).
5. Demonstrates characteristics of bacteria, fungi, virus and explains virus related diseases and economic importance of microbes (BL3)

UNIT-I

History of Life and Evolution: History of earth, Evolutionary theories of origin of life. Experimental verification of chemical origin of life. Darwinism, Natural selection, Sexual selection, Artificial selection, Mendelism, Hugo Vries mutation theory, Neo-Darwinism. Introduction and importance of classification- five kingdoms (Monera, Protista, Fungi, Plantae and Animalia).

UNIT-II

Cell Structure and Internal Organization of Plants: Cell as basic unit of life, overview of the plant cell, cell cycle, cell division, mitosis and meiosis. Concept of Growth, meristems (apical, intercalary and lateral) their functions. Simple tissue (parenchyma, collenchyma and sclerenchyma), complex tissues (xylem and phloem). Tissue systems (epidermal, ground and vascular)

UNIT-III

Plant Systematic and Reproduction: Plant kingdom, salient features of classification. Alternation of generation of the plants. Type studies of Algae (Spirogyra), Bryophytes (Moss), Pteridophyta (Pteris),Gymnosperms (Cycas) and general characteristics and life cycle of Angiosperms. Overview of modes of reproduction-Asexual: vegetative propagation, budding, sporulation, binary fission; Sexual reproduction: pollination, fertilization, development of embryo, endosperm, fruit and seed formation. Apomixes, parthenocarpy, polyembryony type of reproduction.

UNIT-IV

Plant Physiology and Concepts in Plant Biotechnology: Absorption of water soil water, water potential, diffusion, imbibitions, osmosis, plasmolysis, absorption of water, ascent of sap, transportation. Crop improvement - Heterosis and mutation breeding. Plant tissue culture techniques and their applications. Plant growth regulators.

UNIT-V

Introduction to Microbial World: General account of prokaryotes: structure & function of Bacterial cell. Concept of species and strains. Salient properties of Fungi and type study of Rhizopus.General characteristics of Virus. Study of Bacterial viruses - T4, plant viruses TMV, animal viruses HIV. Structure Reproduction in bacteria (asexual- binary fission and sexual - conjugation) and viruses (lytic and lysogenic). Economic importance of beneficial bacteria (agriculture, industry, medicine and biotechnology).

Text Books:

1. Ray F. Evert, Susan E. Eichhorn Biology of Plants W. H. Freeman 2012. Tata McGraw Hill Publishing Co. Pvt. Ltd 9th edition, (2010).
2. Campbell, N.A., Reece, J.B., Urry, Lisa, Cain, ML., Wasserman, S.A., Minorsky, P.V., Jackson, R.B.Biology: A Global 11th edition, Pearson Education Ltd. (2017)

Suggested Reading:

1. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M New York: McGraw-Hill. 6th Edition (2011).

With effect from the Academic Year 2022-23

22CYC01

CHEMISTRY

(Common to All Branches)

Instruction:	3L Hours per Week
Duration of SEE:	3 Hours
SEE	60 Marks
CIE:	40 Marks
Credits:	3

Course Objectives

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

Course Outcomes

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

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

UNIT-I

Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2 , He^+ ,N_2 , O_2 , O_2^{2-} , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II

Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, – Reference electrodes (NHE, SCE)-electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries. Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages.
Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III

Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism -Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid)&Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds) Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides)

Cyclization (Diels - Alder reaction)

UNIT–IV

Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process),ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V

Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications. **Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.**

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).
Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

Text Books:

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd.,New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson,Delhi, 7th edition(2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

Suggested Readings:

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46thedition(2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

With effect from the Academic Year 2022-2023

22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring. safety rules and methods of earthing.

Course Outcomes: After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation,

Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

Text Books:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 201

With effect from the Academic Year 2022-23

22CSC01

PROBLEM SOLVING AND PROGRAMMING

Instruction	2L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are to:

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

Course Outcomes: After completion of course, students would be able to:

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data
6. Handle data using files

UNIT I:

Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II:

Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III:

Conditional Statement, Loops, Arrays and Strings, user-defined Data Types -if..else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV:

Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V:

File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

Text Books and References:

1. R.S. Salaria, Khanna , “Programming for Problem Solving”, Book Publishing Co., Delhi.
2. Jeeva Jose, Khanna , “Taming Python by Programming”, Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by No Starch Press.
5. Eric Matthes,, “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.
6. https://www.coursera.org/specializations/python-3-programming.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta , IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.

With effect from the Academic Year 2022-23

22CYC02

CHEMISTRY LAB

(Common to All Branches)

Instruction:	3P Hours per Week
Duration of SEE	3 Hours
SEE:	50 Marks
CIE	50 Marks
Credits:	1.5

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes

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

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

Chemistry Lab

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2}& Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

Text Books:

1. J. Mendham and Thomas , "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg&A.Gulati,; R. Chand & Co. : New Delhi (2011).

Suggested Readings:

1. Dr.Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

With effect from the Academic Year 2022-23

22MBC02
COMMUNITY ENGAGEMENT

Instruction	3P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1.5

Course Objectives: The main Objectives of this Course are to:

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

Course Outcomes: After the completion of this Course, Student will be able to:

2. Gain an understanding of Rural life, Culture and Social realities.
3. Develop a sense of empathy and bonds of mutuality with Local Communities.
4. Appreciate significant contributions of Local communities to Indian Society and Economy.
5. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
6. Utilise the opportunities provided by Rural Development Programmes.

Module IAppreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

ModuleIII Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

ModuleIV Rural Development Programmes

History of Rural Development in India, Current National Programmes: SarvaShikshaAbhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM AwasYojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

Text Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

With effect from the Academic Year 2022-23

22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives: The objectives of this course are to:

1. Master the fundamentals of writing Python scripts
2. Learn Python elements such as variables, flow controls structures, and functions
3. Discover how to work with lists and sequence data, and files

Course Outcomes: After completion of course, students would be able to:

1. Understand various Python program development Environments
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

Laboratory / Practical Experiments:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations
3. Demonstration of operators
4. Demonstration of selective control structures
5. Demonstration of looping control structures
6. Demonstration of Python Dictionaries.
7. Implementation of searching and sorting techniques.
8. Implementation of string manipulation operations
9. File handling and memory management operations

Text Books and References:

1. R.S Salaria, Khanna, (Programming for Problem Solving", Book Publishing Co., Delhi
2. Jeeva Jose, Khanna,, "Taming Python by Programming", Book Publishing Co., Delhi

With effect from the Academic Year 2022–23

22 MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100
Credits	3

Objectives: The objectives of this course are to:

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamatic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

Outcomes: After completion of course, students would be able to:

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

Lab Experiments:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs:i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function
11. Assembly of a drone

Suggested readings

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/

With effect from the Academic Year 2022-2023

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

Course Outcomes: At the end of the course, the students are expected to

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

List of Laboratory Experiments/Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using
   (i) 3-Ammeter method (ii) 3-Voltmeter method
8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of II Semester of B.Tech. - Biotechnology as per AICTE Model Curriculum 2022-23

B.TECH. - BIOTECHNOLOGY

SEMESTER – II

S. No	Course Code	Title of the Course	Scheme of Instruction			Credits
			Hours per Week			
			L	T	P/D	
THEORY						
1	22MTC06/ 22BTC02	Mathematics-II/Basics of Biology-II	3	1	0	4
2	22PYC07	Physics	3	0	0	3
3	22CEC01	Engineering Mechanics	3	1	0	4
4	22EGC01	English	2	0	0	2
PRACTICAL						
5	22PYC10	Physics Lab	0	0	3	1.5
6	22EGC02	English lab	0	0	2	1
7	22MEC01	CAD AND DRAFTING	0	1	3	2.5
8	22MEC38	Digital Fabrication Lab	0	0	3	1.5
TOTAL			**11**	**3**	**11**	**19.5**

L:Lecture **T:Tutorial** **D:Drawing**
P:Practical **CIE-Continuous Internal Evaluation** **SEE-Semester End Examination**

Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075

With effect from Academic Year 2022-23

22MTC06

Mathematics-II (Biotech
BiPC Stream)

Instruction:	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To discuss the basic operations in Vector Algebra.
2. To discuss Physical interpretations on Scalars and vector functions.
3. To explain various methods of partial fractions.
4. To explain various techniques of integration.
5. To discuss the solutions of first order differential equations.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the basic operations on Scalar and Vectors.
2. Apply the vector differential operators to Scalars and Vector functions.
3. Solve partial fractions by various methods.
4. Evaluate definite and indefinite Integral.
5. Solve the first order ordinary differential equations.

UNIT-I:

Vector Algebra

Addition of vectors, scalar multiplication, angle between two non-zero vectors, linear combination of vectors, component of vectors in three dimensions, scalar product geometrical interpretations, orthogonal projections, properties of dot product, angle between two vectors, vector product of two vectors and properties, scalar triple product, vector triple product.

UNIT-II:

Vector Differential Calculus

Definitions, scalar and vector point functions, vector differential operator, Gradient, Divergence and Curl, Solenoidal and Irrotational vectors, properties of gradient, divergence and curl (vector identities)

UNIT- III

Partial Fractions: Resolving f(x)/g(x) into partial fractions, g(x) contains non repeated linear factors, g(x) contains repeated and non-repeated linear factors, g(x) contains non repeated irreducible factors, g(x) contains repeated and not repeated irreducible factors.

UNIT - IV

Integration: Simple integrations of algebraic, trigonometric and exponential functions. Methods of integration, integration by parts, integration of rational, irrational and Trigonometric functions, definite integrals.

UNIT- V

Differential Equations: Formation of Differential equations, Solutions of first order and first degree differential Equations, Variable Separable, Homogeneous, Linear, Bernoulli and Exact differential Equations.

Text Books:

1. Shanti Narayan, "Vector Calculus", S.Chand Publishers, 2003.
2. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publishers, 2014.

Suggested Reading:

1. William E. Boyce, Richard C. Diprima, "Elementary differential equations", 9th Edition, Wiley Publishers, 2008.
2. Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers, 2016.

With effect from the Academic Year 2022-23

22BTC02

BASICS OF BIOLOGY -II

(for MPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	4

Course Objectives:

1. To impart theoretical knowledge on animal cell, tissues their types and level organization
2. To provide knowledge on basic concepts of Biology and basis of animal kingdom classification.
3. To provide knowledge on various parasites, lifecycle and diseases caused by them.
4. To impart knowledge on ecology, environment and biotic interactions in nature
5. To give an insight on genes, chromosome, blood grouping system, and gene expression

Course Outcomes:

By the end of the course students be able to

1. Identify the basic structure, function of various animal cell organelles, level of organization and types of tissues in animals (BL 2).
2. Explains nomenclature and the animal kingdom classification with its characteristic features. (BL 2).
3. Explain and identify the lifecycles, diseases, treatment and preventive measures of human pathogens (BL 3)
4. Outline population ecology, various biotic and abiotic environmental factors of ecosystem. (BL 2).

UNIT-I

Animal Cell, Tissues and Level of Organization: Structure of animal cell and its organelles. Differences between plant and animal cell. Level of organization, multicellularity, diploblastic and triploblastic conditions. Asymmetry, symmetry: radial symmetry and bilateral symmetry. Acoelomates, pseudo coelomates and coelomates in brief. Animal tissues structure and functions. Different types of animal tissues and their functions. Epithelial, Connective, Muscular and Nervous tissues in brief

UNIT-II

Animal Kingdom Classification: Classification of animal kingdom. Phylogeny of invertebrate and vertebrate phyla. Salient features of non-chordates up to phyla, and chordates up to class level. Binomial and trinomial nomenclature. Concept of species and genus.

UNIT-III

Parasitology: Parasitism and Parasitic Adaptation: Health and disease: introduction, life cycle, pathogenicity, treatment and prevention; Entamoebahistolytica, Plasmodium vivax, Ascarislumbricoides

and Wuchereriabancrofti. Brief account of pathogenicity, treatment and prevention of typhoid, pneumonia, common cold and ring worm.

UNIT -IV

Ecology and Environment: Levels of biological hierarchy, Organism and environment, habitat and niche. Abiotic environmental factors light, temperature, water and soil. Population and ecological adaptations, population attributes: growth, birth and death rate, sex ratio, age distributions, Population density. Population growth models, Biotic environmental factor & interactions-competition, mutualism, commensalism, parasitism, predation & ammensalism.

UNIT V

Genetics: Structure and Functions of DNA, Chromosome; Concept of gene and alleles, multiple alleles, ABO blood groups. Sex chromosomes, Sex linked inheritance. Central Dogma, Characteristics of genetic code, Gene expression and regulation: transcription, translation and regulation in prokaryotes (lac operon)and eukaryotes.

Text Books:

1. Campbell, N.A., Reece, J.B., Urry, Lisa, Cain, ML., Wasserman, S.A., Minorsky, P.V., Jackson, R.B. Biology: A Global 11th edition, Pearson Education Ltd. (2017)
2. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1st edition, 1983.

Suggested Reading

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer Invertebrates: A New Edition, Blackwell Science(2002)
2. K Vaidhyanath, K Pratap Reddy and K Sathya Prasad, to Applied Biology and BS Publications, India, 2004.

With effect from the Academic Year 2022-23

22PYC07

PHYSICS
(Biotech & Chemical)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course Objectives: The objectives of the course is to make the student

1. Learn the basic concepts of wave nature of light
2. Know about the properties of magnetic and dielectric materials
3. Understand the basics of nanomaterials
4. Familiarize with fundamental ideas of quantum mechanics

Course Outcomes: At the end of the course, the student will be able to

1. Demonstrate the physical properties of the light.
2. Find the applications of lasers and optical fibers in engineering and technology.
3. Identify different types of magnetic and dielectric materials.
4. Recall the fundamentals of nanomaterials.
5. Apply the ideas of quantum mechanics for related problems

UNIT-I

Wave Optics: Huygens' principle –Superposition of waves –Interference of light by splitting of wavefront and amplitude –Fresnel's biprism –Interference in thin films (reflected light) – Newton's rings –Fraunhofer diffraction from a single slit – Double slit diffraction–Concept of N-slits–Diffraction grating and its resolving power. Polarization: Introduction–Malus's law–Double refraction –Nicol's prism– Quarter-wave plate and half-wave plate–Optical activity–Laurent's half shade polarimeter.

UNIT-II

Lasers: Characteristics of lasers– Einstein's coefficients–Amplification of light by population inversion– Ruby laser–He-Ne laser– Semiconductor laser–Applications of lasers in engineering and medicine.
Fiber Optics: Introduction –Construction –Principle –Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers –Pulse dispersion –Fiber losses –Fiber optic communication system –Applications.

UNIT-III

Dielectric Materials: Introduction–Dielectric polarization–Types of dielectric polarization: electronic & ionic polarizations (quantitative); orientation & space-charge polarizations (qualitative)–Frequency and temperature dependence of dielectric polarization–Determination of dielectric constant (Schering bridge method)–Ferroelectricity–Barium titanate–Applications of ferroelectrics.
Magnetic Materials: Origin of magnetism –Magnetic moment - Bohr magneton –Classification of magnetic materials: dia, para, ferro, anti-ferro and ferrimagnetic materials– Weiss molecular field theory– Domain theory–Hysteresis curve–Soft and hard magnetic materials–Applications.

UNIT-IV

Nanomaterials: Properties of materials at reduced size–Surface to volume ratio–Quantum confinement– Preparation of nanomaterials: bottom-up approach (sol-gel method) and top-down approach (ball milling method)–Elementary ideas of carbon nanotubes–Applications of nanomaterials.

UNIT-V

Quantum Mechanics: Introduction–Planck's' law of black body radiation – Wien's law and Rayleigh- Jean's law from Planck's law – Photoelectric effect – Compton effect –de-Broglie hypothesis –Wave- particle duality –Physical significance of ψ –Born's interpretation of the wave function –Verification of matter waves by Davisson-Germer's experiment –Uncertainty principle – Schrodinger wave equation (time-dependent and time-independent) –Particle in infinite square well potential.

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

With effect from the Academic Year 2022-23

22CEC01

ENGINEERING MECHANICS

Instruction	3L+1T Periods per week
Duration of End Examination	3 Hours
End Examination	60 Marks
Sessional	40 Marks
Credits	4

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

1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
2. Understand the mechanism of friction and can solve friction problems
3. Analyse simple trusses for forces in various members of a truss.
4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
5. Determine moments of inertia, product of inertia of plane and composite areas and mass moments of inertia of elementary bodies,

UNIT I

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of coplanar force systems.

UNIT – II

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT – III

Analysis of Simple Trusses: Introduction to trusses, Assumptions, analysis of simple trusses using method of joints and method of sections.

UNIT– IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity of elementary and composite bodies

UNIT – V

Moment of Inertia: Definition of MI, Area MI. Polar Moment of Inertia, radius of gyration, transfer theorem, Moment of Inertia of elementary & composite areas, and Product of inertia. Mass moments of inertia of elementary bodies.

Text Books:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

Suggested Reading:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics**,** Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

With effect from the Academic Year 2022-23

22EGC01

ENGLISH

(Common to All Branches)

Instruction	2L Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives: This course will introduce the students:

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

Course Outcomes: After successful completion of the course the students will be able to:

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques

UNIT-I

Understanding Communication in English:

Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I:

Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III

Developing Writing Skills II:

Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response

Vocabulary and Grammar: Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV

Developing Writing Skills III:

Report writing – Importance, structure, elements of style of formal reports; Writing a formal report. **Vocabulary and Grammar:** Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V

Developing Reading Skills:

The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

Vocabulary and Grammar: Words often confused; Use of standard abbreviations.

Text Books:

1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan,2017.
2. Swan Michael, Practical English Usage.OUP.1995.

Suggested Readings:

1. Wood F.T, Remedial English Grammar,Macmillan,2007
2. Zinsser William, On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata, Communication Skills. Oxford University Press,2011.

With effect from the Academic Year 2022-23

22PYC10

PHYSICS LAB

(Biotech & Chemical)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

Course Objectives: The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the physical properties of magnetic and dielectric materials
4. Familiarize with motion of electrons in electric and magnetic fields

Course Outcomes: At the end of the course, the student will be able to

1. Interpret the errors in the results of an experiment.
2. Demonstrate the wave nature of light experimentally
3. Utilize physical properties of magnetic and dielectric materials for various applications
4. Make use of lasers and optical fibers for engineering applications
5. Explain light induced phenomenon and motion of electrons in electric and magnetic fields

Experiments

1.	Error Analysis	:	Estimation of errors in the determination of time period of a torsional pendulum
2.	Fresnel's Biprism	:	Determination of wavelength of given monochromatic source
3.	Newton's Rings	:	Determination of wavelength of given monochromatic source
4.	Single Slit Diffraction	:	Determination of wavelength of given monochromatic source
5.	Diffraction Grating	:	Determination of wavelengths of two yellow lines of light of mercury lamp
6.	Malus's Law	:	Verification of Malus's law
7.	Double Refraction	:	Determination of refractive indices of O-ray and E-ray of given calcite crystal
8.	Polarimeter	:	Determination of specific rotation of glucose
9.	Laser	:	Determination of wavelength of given semiconductor laser
10.	Optical Fiber	:	Determination of numerical aperture and power losses of given optical fiber
11.	Dielectric constant	:	Determination of dielectric constant of given PZT sample
12.	M & H Values	:	Determination of magnetic moment M of a bar magnet and absolute value H of horizontal component of earth's magnetic field

13.	B-H curve	:	Determination of hysteresis loss of given specimen
14.	Planck's constant	:	Determination of Planck's constant using photo cell
15.	e/m of an Electron	:	Determination of specific charge of an electron by J.J. Thomson method

NOTE: A minimum of TWELVE experiments should be done.

With effect from the Academic Year 2022-23

22EGC02

ENGLISH LAB

(Common to All Branches)

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives: This course will introduce the students:

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

Course Outcomes: After successful completion of the course the students will be able to:

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

Exercises

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs . The syllable: types of syllables, consonant clusters.
3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation** : Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions -** Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary –** weaving an imaginative story around a given picture.
9. **Information Gap Activity –** Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation –** Theme, poster preparation, team work and representation.

Suggested Reading

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan,2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India,2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press,2016

With effect from the Academic Year2020-21

22MEC01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

Course Objectives:

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

Outcomes: At the end of the course, the Students are able to

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice-versa.

Text Books:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers,2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”,New Age International Pvt.Ltd,2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt.Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson,2009.

K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications,2011.

With Effect from the Academic Year 2022–23

22MEC38

DIGITAL FABRICATION LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Objectives: The objectives of this course are to:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive &team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

Outcomes: After completion of course, students would be able to:

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in fitting, carpentry, tin smithy, house wiring, welding, casting and machining processes.
3. Make a given model by using workshop trades including fitting, carpentry, tinsmithy and House wiring.
4. Perform various operations in welding, machining and casting processes.
5. Conceptualize and produce simple device/mechanism of their choice.

List of exercises:

Group-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3. a)Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
   b) Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.
6. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
   To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

Group- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha , 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer , June 7, 2019.

Suggested Reading:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

CHAITANYABHARATHIINSTITUTEOFTECHNOLOGY(A)

DepartmentofBio-Technology

Scheme of Instructions of III Semester of B. Tech Bio-Technology

as per AICTE ModelCurriculum2021-22

B.Tech(Bio-Technology)

SEMESTERIII

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	20CSC34	OOPS using Python	3	-	0	3	40	60	3
2	20BTC04	Biochemistry	3	-	-	3	40	60	3
3	20BTC05	Microbiology	3	-	-	3	40	60	3
4	20BTC06	Thermodynamics for Biotechnologists	3	-	-	3	40	60	3
5	20BTC07	Cell and Molecular Biology	3	-	-	3	40	60	3
6	20BTC08	Genetics	3	-	-	3	40	60	3
7	20EGM01	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	Non credit
	PRACTICALS								
8	20CSC35	OOPS using Python Lab	-	-	2	3	50	50	1
9	20BTC09	Biochemistry Lab	-	-	2	3	50	50	1
10	20BTC10	Microbiology Lab			2	3	50	50	1
11	20BTI01	MOOCs/Training/ Internship I	2-3 weeks/90hrs						2
Total			**19**	**1**	**6**				**23**
Clock Hours Per Week-26									

L: Lecture T: Tutorial P: Practical

CIE – Continuous Internal Evaluation **SEE – Semester End Examination**

Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075

20CSC34

OOPS Using Python

Instruction	3Periodsperweek
Duration ofSemester EndExamination	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course Objectives:

The objectives of this course are

1. DescribetheprinciplesofObject-OrientedProgramming.
2. Enable the students to solve problems using OOPsfeatures.
3. Debugging in programs andfiles.
4. Useoflibrarymodulestodevelop applications.

Course Outcomes:

On Successful completion of the course students will be able to:

1. Demonstrate the concepts of Object-Oriented Programming languages to solve problems.
2. Apply the constructs like selection, repetition, functions and packages to modularize the programs.
3. Design and build applications with classes/modules.
4. Find and rectify coding errors in a program to assess and improve performance.
5. Develop packages for solving simple real-world problems.
6. Analyze and use appropriate library software to create mathematical software.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	2	3	1	1	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	1	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	1	1	-	-	-	-	-	-	-	-	-	-
CO 4	-	1	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	-	2	1	1	-	-	-	-	-	-	-	-	-	-
CO6	1	2	-	1	-	-	-	-	-	-	-	-	-	1

UNIT - I

IntroductiontoObjectOrientedProgramming:Introduction to Programming Languages, Features of Object-Oriented Programming,MeritsandDemeritsof OOPs.

Basics of Python Programming: Features of Python, Variables, Identifiers, Datatypes, Input/ Output operations, Operators and Expressions, Operations on Strings, Type Conversion.

UNIT-II

Decision Control Statement: Selection/Conditional Branching, Loop Control Structures, Nested Loops.
Functions and Modules: Uses of functions,Function definition, function call, Variables cope and Life time, Recursion, Lambda functions, map, reduce and filter built-in functions, Recursive Functions, Modules,Packages.

UNIT - III

ClassesandObjects:Introduction,Classes and Objects, initmethod, Class variables, and Object variables, Public and Private Data members,calling methods from other methods, garbage collection, classmethods, staticmethods.

UNIT - IV

Inheritance:Introduction, Inheriting classes, Polymorphism and method overloading, Composition or Containership, Abstract classes and inheritance.
Operator Overloading:Introduction,Implementation of Operator Overloading, Overriding.
File Handling: File types, opening and closing files, reading and writing files, file positions, Regular Expression.

UNIT - V

Error and Exception Handling: Introduction to errors and exceptions, Handling Exceptions, Plotting Graphs in Python (Use of Matplotlib).

Suggested Reading:

1. Reema Thareja “Python Programming”,Oxford Press, 2017.
2. Mike McGrath “Python in easy steps : Makes Programming Fun”, Kindle Edition, 2017.

References:

1. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd.
2. https://anandology.com/python-practice-book/ object_oriented_programming.html
3. http://python-textbok.readthedocs.io/en/1.0/Object_Oriented_Programming.html
4. http://www.tutorialspoint.com/python/python_classes_objects.html
5. https://docs.python.org/3/

20BTC04

BIOCHEMISTRY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Students will learn the structure of carbohydrates, lipids, proteins and nucleicacids
2. Students will learn the functions of carbohydrates, lipids, proteins and nucleicacids
3. Students will learn the metabolism of different biomolecules.

Course outcomes:

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

1. Identify different biomolecule structures and describe the functions of various biomolecules.
2. Examine the energy yield from the catabolism of carbohydrates and explain the steps in anabolism.
3. Evaluate the energy yield from lipids and reconstruct lipids.
4. Outline steps involved in catabolism and anabolism of proteins.
5. Summarize steps involved in catabolism and anabolism of nucleicacids.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	2	2	1	1	1	1	1	1	1	3	3	3	3	3
CO 2	3	3	2	2	1	2	2	1	1	3	3	3	3	3
CO 3	3	3	2	2	1	2	2	1	1	3	3	3	3	3
CO 4	3	3	2	2	1	2	2	1	1	3	3	3	3	3
CO 5	3	3	2	2	2	2	2	1	1	3	3	3	3	3

UNIT-I

Biomolecules: Introduction to biological buffers and its importance in biochemistry, pH, water, Biomolecules: Carbohydrates- classification; Classification and nomenclature of lipids; Amino acid – Classification and its structure, peptide bond- structure; Proteins-classification and Biological functions; Protein structure - primary structure, secondary structure, super secondary structures, Ramachandran Plot, tertiary and quaternary structure; Enzymes – properties.

UNIT-II

Metabolism of Carbohydrates: Carbohydrate Metabolism: Glycolysis – Preparatory phase and Payoff phase, Substrate level Phosphorylation, regulation of glycolysis, HMP Shunt, Citric Acid Cycle, an aplerotic reactions, Electron Transport System and Oxidative Phosphorylation, Mitchell's chemiosmotic hypothesis; Gluconeogenesis; Glycogen metabolism – Glycogenolysis and Glycogenesis.

UNIT-III

Metabolism of Lipids: Lipid Metabolism: β - Oxidation of saturated, unsaturated fatty acid; Cholesterol Metabolism; Metabolic Pathways- Biosynthesis of Saturated and Unsaturated Fatty Acids, synthesis of Triglycerol; Metabolism of Phospholipids and Sphingolipids.

UNIT-IV

Metabolism of Proteins: Amino acids metabolism- Biosynthesis of aromatic amino acids, Peptides; Metabolic fate of Amino group; Nitrogen Excretion and Urea Cycle; Catabolism of aromatic and branched chain amino acids; Transamination, Oxidative Deamination and Oxidative Decarboxylation.

UNIT-V

Metabolism of Nucleic Acids: Structure of nucleotides, nucleosides and nitrogenous bases; chemical structure of DNA and RNA; Nucleic Acid Metabolism- De nova synthesis of Purine and Pyrimidine, salvage pathway, Ribonucleotides, synthesis of Deoxyribonucleiotides; Degradation of Purine and Pyrimidine Nucleotides.

Texts Books:

1. EricE.Conn, PaulKStumpf, George Bruening, Roy HDoi,"Outlines of Biochemistry",5//E,John Wiely and Sons, 2006.
2. David Lee Nelson and Michael M.Cox, Lehninge "Principles ofBiochemistry",6th edition,W.H.Freeman,2013.

Suggested Reading:

1. Donald Voet and Judith G.Voet,"Biochemistry",4th edition, JohnWiley & Sons, NewYork, 2011.
2. Reginald Garrett and Charles Grisham,"Biochemistry",5th edition,Cengage Learning, 2012.
3. Jeremy M.Berg, John L.Tymoczko and Lubert Stryer,"Biochemistry",6th Edition.W.H.Freeman and Company,2010.

With effect from the Academic Year 2021-22

20BTC05

MICROBIOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Understand the historical perspectives of microbiology.
2. Describe the prokaryotic cell structure
3. Classification of different groups of microorganisms.
4. Concepts of culture media preparation sterilization techniques and microbial growth.
5. Describe the roles of microorganisms in human health.

Course Outcomes:

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

1. Relate the contribution of various scientists in the development of microbiology
2. Classify micro organisms based on their characteristics
3. Apply the concept of culturing microorganisms aseptically
4. Explain various ecological aspects of micro organisms like diversity, distribution, specific interactions, and the effect that they have on eco systems.
5. Illustrate the mechanisms for the propagation of infectious diseases caused by microorganisms

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	1	1	1	2	1	1	2	1	1	1	2	3	2	2
CO 2	1	1	1	2	1	1	2	1	1	1	2	3	3	3
CO 3	1	1	2	2	1	1	2	1	2	1	3	3	3	3
CO 4	1	1	2	2	1	1	3	2	2	1	3	3	3	3
CO 5	1	1	2	2	1	3	1	2	2	1	3	3	3	3

UNIT-I

History and Introduction to Microbiology: History and scope of microbiology, contributions of Antony van Leuwenhoek, Louis Pasteur, Robert Koch, Iwanowskii, Edward Jenner; prokaryotic cell structure – plasma membranes, cytoplasmic matrix – inclusion bodies, ribosome, bacterial chromosome and plasmids, cell wall, components external to cell wall – capsule, slime layer, pili, fimbriae, flagella, bacterial endospores and theirformation.

UNIT-II

Classification of Microbial World: General and colony characters of major groups of microorganisms - algae, fungi, protozoa, bacteria and virus; Identification of microorganisms by major taxonomical characteristics (morphological, physiological, ecological, cultural, metabolic/biochemical, immunological and genetic); Classification of microorganisms - Haeckel's three kingdom concept, Whittaker's five kingdom concept, Three domain concept of Carl Woes.

UNIT-III

Microbial Nutrition and Growth: Methods of culturing of microorganisms - culture media, (liquid, semi-solid and solid media, synthetic media and complex media), Isolation of pure cultures (streak, spread and pour plate methods); Concept of sterilization - methods and their application- physical methods (heat, filtration and radiation), chemical methods (phenolics, alcohols, halogens, heavy metals, dyes, quaternary ammonium compounds, aldehydes, gaseous agents); Methods of preservation of microorganisms and their importance (Bacterial cultures); Microbial growth - growth curve, mathematical expression of growth, measurement of microbial growth (cell numbers and cellmass).

UNIT-IV

Microbial Ecology: Principles of microbial ecology, nutrient acquisition, microbial competition and antagonism, environments and micro environments, Association of microbes with eukaryotes, Rumen micro flora, Aquatic habitats: Marine and fresh water; terrestrial habitats; key nutrient cycles: Carbon, Nitrogen and Sulphur.

UNIT-V

Microbiology and Human health: Microorganisms related to human health. Normal microbial flora, Pathogenic microbes and their diseases - typhoid, T.B, syphilis, AIDS, Influenza. Food poisoning (Staphylococci, C. botulinum) Food intoxication. Dynamics of infectious disease (Endemics, Epidemics and Pandemics)

Text Books:

1. Gerard Tortora, Berdell Funke, Christine Case, Derek Weber, Warner Bair Pearson, Microbiology: An Introduction; 13th edition (January 8,2018)
2. MichaelT.Madigan,JohnM.Martinko,David A.Stahl,DavidP.Clark,BrockBiologyofMicroorganisms, Publisher: Benjamin-Cummings Pub Co; 13th edition (17 December2010)

Suggested Reading:

1. Powar C.B. and Daginawala H.F., "General Microbiology – Vol I & II", 2nd edition, Himalaya publishing house,2005.
2. ArtiKapil, Ananthanarayan and Paniker's "Text book of Microbiology", 9th edition, Orient Blackswan,2013.
3. Roger Y Stanier, "General Microbiology", 5th edition, Palgrave MacmillanLimited,1999.

20BTC06
THERMODYNAMICS FOR BIOTECHNOLOGISTS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. The course aims at providing the students with knowledge about the Thermodynamic principles to solve practical problems.
2. The course also gives an insight into the concepts of Solution Thermodynamics.
3. The course aims to give the students an understanding of chemical and Phase equilibrium conditions.
4. The course also deals with Bioenergetics.
5. The course aims to provide students the knowledge to perform stoichiometric and energetic analysis of cell growth and product formation

Course Outcomes:

At the end of the course, students will be able to

1. Calculate heat and work effects for closed systems and cyclic processes.
2. Understand volumetric properties of fluids.
3. Determine the coefficient of performance of heat engines and heat pump
4. Predict the oxygen consumption and heat evolution for aerobic cultures
5. Calculate equilibrium conversions and yields for single reactions.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	3	3	3	3	2	-	1	-	2	2	-	-	3	3
CO 2	3	3	2	3	1	2	2	1	3	1	-	2	2	3
CO 3	3	3	-	1	-	2	3	-	-	-	-	2	2	1
CO 4	3	3	2	2	-	2	2	-	1	-	-	2	2	1
CO 5	3	3	2	2	2	-	3	-	1	-	-	-	3	3

UNIT-I

Introduction To Thermodynamics: System Definition and Classification of system – closed and open systems based on the number of components, exchange of mass and heat. State and Path Functions, equilibrium, Phase rule. Thermodynamic Properties of fluids. Forms of energy, classification of properties. I-Law of Thermodynamics, application of I-law to closed.

Volumetric Properties of Fluids: PVT behavior of pure fluids. Real and Ideal Gas. Equations of state – Ideal gas law, Virial equations of state (restricted to first two terms). Cubic equations of state – Vander Waals and Redlich kwong. Processes involving ideal gases (isochoric, isobaric, isothermal, adiabatic, polytropic – simple applications)

UNIT-II

The Second Law Of Thermodynamics: Limitations to I-law, qualitative statement of Kelvin Plank and Clausius versions of II-law, entropy – definition, entropy and heat calculations for ideal gases. Maxwell relations – problems not included, Residual properties – definition (VR, HR, SR, GR – basic property relations for ideal gases, problems not included)

UNIT-III

Solution Thermodynamics: Partial molar properties – definition and simple applications involving the calculation of partial molar properties for binary systems using analytical methods (no graphical method). Concepts of Chemical potential and fugacity (for pure species and species in solution). Lewis Randall rule, Raoult's law, Henry's law – Definition and simple applications. Excess properties – definition and fundamental relation for excess Gibbs free energy, (problems not included). Activity and activity coefficients, correlations to calculate activity coefficients – Margules, Van Laar and applications involving binary systems.

UNIT-IV

Topics In Phase Equilibria And Chemical Reaction Equilibria: Vapor-liquid equilibrium calculations for binary systems – P-x-y, T-x-y diagrams, using simple Raoult's law to the binary mixture. Chemical Reaction Equilibria: Equilibrium criteria for homogenous chemical reactions. Standard Gibbs energy change of reaction, **Reaction co-ordinate** –definition. Evaluation of equilibrium constant – numerical problems not included. Effect of pressure and temperature on equilibrium constant – qualitative treatment, simple problems involving temperature dependence of equilibrium constant. Calculation of equilibrium conversions and yields for single reactions.

UNIT-V

Bioenergetics: Energetics of Metabolic Pathways, Energy coupling (ATP & NADH). Stoichiometry and energetic analysis of Cell Growth and Product Formation. Thermodynamics of microbial growth. Oxygen consumption and heat evolution in aerobic cultures. Energy balance equation for cell culture

Text Books:

1. J.M.Smith, H.C. Van Ness and M.M. Abbott, "Introduction to Chemical Engineering Thermodynamics", 6th ed,TMH, 2003.
2. J.A. Roels, "Energetics and kinetics in biotechnology", Elsevier,1983.
3. Y.V.C. Rao, Revised edition, "An introduction to thermodynamics", UniversitiesPress,2004.

Suggested Reading:

1. Robert A. Alberty, "Biochemical Thermodynamics: Applications of Mathematica", John Wileyand Sons,2006.
2. Stanley I. Sandler, "Chemical and Engineering Thermodynamics", 3rd Edition,Wiley,1999.
3. K.V.Narayanan," ATextbookofChemicalEngineeringThermodynamics",PHILearningPvt.Ltd, 2004.

With effect from the Academic Year 2021-22

20BTC07

CELL AND MOLECULAR BIOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of cell biology i.e., concept of cellularorganelles and their functions.
2. Students are taught the structure of the cytoskeleton,and how it maintains the cell structure integrity.
3. Student is made to understand the basics of molecular biology and the centraldogma of the genetic material

Course Outcomes:

At the end of the course, students will be able to

1. Recognize the structure and functions of cellorganelles.
2. Interpret the knowledge of transport of metabolites and cell cycle check points in their experimental work.
3. Distinguish the organization and Replication of DNA, damages and repairs.
4. Identify the structure and function of transcripts and the mechanism of transcription by RNA polymerases.
5. Illustrate the mechanism of translation and post translation mechanism.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	1	2	-	1	-	2	1	3	2	2	2	3	3	1
CO 2	3	2	1	2	2	2	1	2	3	1	2	3	3	2
CO 3	3	1	2	2	3	3	2	3	2	2	1	3	3	3
CO 4	2	2	3	2	1	1	1	2	1	3	2	3	3	-
CO 5	2	2	1	2	2	3	2	-	1	2	3	3	3	-

UNIT-I

CellStructure,OrganellesandtheirFunctions: Cell structure and organization in bacteria, plants and animal cells; structure and functions of cell wall, lysosomes, ribosomes, Golgi complex, peroxisomes, glyoxysomes, mitochondria, plastids, endoplasmic reticulum, vacuoles, centrioles; cytoskeleton - composition, structure and functions of microtubules, microfilaments and intermediatefilaments; nucleus, itsultra-structure,(nuclear envelope, nucleoplasm, chromatinfibers).

UNIT-II

Membrane Transport and Cell Cycle: Prokaryotic and Eukaryotic -Bio membrane – lipid composition and structural organization, protein components and basic function, transport across membrane – passive diffusion, facilitated diffusion, osmosis, active transport (Na+ /K+ Pump), cotransport; uniport, antiport, symport. Cell cycle: Different phases of cell cycle; check points of cell cycle; Regulation of cell cycle - cyclins and cyclin-dependent kinases, cell-cell junctions and Apoptosis.

UNIT III

OrganizationandReplicationofDNA: Structure of DNA–Watson and Crick'smodel; the role of histone and non-histone proteins in the structural organization of chromosomes; telomere and its importance; DNA Replication: Experimental evidence, enzymology of replication, complex replication apparatus; chromosomes; telomere and its importance; DNA Replication: Experimental evidence, enzymology of replication, complex replication apparatus; unidirectional, bi-directional and rolling circle replication; DNA damage and repair: Types of DNA damages- deamination, alkylation, pyrimidine dimmers; DNA Repairmechanisms-photoreactivation,Excisionrepair,mismatchrepair.

UNIT-IV

Mechanism of Transcription: Structure of promoters- RNA polymerases of the prokaryotic and eukaryotic organism; transcription- initiation, elongation and termination; post transcriptional processes of eukaryotic RNA: structure and functions ofRNA-(rRNA,mRNA,tRNA,snRNA),prokaryotic and eukaryotic transcription. Processing of t-RNA,r-RNA,m-RNA splicing; concept of ribozyme,inhibitors of transcription.

UNIT-V

Mechanism of Translation: Ribosome- structural features; features of genetic code, wobble hypothesis; protein synthesis: translation in prokaryotes and eukaryotes- initiation of translation, elongation of polypeptide chain, termination of translation; Post translation modification, Gene regulation by enhancers and silencers, inhibitors of protein synthesis.

Text Books:

1. Geoffrey M.Cooper and Robert E.Hausman, "Thecell: Amolecular approach", 6thedition, Sinauer Associates, 2013.
2. GeraldKarp,"Cell and Molecular Biology": concepts and experiments, 6thedition, JohnWiley & sons, 2009.
3. David Freifelder,"Molecular Biology", 2ndedition, Narosa Publication, 2007.

Suggested Reading:

1. Rastogi S.C.,"Cell and Molecular Biology", 2nd edition, NewAge International, 2006.
2. Benjamin Lewin, Jocelyn E.Krebs, Elliott S.Goldstein, Stephen T.Kilpatrick, "Lewin's GenesXI", Jones and Bartlett Publishers, 2014.

20BTC08

GENETICS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives

1. To enable students to understand the basics concepts of genetics and inheritance of characteristics.
2. To impart knowledge of the structure of chromosomes, aberrations, mutations and their causes.
3. To enlighten about consequences of linkage, crossing over, sex determination and sex liked disorders.
4. To provide an insight into the maternal inheritance and quantitative genetics.

Course Outcomes:

At the end of the course, students will be able to

1. Explain the laws of inheritance and gene interactions.
2. Illustrate the types of chromosomes, structure, aberrations and mutations.
3. Predict and map the organization of genes due to linkage and crossing over mechanism.
4. Categorize sex determination, the chromosomal basis of genetic disorders and sex-linked genes.
5. Predict maternal inheritance and genotypic frequencies in a population.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	2	2	1	2	1	2	2	-	-	-	2	2	1	2
CO 2	2	2	2	1	1	2	2	2	1	-	2	2	2	2
CO 3	2	3	2	2	1	2	2	-	-	-	2	2	2	3
CO 4	2	3	2	3	1	2	3	1	-	-	2	2	2	3
CO 5	3	3	2	2	1	3	3	-	-	2	2	2	2	2

UNIT-I:

Physical Basis of Heredity: Definitions; Genotype, phenotype, Heredity, Variations, Gene and Alleles, Back cross, Test cross; Mendel's laws of inheritance – segregation, independent assortment, modification of Mendelian principles: Dominance and recessive genes, co-dominance, incomplete dominance, Gene and Alleles, multiple alleles; coat color in rabbits and Blood groups. Gene interactions, epistatic interactions, pleiotropism. Lethal alleles, Penetrance (complete & incomplete), Expressivity, Pleiotropy, and Phenocopy.

UNIT-II

Chromosome Structure and Aberrations: Prokaryotic and eukaryotic genome; chromosomal aberrations-structural aberrations (deletions, duplication, inversion and translocation), numerical aberrations (aneuploidy, euploidy, auto polyploidy and allopolyploidy). Mutations – spontaneous, induced; physical and chemical mutagens; lethal mutation (characteristics and types), AMES test, applications of mutations.

UNIT-III

Linkage and Crossing Over: Concept of linkage and crossing over, the cytological basis of crossing over (in Drosophila and Maize), factors affecting recombination frequency, linkage maps; mechanism of recombination – model involving single strand breaks and double strand break in DNA duplex, the significance of Crossing over. Two-point and three-point test cross. Interference. Tetrad analysis.

UNIT-IV

Sex Determination, Sex-Linked and Genetic Disorders: Sex chromosomes, sex determination mechanism Chromosomal: XX-XY, XX-XO, ZZ-ZW; Genic balance theory, Environmental, Hormonal and molecular basis. Y chromosome in melandrium. Gynandromorphs. Dosage compensation: Maryleon's hypothesis; Inheritance of X- linked genes, sex influenced traits in human beings. Garrod's inborn errors of metabolism.

UNIT-V

Extra Chromosomal Inheritance and Quantitative Genetics: Extra chromosomal inheritance – the inheritance of mitochondrial and chloroplast genes, maternal inheritance (CMS, Mirabilis jalapa). Transgressive segregation, quantitative characters, Gene frequency, gene pool, Hardy- Weinberg Law, equilibrium, Fitness and selection Goodness of fit:Chi-square-test.

Text Books:

1. Snustad, D.Peter, Simmons Michael, "Principles of Genetics" 6th edition, John Wiley& Sons publication, 12.
2. Singh, B.D. "Genetics - 3rd edition", Kalyani Publications, 2004.
3. Gardner, E. J., Simmons, M. J., Snustad, D. P. and Snustad, "Principles of Genetics", 8th Edition, John Wiley and Sons, Inc.2008.

Suggested Reading:

1. Verma PS, Agrawal VK, "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology".9th edition, S. Chand & Company Ltd., New Delhi, 2014.
2. Gupta PK, "Genetics", 4th Rev Edition (2nd Reprint) Rastogi Publications,2011.

With effect from the Academic Year 2021-22

20EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/BTech III/IV Semester - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives: The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Course Outcomes: After successful completion of the course the students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	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
CO 1	-	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-

Unit-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

Unit-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - To Equality, to certain Freedom under Article 19, to Life and Personal Liberty Under Article 21. Fundamental Duties - the legal status.

Unit-III

Union Government and its Administration - Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States. Parliamentary form of government in India: Executive-President's role, power and position.

Unit-IV

Legislature and Judiciary: Central Legislature-Powers and Functions of Lok Sabha and Rajya Sabha.Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism.

Unit-V

Local Self Government - District's Administration Head (Collector): Role and Importance.Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation.Panchayati Raj: Introduction, Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: Position and Role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed Prof V Ravindra Sastry, Telugu Akademy, 2nd edition, 2018.
2. Indian Constitution at Work, NCERT, first edition 2006, Reprinted- January 2020.

Suggested Reading:

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

Online Resources:

1. 1.http://www.nptel.ac.in/courses/103107084/Script.pdf

With effect from the Academic Year 2021-22

20CSC35

OOPS Using Python LAB

Instruction	2 Periodsperweek
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives: The objectives of this course are

1. Identification and installation of required software to work with Python.
2. Program development using OOPsconcepts.
3. Handling of errors in program code.
4. Use of library modules to develop applications.

Course Outcomes: On Successful completionof the course, the student will be able to

1. Inspect and identify suitable programming environment to work with Python.
2. Choose appropriate control constructs, data structures to build the solutions.
3. Develop the solutions with modular approach using functions, packages to enhance the code efficiency.
4. Analyze and debug the programs to verify and validate code.
5. Demonstrate use of STLs and modules to build applications.
6. Determine the requirements of real-world problems and use appropriate modules to develop solutions.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	1	2	-	-	-	-	-	-	-	-	-	-	-	1
CO 2	1	2	-	1	-	-	-	-	-	-	-	-	-	-
CO 3	1	2	1	1	-	-	-	-	-	-	-	-	-	-
CO 4	1	2	-	1	-	-	-	-	-	-	-	-	-	-
CO 5	1	3	1	2	-	-	-	-	-	-	-	-	-	-
	1	2	1	1	-	-	-	-	-	-	-	-	-	1

Labexperiments:

1. Installation of any Object-Oriented ProgrammingLanguage and IDE.
2. Simple scripts to demonstrate the use of basic data types and operators.
3. Simple scripts to demonstrate the use of control structures.
4. Functions and Lambda function and parameter passing.
5. Experimentation with Modules.
6. Implementation of classes with attributes and methods.
7. Demonstration of inheritance.
8. Experiments on Overloading.
9. Experimentation of Files and Regular Expressions.
10. Building code to demonstrate Exceptions and built-intools.
11. Demonstration of Plotting graphs.

Text Book:

1. Reema Thareja"Python Programming", Oxford Press,2017.

Suggested Reading and References:

1. https://vknight.org/cfm/labsheets/04-object-oriented-programming/
2. http://learning-python.com/class/Workbook/x-exercises.htm
3. https://inst.eecs.berkeley.edu/~cs61a/fa14/lab/lab06/#inheritance
4. https://anandology.com/python-practice-book/ object_oriented_programming.html
5. http://stanfordpython.com/
6. https://docs.python.org/3/

20BTC09

BIOCHEMISTRY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Students will learn the laboratory safety and standard operating procedures.
2. Students will learn how to estimate and analyze different biomolecules.

Course Outcomes:

At the end of the course, students will be able to

1. Apply the laboratory safety and standard operating procedures and prepare the solutions and biological buffers.
2. Estimate and analyze carbohydrates by different methods.
3. Estimate and analyze aminoacids and proteins by different methods.
4. Estimate and analyze lipids and compare the acid value, Saponification value and iodine valve of various lipids**.**
5. Estimate and analyze nucleic acids.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	3	2	3	3	1	3	2	-	3	3	3	3	3	3
CO 2	2	3	2	2	1	-	1	-	3	2	3	3	3	1
CO 3	2	3	2	2	1	-	1	-	3	2	3	3	3	1
CO 4	2	3	2	2	1	-	1	1	3	2	3	3	3	1
CO 5	2	3	2	2	1	-	1	1	3	2	3	3	3	1

List of Experiments:

1. Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units
2. Preparation of Solutions – percentage solutions, molar solutions, normal solutions and dilution of stock solution
3. Measurement of pH
4. Preparation of buffers and reagents
5. Estimation of sugars from the given sample by DNS method
6. Estimation of Carbohydrates by Anthrone method
7. Estimation of Aminoacids by Ninhydrin method
8. Estimation of Proteins by Biuret method
9. Estimation of Proteins by Lowry method
10. Determination of Acid value, Saponification value and Iodine Number of Fat
11. Estimation of Cholesterol by Liebermann Burchard method
12. Estimation of DNA by Diphenylamine method
13. Estimation of RNA by Orcinol method

With effect from the Academic Year 2021-22

20BTC10

MICROBIOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives: Students during their course of time are made to:

1. Handle and focusing of Bright Field microscope
2. Perform physical and chemical sterilization methods for control of microorganisms
3. Prepare microbial culture media
4. Isolate pure cultures using various techniques
5. Perform different staining techniques

Course Outcomes: At the end of the course students will be able to

1. Examine the microbial cell structures using of Bright Field microscope
2. Demonstrate sterilization of equipment and various types of media
3. Prepare the basic culture media for the growth of microorganisms
4. Demonstrate the isolation of pure microbial culture from soil and water
5. Predict nomenclature of microorganisms based on their metabolic activity

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	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
CO 1	1	3	1	2	2	3	1	2	3	1	3	3	2	2
CO 2	1	3	1	2	1	3	1	1	3	1	3	3	3	3
CO 3	1	3	2	2	1	3	2	1	3	1	3	3	3	3
CO 4	1	3	1	2	1	3	1	1	3	1	3	3	3	3
CO 5	1	3	1	2	1	3	1	1	3	1	3	3	3	3

List of Experiments

1. Calibration of Microscope and Measurement of Microorganisms-Micrometer.
2. Staining and Identification of microorganism: (a) Simple and Differential staining techniques.
3. Sterilization techniques (Autoclaving, Hot Air Oven, Radiation and Filtration).
4. Preparation of culture media (a) broth type of media (b) Agar.
5. Culturing of microorganism (a) broth (b) pure culture techniques- Streak plate, Pourplate.
6. Antibiotic tests- Disc diffusion method, minimum inhibitory concentration.
7. Biochemical tests- IMIVC test, Catalase, Coagulase test, Gelatinase test, Oxidase.
8. Factors affecting the bacterial growth and study ofthe growth curve.
9. Measurement of Microbial Growth by Turbidometry and enumeration of bacterial numbers by serial dilution.
10. Measurement of Microbial Growth by Viable Count.
11. Production of Beer and Wine (open-ended)
12. Coliform test (structured enquiry)

Suggested Reading:

1. Michael J.Leboffe, Burton E. "Microbiology: Laboratory Theory and Application" 4thEdition Pierce Morton Publishing Company; January 1,2015.
2. Gopal Reddy M, M.N. Reddy, D.V.R. SaiGopal and K.V. Mallaiah, "Laboratory Experiments in Microbiology",3rd edition, Himalaya Publishing House Pvt Ltd,2008,
3. Gunasekaran P., "Laboratory manual in Microbiology", 3rdedition, New Age International Publ., New Delhi, 2007.

20BTI01

MOOCs/Training/ Internship I

Please refer Annexure - 1

With effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OFTECHNOLOGY (A)

Department of Bio-Technology

Scheme of Instructions for IV Semester of B. Tech Bio-Technology as per AICTE ModelCurriculum 2021-22

B. Tech (Bio-Technology)

SEMESTER IV

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20MTC23	Engineering Mathematics for Biotechnologists	3	1		3	40	60	4
2	20BTC12	Bioprocess Engineering	3	-	-	3	40	60	3
3	20BTC13	Immunology & Immunotechnology	3	-	-	3	40	60	3
4	20BTC14	Instrumental Methods in Biotechnology	3	-	-	3	40	60	3
5		Professional Elective - 1	3	-	-	3	40	60	3
6	20EGM03	Universal Human Values-II: Understanding Harmony	3	-	-		40	60	3
7	20CEM01	Environmental Science	2	-	-	2	-	50	Non credit
PRACTICALS									
8	20BTC15	Bioprocess Engineering Lab	-	-	2	3	50	50	1
9	20BTC16	Immunology Lab	-	-	2	3	50	50	1
10	20BTC17	Instrumentation Lab	-	-	2	3	50	50	1
Total			**20**	**1**	**6**				**22**
Clock Hours Per Week –27									

L: Lecture T: Tutorial P: Practical

CIE –Continuous InternalEvaluation SEE – SemesterEnd Examination

Professional Elective – 1	
20BTE01	Environmental Biotechnology
20BTE02	Process Dynamics and Control for Biotechnologists
20BTE03	Intellectual Property Rights and Bioethics
20BTE04	*Enzyme technology*
20BTE05	*Industrial Biotechnology*

20MTC23

ENGINEERING MATHEMATICS FOR BIOTECHNOLOGISTS

(For Bio-Technology)

Instruction:	3L+1T Hours per week
Duration of End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	4

Course Objectives:

To learn

1. To discuss Mean value theorems
2. To learn the Laplace and Inverse Laplace transforms for solving engineering problems
3. To discuss vector line, surface and volume integrals
4. To discuss solution of higher order differential equations.
5. Solve algebraic and transcendental equations

Course Outcomes:

On the successful completion of the course, the student shall be able to

1. Analyse the geometrical interpretation of Mean value theorems
2. Find Laplace transform and inverse Laplace transform and can solve Linear Differential equations.
3. Solve line, surface and volume integrals by Green's, Guass, Stoke's theorem
4. Solve the higher order linear differential equations.
5. Derive the solutions when system of equations has more than two unknowns and learn to reduce the instability of equations.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 3	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 4	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-	-
CO 5	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-

UNIT-I:

Differential Calculus

Rolle's Theorem, LaGrange's Mean value theorem, Cauchy's mean value theorem (without proofs). Taylor's series and Maclaurin's series for single variable. Curvature, radius of curvature and Evolutes (Cartesian form only)

UNIT-II:

Laplace Transform

Laplace Transform of standard functions, Linearity property, change of scale property. Shifting theorems, Laplace Transform of Periodic Function, Unit step function and Unit impulse function. Transforms of derivatives, transforms of integrals, Multiplication by □□ and division by □. Inverse Laplace Transform properties, Inverse Laplace Transform by partial fractions and Convolution theorem, Applications of Laplace Transform (Solution of Linear Differential Equations).

UNIT-III:

Vector Integral Calculus:

Line integral, Surface integral and Volume integral. Green's theorem in the plane, verifications of Stoke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-IV:

Differential Equations of Higher order

Solutions of higher order linear equations with constants coefficients, Method of variation of parameters, solution of Cauchy's homogeneous linear equation.

UNIT-V:

Numerical Methods

Solutions of Algebraic and Transcendental Equations: Method of Bisection, RegulaeFalsi Method (method of false position) Secant Method, Newton Raphson Method. Solution for simultaneous equation –Gauss sidle method

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. A.R.K JAIN and S.R.K IYENGER, "Advance engineering mathematics",3rd edition, Narosa publications, 2007.
3. Narayan Shanti and Mittal P.K. ,"Differential Calculus", 30th edition, S Chand publishers, 2005.
4. Dr B S Grewal "Numerical Methods in Engineering & Science" Khanna Publishers, 11th edition,2013

Suggested Reading:

1. Joseph Edwards,"Differential Calculus For Beginners", ArihantPublishers, 2016.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley publishers, 2015.
3. R.K.Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5thedition, 2016

With effect from the Academic Year 2021-22

20BTC12

BIOPROCESS ENGINEERING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. The course aims at providing knowledge to students on the scope and chronological development of fermentation technology.
2. To understand the types of fermentation process and designof fermentation.
3. To learn about the ancillaries of fermentor andtheir applications.
4. To gain in-depth knowledge about the working principles and operationof fermenters.

Course Outcomes:

At the end of the course, the students are able to

1. Apply the knowledgefermentationprocessesand aseptic transferofsporesuspensioninbioprocess industries.
2. Design fomenters and control process parameters, media formation in bioprocesses, solid state and slung processes.
3. Determine oxygen transfer ratio in aerobic fermentation used infermentation industries.
4. Apply the knowledge of scale up and scale down technique in bio process industries and able to determine power requirementsin bioreactors.
5. Apply knowledge of different bioreactors like air lift, fed batch, batch and continuous in bioreactors while evaluating their performances inbioprocesses industries.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	2	2	2	1	1	1	2	2	2	1	1	1	3	2
CO 2	2	2	3	2	1	1	2	2	2	1	2	2	2	3
CO 3	2	2	3	3	1	1	1	1	1	1	1	2	2	1
CO 4	2	2	3	2	1	1	2	2	2	1	2	2	2	3
CO 5	2	2	3	2	1	2	2	2	2	1	2	2	2	3

UNIT-I

Introduction to Fermentation Processes: The range of fermentation processes; the chronological development of the fermentation industry; Industrial applications; Future trends in fermentations; Aseptic transfer of spore suspension; Transfer of inoculums from seed tank to Fermentor.

UNIT- II

Media Design: General requirements of fermentation processes, Basic design and construction of fermenter and ancillaries, Main parameters to be monitored and controlled in fermentation processes; Typical media, Media formulation, energy resources, carbon and nitrogen components Solid- substrate, slurry fermentation and its applications, Placket Burman design.

UNIT-III

Aeration and Agitation in Fermentations: Basic Mass transfer concepts; Oxygen transfer from gas bubble to cells; Oxygen transfer in fermentations; Bubble aeration and Mechanical agitation; Correlations for mass transfer coefficients; Gas Hold up; Determination of oxygen transfer rates, K_La values; Other Factors affecting the values of mass transfer coefficients infermentation vessels.

UNIT-IV-

Cell Growth Kinetics: Batch Growth, Balanced Growth, Effect of Substrate Concentration, Monod Equation, Kinetics of Substrate Uptake in Cell Culture, Effect of Culture Conditions on Cell Kinetics Determining Cell Kinetic Parameters from Batch Data, Yields in Cell Culture, Batch and continuous sterilization kinetics, Effect of Maintenance on Yields, Kinetics of Cell Death

UNIT-V

Bioreactors/Fermentors: Batch, Fed-batch and Continuous Fermentation systems; Dual and multiple fermentations; Comparison between batch and continuous fermentations; Steady state, unsteady state continuous fermentation theories; Examples of continuous fermentation; Practical problems with continuous operations. Monitoring and Control of fermentations, the behavior of microbes in different reactors viz. air lift, fluidized, batch, packed bed, Bubble column, trickle bedreactors.

Text Books:

1. Pauline M. Doran, “Bioprocess Engineering Principles”, AcademicPress,1995
2. Stanbury PF, Whitaker A and Hall S J, “Principles of Fermentation Technology” 2nd edition, Elsevier,2013.
3. Bailey JE and Ollis DF, “Biochemical Engineering Fundamentals”, 2nd edition, McGrawHill,1986.

Suggested Reading:

1. Shuler M and Kargi F, Bioprocess Engineering, Prentice Hall of India Pvt. Ltd., NewDelhi,2002.
2. Harvey W. Blanch, Douglas S. Clark, “Biochemical Engineering” 1st edition,CRC,1997

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With effect from the Academic Year 2021-22

20BTC13
IMMUNOLOGY AND IMMUNOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Students learn about the basic components and responses ofthe Immune system.
2. Knowledge of the structure of Antigen and antibody and the processing ofAntigen
3. Importance of Antigen and Antibody interactions.
4. Students understand the significance of the complement systemand hypersensitivity.
5. The immunological basics for diseases are taught tothe students.

Course Outcomes:

At the end of the course, students will be able to

1. Identify Immune system components and how they work in a coordinated way.
2. Differentiate the structure ofantigen-antibody and the methods of processing of antigen
3. Analyze the Immune system related underlying causes in Allergies, Asthma, and otherhypersensitive reactions.
4. Acquainted with the diseases caused due to Immune system malfunctioning.
5. Explain the Immune system related medical complications in transplantation andCancers.
6. Apply the principles of immunological techniques in the development of medical diagnostickits.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

CO / PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	1	3	-	-	2	-	2	-	2	-	3	3	1
CO 2	3	3	3	3	-	3	-	-	2	3	2	3	3	2
CO 3	2	2	2	2	1	3	-	3	3	1	2	3	3	1
CO 4	1	2	2	2	2	3	-	3	2	1	-	3	3	1
CO 5	1	2	2	2	2	3	1	2	1	2	-	2	3	1

UNIT-I

Immune System: Introduction to immunity, types of immunity – innate and adaptive immunity, humoral and cell mediated immune response, hematopoietic, cells of the immune system, Organs of the immune system–the primary (bone marrow and thymus) and secondary (lymph node, spleen, MALT, GALT) lymphoid organs, Pro-inflammatory and anti-inflammatory cytokines.

UNIT-II

Antigen and Antibody and its Structure and properties and processing and presentation of Antigen: Antigen– immunogenicity and antigen city, factors influencing immunogenicity, haptens and adjutants, epitopes; Immunoglobulin– structure, classes and function, antigenic determinants of immunoglobulin – isotype, allotype, idiotype. Major histocompatibility complex (MHC) organization, classes and function;

Antigen processing and presentation – the role of antigen presenting cells, endogenous antigens (cytosolic pathway), exogenous antigens (endocytic pathway), presentation of nopeptide antigen.

UNIT-III

The Complement System and Hypersensitivity: Complement system – components, function, activation (classical and alternative pathway); hypersensitive reactions – Type I (IgE mediated hypersensitivity), type II (antibody mediated cytotoxic hypersensitivity), type III (Immune complex mediated hypersensitivity), type IV (delayed type hypersensitivity).

UNIT-IV

Medical Applications of Immunology: Autoimmunity–organ specific (Insulin Dependent Diabetes Mellitus, Myasthenia Gravis) and systemic (Systemic Lupus Erythematosus, Rheumatoid Arthritis) autoimmune diseases, treatment of autoimmune diseases; Transplantation – the immunological basis of graft rejection, immunosuppressive therapy (general and specific), immune prophylaxis (attenuated, inactivated and DNA vaccines), immunology of cancer- tumor antigens, immune response to the tumor, cancer immunotherapy.

UNIT-V

Immunological techniques: Production of monoclonal antibodies by hybridoma technology and its applications. Strength of antigen and antibody interaction, affinity, avidity, cross reactivity, precipitation, agglutination, IEP, RIA, ELISA, western blotting, immune fluorescence, FACS.

TextBooks:

1. Judith A.Owen, Jenni Punt,Sharon A. Stanford,"KubyImmunology",7th edition,W.H.Freeman,2013.
2. PeterJ. Delves, SeamusJ. Martin, DennisR. Burton, Ivan M. Roitt, "Roitt's Essential Immunology",12th edition, John Wiley &Sons, 2011.

Suggested Reading:

1. Kenneth Murphy, "Janeway's Immunobiology", 8thedition,GarlandScience, 2011.
2. Abdul K. Abbas, Andrew H. Lichtman, Shiv Pillai, "Cellular and Molecular Immunology, 7thedition", ElsevierHealthSciences,2011.
3. Sunil Kumar Mohanty and K. Sai Leela, "Textbook of Immunology", 2ndedition,JP Medical Ltd, 2014.

With effect from the Academic Year 2021-22

20BTC14
INSTRUMENTAL METHODS IN BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

Students are made to understand the following concepts during their course of time:

1. Types of Analytical methods, Instruments used for Analysis and Importance of microscopy
2. Types of Instruments used for isolation of Bimolecular and Sub cellularorganelles
3. Types of ChromatographicTechniques
4. Charge based separationTechniques
5. The principles and applications of spectroscopicmethods

Course Outcomes:

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

1. Explain the instrumental errors and working of different microscopes.
2. Describe various techniques to isolate cellular components andproducts.
3. Compare various techniques in the purification of cellularproducts.
4. Illustrate various electrophoresis techniques to isolate DNA/Protein from amixture.
5. Explain the working of various spectroscopicinstruments.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	3	3	2	1	1	2	1	1	1	1	3	3	3	3
CO 2	3	1	2	1	1	2	1	1	1	1	3	3	3	2
CO 3	3	2	1	1	2	1	1	1	1	1	2	3	3	2
CO 4	3	2	1	1	2	1	1	1	1	1	2	3	3	2
CO 5	3		2	1	1	2	1	1	1	1	3	3	3	2

UNIT-I

Analytical Methods and Microscopy: Types of Analytical Methods - Instruments for Analysis (Types)- Uncertainties in Instrumental measurements - Sensitivity and detection limit for instruments; principle, procedure, and applications of Bright field. Dark field, fluorescent and electron microscopy.

UNIT-II

Instruments For Isolation Techniques: Cell disruption by French press, Sonification, freeze thaw technique; use of liquid N2 and chemical approaches involved in cell disruption; Isolation of Biomolecules and cell organelles: centrifugation; basic principles of sedimentation, sedimentation coefficient, Svedberg Unit; various types of centrifuges, their uses, rotors, fixed angle, vertical, swing out, zonal rotors; preparative centrifugation, differential density gradient centrifugation, analytical ultra-centrifugation; Materials used in the preparation of density gradient- sucrose & cesium chloride; Isolation of sub cellular organellesandBiomolecules.DeterminationofmolecularweightandpurityofBiomoleculesbyanalyticalultra-centrifugation.

UNIT-III

Separation Techniques: Partition coefficient, partition chromatography, counter current distribution, adsorption chromatography, Paper, TLC& GLC, adsorption media, solvent, continuous and gradient elution, fraction collection and detection of pure molecules. Methods based on size: Gel permeation chromatography, principle application- Molecular weight determination. Dialysis and its significance. Affinity chromatography, application & technique for purification of proteins and nucleic acids.

UNIT-IV

Charge Based Separation Techniques: Principle and application of Ion exchange chromatography, use of ion exchange- cation& anion exchangers, pH and salt gradients for elution of proteins, amino acids and nucleotides. Electrophoresis: Migration of charged molecules in electric field-moving boundary, paper, cellulose acetate, starch gel electrophoresis, SDS PAGE, Determination of molecular weight, iso-electric focusing and its significance. Identification of specific proteins by western blotting. Agarose gel electrophoresis-separation of DNA & RNA, by agarose gel electrophoresis, recovery of DNA fragments from agarose gels, southern & northern blot techniques and their significance, pulse field gelelectrophoresis.

UNIT-V

Spectrometric Identification Techniques: Basic concepts of spectroscopy, Visible & UV spectroscopy & Explain Beer lamberts law; Principles and application of Colorimetry & Flame photometry, Nephelometry; Principles and applications of Atomic absorption Spectrophotometry; Principles & applications of IR, ESR NMR & Mass spectroscopy; Explains the laws of photometry.

Text Books:

1. Dinesh Kumar Chatanta, Prahlad Singh Mehra Instrumental Methods of Analysis in Biotechnology I K International Publishing House Pvt. Ltd (2012Edition)
2. Keith Wilson and John Walker, "Principles and Techniques of Biochemistry and Molecular Biology", 6thEdition, Cambridge University Press,2005.
3. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India,2012.

Suggested Reading:

1. S. Malathi, Pallavi Mangesh Patil,SunilKumar,Instrumental Methods Of Analysis Thakur Publication Pvt Ltd (2020 Edition)
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan, Introduction to Spectroscopy, Cengage Learning India Private Limited (2015Edition)
3. GW Ewing, "Instrumental Methods of Chemical Analysis", 4th edition, McGrawHill,1985.
4. Hobert H Willard D.L.Merritt and J.R.J.A.Dean, "Instrumental Methods of Analysis", CBS Publishers & Distributors,1992.
5. Skoog DA, "Fundamentals of Analytical Chemistry", ThomsonBrooks/Cole,2004.

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With effect from the Academic Year 2021-22

20BTE01

ENVIRONMENTAL BIOTECHNOLOGY

(Professional Elective - I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

The course aims

1. To provide theoretical concepts and comprehensive knowledge ofbioremediation methods.
2. To provide knowledge on metal leaching and non-conventionalfuel production.
3. To impart theoretical basics on various methods used in the treatment ofwastewater.
4. To provide knowledge on the degradation ofXenobiotic compounds.
5. To update the students with the available information on biotechnological applications in hazardous waste management.

Course Outcomes:

At the end of the course, students will be able to

1. Describe the process of bioremediation indetail.
2. Explain the use of Microorganisms for metal leaching and biofuelsgeneration.
3. Illustrate different methods of waste water treatment and green energygeneration.
4. Categorize different types of wastes and their degradation methods.
5. Evaluate various biotechnological applications for hazardous wastemanagement.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	3	-	2	-	1	1	2	-	2	2	-	2	2	1
CO 2	2	2	3	2	2	2	3	-	2	2	2	3	2	2
CO 3	2	1	3	2	2	2	3	-	2	2	2	3	2	2
CO 4	3	2	3	3	2	3	2	-	2	2	1	3	1	1
CO 5	3	3	3	3	3	3	3	1	3	3	2	3	3	3

UNIT-I

Bioremediation: Introduction to bioremediation and its types- In situ, Ex-situ, Intrinsic and Extrinsic Bioremediation; Constraints and priorities of Bioremediation, Bio stimulation of naturally occurring microbial activities Bio-augmentation; Solid-phase bioremediation- Land farming, composting, Bio pile; Phytoremediation techniques, Slurry/Liquid phase bioremediation, Bio restoration

UNIT-II

Metal Biotechnology and Biofuels: Bioleaching- Types, mechanisms and advantages of microbial leaching; Biosorption and Microbial transformation; Microorganisms and their role in energy requirements of mankind; Production of non-conventional fuels: Methane (Biogas), biohydrogen, bioethanol and Algal biofuels; Application of isolated enzymes versus whole cell systems for remediation and biofuels generation-Microbial Fuel Cells

UNIT-III

Biological Waste Water Treatment: Sources of wastewater and its types, General composition of wastewater; Biological processes for domestic and industrial waste water treatment; Aerobic systems – Activated sludge process, trickling filters, Rotating biological contractors (RBC), Fluidized bed (and biofilm) reactor; Anaerobic biological treatment-Contact digesters, Packed column reactors, UASB, Other advanced bioreactor configurations

UNIT-IV

Degradation of Xenobiotic Compounds: Xenobiotics and Recalcitrant-Definition, Sources and examples; Co- metabolism; Biodegradation of Xenobiotics present in Environment-Degradative plasmids; Oil Pollution and Bioremediation of Contaminated soils; Biological Detoxification-Cyanide, Toxic Organics and Phenols.

UNIT-V

Hazardous Waste Management: Introduction to general Solid and Hazardous Waste management-landfills, recycling and processing of organic residues; minimal national standards for waste/wastewater release into the environment; Biotechnological applications to hazardous waste management; Global Environmental problems and Biotechnological approaches for management; Nuclear waste generation and treatment.

Text Books:

1. Alan Scragg “Environmental Biotechnology”, 2nd edition, Oxford End Press,2005.
2. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis HorwoodLtd.,2007.

Suggested Readings:

1. Environmental Biotechnology By Priv.-Doz. Dr.Hans-Joachim Jördening, Prof.Dr. Josef Winter, Wiley-VCH Verlag GmbH & Co.KGaA.2005.
2. Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., General Microbiology, McMillanPublications,2009.

With effect from the Academic Year 2021-22

20BTE02

PROCESS DYNAMICS & CONTROL FOR BIOTECHNOLOGISTS
(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. The course aims at providing dynamics of system process, flow, level andtemperature etc.
2. The course aims at incorporating concepts of the response of first order systems for non-interacting and interacting systems.
3. The course aims at providing knowledge on the design of control systems for open and closeloop control.
4. The course aims at inculcating concepts of the control of pH of process andbiochemical reactions.

Course Outcomes:

Upon completing the syllabus, the students will be able to

1. Use the knowledge of Process dynamics to control level, temperature, flow variable etc. in bioprocess industries.
2. Devise a simple feedback control strategy for a bioprocess
3. Incorporate the knowledge of closed loop and open loop tuning methods to fine tune thecontrol parameters.
4. Use the knowledge of control valve sizing in the design of control valve system inbioprocess units.
5. Apply the knowledge of process control to regulate the pHof bioreactors.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	3	3	2	1	1	2	2	1	2	1	1	2	2	2
CO 2	3	3	3	2	2	1	1	2	2	1	1	2	2	2
CO 3	3	3	3	2	2	1	1	1	1	1	1	3	2	3
CO 4	1	2	2	1	1	2	2	1	1	1	1	2	2	2
CO 5	2	3	3	2	2	3	3	2	3	1	2	3	3	3

UNIT-I

Process Dynamics: Laplace transform of simple functions, transforms of derivatives, solutions of differential equations, inversion by partial fractions, Partial fractions. Process variables, Dynamics of simple processes – Flow, level, Temperature, Pressure and Concentration; Transfer function – Properties, response of simple processes for Step, Impulse and Sinusoidal Forcing functions. Concept of Time Constant, Linearization, Response of first order systems in series - Non-interacting andInteracting systems.

UNIT-II

Control Actions and Controllers: Controller and Control system – measuring device and final control elements, Open and Closed loop control, Negative and Positive feedback control, Servo and Regulatory problems. Ideal transfer functions –Control valve, Controllers, Proportional, Integral and derivative actions – PI. PD and PID controls. Block diagram- Development of block diagram, over all Transfer function for single loop system, overall transfer function for change in set point and load, transportation lag.

UNIT-III

Optimum Controller settings: Controller Tuning – Evaluation criteria with l/4th decay ratio, Criteria for good control- IAE. ISE, ITAE. Controller Tuning – Ziegler –Nicholas and Cohen Coon methods. Continuous cycling method, Control of processes with a time delay.

UNIT-IV

Final Control Element: I/P Converter– pneumatic, electric and hydraulic actuators. Control valves – Construction, valve sizing, valve characteristics, valve positioner. Control of Globe, Butterfly and Diaphragm valves.

UNIT-V

Advanced Control Strategies: Brief description of Cascade control. Feed forward control, Ratio control, with a simple example. Dynamics and Control of pH of a process and Biochemical reactor.

Text Books:

1. Donald R.Coughanowr , Process Systems Analysis and Control, 2nd ed., McGraw HillInc.,1991.
2. George Stephanpoulos,"Chemical process control",PearsonPrenticeHall,1984.
3. Seborg, Edgar, Mellichamp, Doyle, "Process Dynamics and Control", 3rd edition John Weilyand Sons, 2010.
4. Harriott P, "Process control", Tata McGraw-Hill publishing Co., New Delhi,Reprint1991.

Suggested Reading:

1. PatranabisD,PrinciplesofProcessControlby2nded.,TataMcGraw-HillpublishingCo.,NewDelhi, Reprint1997.
2. Eckman D.P., Automatic process control, Wiley Eastern Ltd., NewDelhi,1993.

With effect from the Academic Year 2021-22

20BTE03

INTELLECTUAL PROPERTY RIGHTSAND BIOETHICS

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objective:

This course is intended to impact awareness on intellectual property rights and various regulatory issues related to IPR

Course Outcomes:

1. Demonstrate a breadth of knowledge inIntellectual property
2. Understand the overview of Patents, Searching, filling and draftingof Patents
3. Understand the overview of copyright, GI, trademark, and tradesecret
4. Understand about different national and international: Conventions and Treaties Governingthe IPRs
5. Understand various aspects of bioethics and its practicalimplications

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	1	1	1	1	1	3	2	3	2	1	1	3	2	2
CO 2	1	1	1	1	1	3	2	3	2	1	1	3	2	2
CO 3	1	1	1	1	1	3	2	3	2	1	1	3	2	2
CO 4	1	1	1	1	1	3	2	3	2	1	1	3	2	2
CO 5	1	1	1	1	1	3	3	3	2	1	1	3	3	3

UNIT I

Introduction to IPR: Discovery, Invention, Creativity, Innovation, History & Significance of IPR, Overview of IPR- Patent, Copyright, Trade Mark, Trade Secret, GI, Industrial Design & Integrated Circuit, Non-patentable criteria.

UNIT II

Patents: Patents-Patentability Criteria, Types of Patents-Process, Product & Utility Modes, Software Patenting and protection, Patent infringement- Case studies- Apple Vs Samsung, Elfish LLC VS Microsoft, Overview of Patent search- Types of Searching, Public & Private Searching Databases, Basics of Patent Filing & Drafting, Indian Patents Law.

UNIT III

Copyrights, Geographical Indications, Trademark and Trade secrets: Types of Copyrights, Procedure for filing, copyright infringement, Copyright Law, Geographical Indications- Tirupati Laddu, Darjeeling Tea, Basmati rice. Trade Marks- Commercial importance, protection, registration, Case Studies- Sabena and Sabena, Castrol Vs Pentagon, Trade Secrets- Case Studies-Kentucky Fried Chicken (KFC), Coca-Cola.

UNIT IV

Protection of Industrial Designs & International Conventions & Treaties: Industrial Designs- Scope, protection, filing, infringement; Overview of WTP. GATT. TRIPS. WIPO, Patent Cooperation Treaty (PCT), International IPR Agreements Regulating Plant Varieties and Plant Breeders' Rights.

UNIT V

Bioethics: Principles of bioethics: Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc. The expanding scope of ethics from biomedical practice to biotechnology, bioethics vs. business ethics, The legal, institutional and socioeconomic impacts of biotechnology; biotechnology and social responsibility, Biosafety regulations and national and international guidelines with regard to recombinant DNA technology. Guidelines for research in transgenic plants. National and international regulations for food and pharma products.

Text Book:

1. Deborah E.Bouchoux, Intellectual Property for Paralegals- The law of Trademarks, Copyrights, Patents & Trade secrets, 3rd Edition, Cengagelearning,2012.
2. N.S. Gopalakrishnan& T.G. Agitha, Principles of Intellectual Property, Eastern BookCompany, Lucknow, 2009.
3. Goel and Parashar. IPR, Biosafety and Bioethics Pearson Education India; First edition (1 January2013)

References:

1. M.M. S. Karki, Intellectual Property Rights: Basic Concepts, AtlanticPublishers,2009.
2. Neeraj Pandey &KhushdeepDharni, Intellectual Property Rights, PhiLearning Pvt. Ltd.
3. AjitParulekar and Sarita D'Souza, Indian Patents Law- Legal & Business Implications; Macmillan India Ltd, 2006.
4. B.L. Wadehra, Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd.India2000.
5. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House,Delhi,2010.

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With effect from the Academic Year 2021-22

20BTE04
ENZYME TECHNOLOGY
(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn about basic aspectsof enzymes.
2. To understand the catalytic strategies and mechanism ofenzyme action.
3. To learn the role of enzyme kinetics andits action.
4. To understand the methods ofenzyme immobilization
5. To study about mass transfer kinetics ofimmobilized enzymes.

Course Outcomes:

At the end of the course, students will be able to

1. Discuss the nomenclature and classification, properties, isolation and purificationof enzymes.
2. Describe the catalytic strategies and mechanism ofenzyme action
3. Explain the kinetics of enzyme actionand inhibition.
4. Compare various enzyme immobilization techniques and analyze the mass transfer effectsin immobilized enzyme systems.
5. Outline the applications of enzymes indifferent fields.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	1	1	2	2	1	1	2	1	1	1	2	3	3	3
CO 2	2	2	2	2	1	1	2	1	1	1	2	3	3	3
CO 3	2	1	2	1	2	1	2	1	1	1	2	3	3	3
CO 4	2	2	2	2	1	1	2	1	1	1	2	3	3	3
CO 5	3	3	2	2	1	1	2	1	1	1	2	3	3	3

UNIT-I

Introduction to Enzymes: Enzyme, coenzymes, cofactor; general properties of enzymes; Enzyme nomenclature; Classification of enzymes based upon the type of reaction they catalyze, Factors affecting the rates of chemical reactions - Collision theory, transition state theory, Mechanism of catalysis; isolation and purification of crude enzyme extracts from the plant, animal and microbial sources; Development of enzymatic assays.

UNIT-II

Catalytic Strategies and Mechanisms of Enzyme Action: Catalytic strategies – Lysozyme, Ribonuclease A, Carboxypeptidase A, chymotrypsin; Mechanisms of enzyme action; Concept of active site and energetics of enzyme-substrate complex formation; Specificity of enzyme action.

UNIT-III

Kinetics of Enzyme Action and Enzyme Inhibition: Kinetics of single substrate reactions; Turn over number; Derivation of Michaelis -Menten equation; Kinetics of Multi-substrate reaction; Types of Enzyme Inhibition - Reversible inhibition and Irreversible inhibition; Allosteric enzymes.

UNIT-IV

Enzyme Immobilization and Mass Transfer Effects in Immobilized Enzyme Systems: Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding; Overview of applications of immobilized enzyme systems; Analysis of Film and pore Diffusion Effects on the kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors.

UNIT-V

Applications of Enzymes: Applications of commercial enzymes; Proteases; Amylases; Lipases; Cellulases; Pectinases; Isomerases in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic purposes; Design of enzyme electrodes and their application as biosensors in industry, health care and environment.

Text Books:

1. Trevor Palmer, Philip Bonner, "Enzymes", 2nd edition, WoodheadPublishing,2007.
2. Andreas S. Bommarius, Bettina R. Riebel, "Biocatalysis - Fundamentals and Applications", Wiley-VCH, 2004.

Suggested Books:

1. Shanmugan, S., "Enzyme technology" I. K. International PvtLtd,2009.
2. Voet and Voet J.G, "Biochemistry", 4nd edition, John C.Wiley andSons, 2010.

With effect from the Academic Year 2021-22

20BTE05

INDUSTRIAL BIOTECHNOLOGY

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To know about the Bioprocess-overview and variousprimary metabolites
2. To know about the production and application ofmicrobial metabolites
3. To make the student understand the productionof enzymes
4. To make the student understand the biotechnologically important products like recombinant proteins,vaccines etc.
5. To make the student understand the importance and production ofvarious beverages

Course Outcomes:

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

1. Describe the importance ofIndustrial Bioprocesses
2. Manipulate the ideas for the production ofmicrobial metabolites
3. Apply the concept of biosynthesizing enzymes and otherimportant products
4. Explain the methodologies behind the production of modern products like recombinantvaccines and monoclonal antibodiesin industries
5. Apply the concept to producecommercially important

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	3	2	3	2	1	1	1	1	1	1	2	3	3	3
CO 2	3	2	3	1	1	2	1	1	1	1	2	3	3	3
CO 3	3	2	3	1	1	2	1	1	1	1	2	3	3	3
CO 4	3	2	3	1	1	2	1	1	1	1	2	3	3	3
CO 5	3	2	3	1	1	2	1	1	1	1	2	3	3	3

UNIT-I

Introduction to Industrial Bioprocess: Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of upstream and downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation

UNIT-II

Production of Microbial Metabolites: Primary Metabolites: Organic acids -Citric acid, Lactic acid, Amino acids -Glutamic acid, Phenyl alanine, Alcohols –Ethanol, Secondary metabolites: Antibiotics-Penicillin, VitaminB_{12}

UNIT-III

Production of Enzymes and Other Products: Production of industrial enzymes (proteases & amylases), Production of biopesticide, Biofertilizers, Bio preservative (Nisin), biopolymers (Xanthan gum & PHB), Cheese, Beer, SCP, Biodiesel

UNIT-IV

Production of Modern Biotechnology Products: Production of recombinant proteins having therapeutic and diagnostic applications (insulin, human growth hormone & Interferon), Industrial Production, Purification, and Process development of recombinant vaccines (hepatitis B vaccine, cholera vaccine) and monoclonal antibodies

UNIT-V

Production of Beverages: Production of beverages, beer, wine, microbes in baking - production of Baker's Yeast, Production of fermented milk products

Text Books:

1. Trevor Palmer, Philip Bonner, "Enzymes", 2nd edition, WoodheadPublishing,2007.
2. Andreas S. Bommarius, Bettina R. Riebel, "Biocatalysis - Fundamentals and Applications", Wiley- VCH, 2004.

Suggested Books:

1. Shanmugan, S., "Enzyme technology" I. K. International PvtLtd,2009.
2. Voet and VoetJ.G, "Biochemistry", 4nd edition, John C.Wiley andSons,2010.

Code: 20EGMO3

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

(**B.E/B.Tech II/III Year** -Common to all Branches)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60Marks
CIE	40 Marks
Credits	3

Introduction

This course discusses the role of human values in one's family, in society and in nature. In the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes

By the end of the course,

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

The course has 28 lectures and 14 practice sessions:

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	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
CO 1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	-
CO 2	-	-	1	-	-	1	1	-	1	-	1	1	-	-	-
CO 3	--	-	-	-	-	1	-	-	-	1	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	1	-	-	-	-	1	1	1	1	-	-	-

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Unit 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:

a. At thelevel of individual: as socially and ecologically responsible engineers, technologistsand managers
b. At the level of society: as mutually enriching institutions and organizations

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment/Assessment by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher's manual
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. A Nagaraj Jeevan Vidya: EkParichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful"
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom -
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book)

20CEM01

ENVIRONMENTAL SCIENCE

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives:

To enable the student

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes:

At the end of the course, student is able to

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and affects of over utilization.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framingof legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	1	-	-	-	-	-	3	-	-	-	-	1	1	-
CO 2	1	-	-	-	-	-	2	1	-	-	-	1	-	-
CO 3	1	-	-	-	-	-	2	1	-	-	-	1	-	-
CO 4	1	-	-	-	-	1	2	1	-	-	-	1	1	-
CO 5	1	-	-	-	-	1	2	1	-	-	-	1	-	-

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, “Introduction to Environmental Science”, B S Publications, 2004.
2. Suresh K. Dhameja, “Environmental Studies”, S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao,” Environmental Pollution Control Engineering”, Wiley, 1991.
2. S. S. Dara, “A Text Book of Environmental Chemistry &Pollution Control”, S. Chand Limited, 2006

20BTC15
BIOPROCESS ENGINEERING LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

To provide the hands-on training to students to practically see the integrated bioprocess operations right from the beginning of medium preparation to fermenter operation

Course Outcomes:

At the end of the course the students are able to

1. Describe the importance of media and other rheological parameters duringfermentation process
2. Analyze the difference between batch and fed batch processes
3. Demonstrate the preparation of media and its optimization usingstatistical techniques
4. Estimate the growth kineticsof microorganisms.
5. Determine the mass transfer coefficient in fermentation

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / PSO / CO	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
CO 1	3	3	2	2	2	3	3	3	3	3	1	2	2	3
CO 2	3	2	3	2	2	2	3	3	3	3	2	2	3	3
CO 3	3	3	3	3	3	3	3	3	3	3	2	2	3	3
CO 4	3	3	3	3	2	3	3	3	3	3	2	2	3	3
CO 5	3	3	3	3	2	3	3	3	3	3	2	2	3	3

List of Experiments:

1. Study of rheological parameters infermentation broth
2. Study of batch and fed-batchfermentation processes
3. Estimation of Specific growth rate and doubling time of amicroorganism
4. Estimation of Monod parameters and determine thegrowth kinetics (Structured)
5. Bioreactor instrumentation andits control
6. Study of enzyme immobilization and determine itsactivity (Structured)
7. Media optimization by using Plackett-Burmandesign (Open)
8. Production of citric acid by *Aspergillus niger*and its estimation bytitrimetric method
9. Substrate utilization and productformation kinetics
10. Determination of KLa by Sulphiteoxidation method

With effect from the Academic Year 2021-22

20BTC16
IMMUNOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

A student identifies significance of blood grouping.

1. The applications of Antigen-antibody agglutinationare demonstrated.
2. The applications of Antigen-antibody Precipitationare demonstrated.
3. Students learn about diagnostic kits basedon immunology.
4. Students learn tointerpret results.

Course Outcomes:

At the end of the course, students will be able to

1. Demonstrate how Antigens and Antibody interact
2. Identify agglutination and precipitation reactions.
3. Interprets the results based on the results of the antigen-antibody interaction.
4. Analyze the importance of different Immunological techniques developed.
5. Outline the importance of blood group matching in blood transfusions and other cases are practically demonstrated.
6. Differentiate the B-cells and T-cells

PO / PSO / CO	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
CO 1	3	2	3	2	3	2	1	2	3	3	2	3	3	2
CO 2	2	2	3	2	3	2	1	2	3	3	2	3	3	1
CO 3	2	2	3	3	2	1	2	1	2	2	1	3	3	1
CO 4	3	2	3	2	3	2	-	1	2	2	1	3	3	1
CO 5	2	1	2	2	3	2	-	1	2	2	1	3	3	1

List of Experiments:

1. ABO Blood Grouping and Identificationof Rhtyping
2. Rocketimmune electrophoresis
3. Ouchterlony Double Diffusion for AntigenAntibody Patterns (ODD)
4. Immuno-electrophoresis (IEP)
5. Radial ImmuneDiffusion test (RID)
6. Widal test
7. VDRL tests
8. Total and Differential count of RBC & WBC byMicropipette method
9. Erythrocyte sedimentationrate
10. Enzyme Linked Immuno sorbent Assay (ELISA) for Antigen capture andAntibody capture.
11. Estimation of Immunoglobulins by Precipitation with Saturated Ammonium Sulphate.
12. Isolation and microscopic visualization of T cells and B cells.

Lab Manual:

1. Arti Nigam and Archana Ayyagari, Lab Manual in Biochemistry, "Immunology and Biotechnology", Tata McGraw HillEducation,2007.
2. S.Ramakrishna and K.N.Sulochana,"Manualof Medical Laboratory Techniques",1st edition,J.P.MedicalLtd,2013.

20BTC17
INSTRUMENTATION LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

With help of this course, Students are expected to

1. Understand the basic concepts for the operation of pH andspectrophotometer.
2. Estimate the micro and macro molecules by using chromatographytechniques.
3. Separate the biomolecules with the application of different methods ofelectrophoresis.

Course Outcomes:

At the end of the course, students will be able to

1. Apply the instrumentation techniques to their real-lifeapplications
2. Demonstrate the preliminary identification of biomolecules by partition chromatographymethod
3. Design the experiment to find the molecular weight of an unknownprotein
4. Examine the analytes by using UV-Visible spectrophotometer, Conductivity meter, Nephelometer, andflame photometer
5. Justify their results on the separation of biomolecules by differential centrifugation methods

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	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
CO 1	3	2	3	2	2	2	1	1	3	1	3	3	3	3
CO 2	2	1	2	2	1	1	1	1	3	1	3	3	3	3
CO 3	2	1	2	2	1	1	1	1	3	1	3	3	3	3
CO 4	2	1	2	2	1	1	1	1	3	1	3	3	3	3
CO 5	2	1	2	2	1	1	1	1	3	1	3	3	3	3

List of Experiments

1. The calibration of pH meter and measurement of pH for differentsolutions
2. Estimation of Ascorbic acid by colorimetricassay
3. Estimation of unknown samples by using a conductivitymeter
4. Estimation of different macromolecules by visiblespectrophotometer
5. Verification of Lambert - Beers law by UV -VISspectrophotometer
6. Estimation of proteins and nucleic acids by UVmethod
7. Estimation of turbidity usingNephelometer
8. The separation of different macromolecules by Thin layer chromatography (Structuredenquiry)
9. The separation of different macromolecules by paper chromatography (Open-ended)
10. The separation of different macromolecules bySDS-PAGE
11. Estimation of minerals byFlame photometry
12. Estimation of Thiamine and Riboflavin byFluorimetry
13. Preparation of Standard curve using UV-VIS & FlamePhotometry
14. Fractionation of Plasma Proteins byElectrophoresis
15. Membrane protein extraction by differentialcentrifugation

Suggested Reading:

1. Sivasankar, Instrumental Methods of Analysis, Oxford higher education, OUP, India,2012.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of V Semester of B. Tech Bio-Technology
as per AICTE Model Curriculum 2022-23
B. Tech (Bio-Technology)

SEMESTER V

S.No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
THEORY									
1	20BTC18	Fluid Mechanics and Heat Transfer	3	-	-	3	40	60	3
2	20BTC19	Genetic Engineering and rDNA Technology	3	-	-	3	40	60	3
3	20BTC20	Plant Biotechnology	3	-	-	3	40	60	3
4	20MTC24	Biostatistics	3	-	-	3	40	60	3
5	20BTC21	Introduction to Anatomy and Physiology of Humans	3	-	-	3	40	60	3
6		**Open Elective-I**	3	-	-	3	40	60	3
7	20EGM02	Indian Traditional knowledge	2	-	-	2	-	50	Non-credit
PRACTICALS									
8	20BTC22	Fluid Mechanics and Heat Transfer Lab	-	-	2	3	50	50	1
9	20BTC23	Genetic Engineering Lab	-	-	2	3	50	50	1
10	20BTC24	Plant Biotechnology Lab	-	-	2	3	50	50	1
11	20BTI02	Industrial / Rural Internship -II	3-4 weeks/ 90 hours				-	50	2
		Total	**20**	**-**	**6**				**23**
Clock Hours Per Week – 26									

L: Lecture **T: Tutorial** **P: Practical**

CIE – Continuous Internal Evaluation **SEE – Semester End Examination**

Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075

FLUID MECHANICS AND HEAT TRANSFER 20BTC18

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in flow of fluids, flow field, flow past immersed bodies.
2. The course is designed to give an understanding on measurement of viscosity, flow measuring devices.
3. The course also deals with basic concepts in heat transfer, evaporation and condensation.

Course Outcomes:

At the end of the course students will be able to

1. Measure the viscosity of different fluids in bio processing.
2. Derive a relation between pressure drop and viscosity.
3. Compare and contrast the merits and demerits of different flow measuring devices.
4. Calculate the rate of heat transfer through various geometries.
5. Calculate the overall heat transfer coefficient in different evaporators and condensers.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	0	1	2	0	2	0	0	0	0	1	3	3
CO2	2	1	0	1	0	0	0	0	0	0	0	1	3	3
CO3	2	2	0	1	2	2	2	0	0	0	0	1	3	3
CO4	2	1	0	1	2	2	2	0	0	1	0	3	3	3
CO5	2	1	1	1	2	2	2	0	0	1	0	3	3	3

UNIT-I

Basic Concepts in Flow of Fluids: Introduction, Nature of fluid, Rheology of fluids -Newton's law of viscosity; Concept of Newtonian and non-Newtonian fluids-Different types of non-Newtonian fluids with examples in bioprocessing; Measurement of viscosity using impeller viscometer, plate and cone viscometer, coaxial cylinder viscometer etc.

UNIT-II

Flow Field: Friction losses in laminar flow through a circular tube (Hagen-Poiseuille equation), Friction losses in turbulent flow (Fanning equation), Pumping of fluids flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow – characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen - Poiseuille equation.

UNIT-III

Flow Past Immersed Bodies: Definition of drag and drag coefficient; Friction in flow through beds of solids(Ergun Equation); Brief introduction to flow of compressible fluids; Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box; Flow measuring devices-manometers, orifice-meter, venturimeter and rotameter; Brief description of Pumps(principal of centrifugal and positive displacement pumps) and Blowers.

UNIT-IV

Basic Concepts in Heat Transfer: Introduction and Mechanisms of heat transfer; Conduction heat transfer (through slab, cylinder & Sphere); Conduction through solids in series, Forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and Biological materials; Heat transfer correlations and calculations, basic heat exchange equipment.

UNIT-V

Basic Concepts in Evaporation and Condensation: Introduction, Types of evaporation equipment and operation methods; Overall heat transfer coefficients in evaporators; simple material balances; Calculation methods for single effect evaporators, Evaporation of biological materials; Types of condensation, numerical problems and condensation equipment.

Text books:

1. W L McCabe and JC Smith, "Unit operations in Chemical Engineering", 6th edition, cGraw Hill Intl. Ed, 2005.
2. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall India Pvt. Ltd. 1993

Suggested Reading:

1. Kothandaraman CP, Rudramoorthy R, "Basic Fluid Mechanics", New Age International Publishers, New Delhi,1998.
2. Sachdeva RC, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996.
3. Pauline M. Doran, "Bioprocess Engineering Principles", Academic press, 1995.

Head
Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075.

Text Books:

GENETIC ENGINEERING AND rDNA TECHNOLOGY

20BTC19

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To provide theoretical concepts, basic principles and tools used in rDNA technology.
2. To learn essential features and various vectors used in gene cloning and rDNA technology.
3. To learn the principle, methodology and applications of PCR and molecular markers.
4. To learn the range of cloning strategies those are employed to clone a DNA sequence.
5. To know how rDNA technology is used to produce proteins.

Course Outcomes:

At the end of the course, students will be able to

1. Explain the basic principles and tools used in rDNA research starting from the isolation of nucleic acid, enzymes etc.
2. Compare various types of cloning vectors and expression vectors and their use in rDNA technology.
3. Discuss the principle, types and applications of PCR and molecular markers.
4. Describe the cloning strategies and sequencing methods.
5. Summarize the high-level expression of proteins in different hosts and production of recombinant proteins for the human welfare

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	1	0	0	0	0	1	0	1	1	2
CO2	1	1	0	0	1	0	0	0	0	1	0	1	1	2
CO3	1	1	0	0	1	2	0	0	0	1	0	1	1	2
CO4	1	1	0	0	1	2	0	0	0	1	0	1	1	2
CO5	1	1	1	0	1	2	1	3	0	1	0	1	1	2

UNIT-I

Isolation and Purification of DNA and Enzymes Used in Cloning: Isolation and purification of nucleic acids (genomic/plasmid DNA& RNA), quantification and storage of nucleic acids; Agarose gel electrophoresis; Enzymes used in genetic engineering - Restriction enzymes – Exo and Endo nucleases, Methylases, Polymerases, Ligase, Phosphatase, Kinase, DNase, RNase; Homopolymer tailing, Linkers & Adaptors; Restriction mapping; Blotting techniques – Southern, Northern and Western Blotting.

UNIT-II

Cloning Vehicles: Essential features of cloning vectors; Cloning vectors - Plasmid vectors - pBR 322, pUC 18/19; Phage vectors – λZAP, λEMBL4; M13 derived vectors –M13mp18; Phagemid- Blue script vectors; Cosmid- pJB8; Artificial chromosomes - BAC, YAC; Viral Vectors – SV40, Baculovirus, Retrovirus; Ti-Plasmid; Expression vectors - pET vectors.

UNIT-III

Polymerase Chain Reaction and Molecular Markers: PCR – Principle, Designing of primers, PCR Methodology, RT-PCR, Multiplex PCR, PCR for site-directed mutagenesis, Applications of PCR; Molecular marker – RFLP, RAPD, AFLP.

UNIT-IV

Cloning Strategies and DNA sequencing: Construction of cDNA and Genomic library; Gene transfer techniques: biological methods, chemical methods, physical or mechanical methods, Agrobacterium- mediated gene transfer in plants; Detection o clones with the desired gene; DNA Sequencing-Chain termination DNA Sequencing, Pyro sequencing, automation of DNA sequencing.

UNIT-V

Expression of Recombinant Proteins and Applications of rDNA Technology: High-level expression of proteins in different host systems in E. coli, yeast, insect and mammalian cells; Applications of rDNA Technology - Recombinant Insulin, Recombinant Factor VIII, Golden rice. Introduction to Gene therapy (Ex vivo & In vivo), case study of ADA as an example. Safety guidelines for rDNA research.

Text Books:

1. Brown, T.A., "Gene Cloning and DNA Analysis: An Introduction", 7th edition. Wiley Blackwell, 2016.
2. Primrose, S.B., Twyman, R.M., "Principles of Gene manipulation and Genomics", 7th edition, John Wiley & Sons,2013.
3. Glick, B.R., Patten, C.L, "Molecular Biotechnology: Principles and applications of Recombinant DNA", 6th edition, ASM Press,2022

Suggested Reading:

1. Desmond S T Nicholl, "An Introduction to Genetic Engineering", 3rd edition, Cambridge End Press, 2008.
2. Richard J. Reece, "Analysis of Genes and Genomes", Wiley, 2004.

Text Books:

PLANT BIOTECHNOLOGY 20BTC20

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The course aims to

1. Enable the students to understand explicitly the basic concepts and applications of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for the production of secondary metabolites in vitro using plant cell and tissue culture.
4. To understand the methods of gene transfer in plants for the production of Transgenics.
5. To understand the various strategies and sources of transgenes for crop improvement.

Course Outcomes:

At the end of the course, the students are able to

1. Describe the theoretical concepts behind the establishment of in vitro techniques.
2. Explain the importance and applications of various in vitro techniques.
3. Identify methods used for the production of plant secondary metabolites in in vitro at a commercial scale.
4. Analyze the appropriate vectors and gene transfer methods for the production of Transgenics.
5. Outline the strategies for the production of transgenics for crop improvement and environmental concerns.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	1	1	0	2	1	0	0	0	1	2	1
CO2	1	0	0	1	1	2	1	1	0	0	0	1	2	2
CO3	1	1	0	0	1	2	1	1	0	0	1	1	3	3
CO4	1	0	0	1	1	2	1	1	0	0	0	1	3	3
CO5	1	0	0	0	1	2	1	1	0	0	1	1	3	3

UNIT-I

Introduction To Plant Tissue Culture: Introduction to cell and tissue culture: History, Totipotency, Plasticity, Cell Theory, Tissue culture media (composition, preparation); Sterilization techniques; Callus and cell suspension culture; Organogenesis and Embryogenesis and their applications.

UNIT-II

Tissue Culture In Crop Improvement: Micropropagation of virus-free plants; Somaclonal variation; Haploids in plant breeding; Genetic fidelity of plants raised through tissue culture; Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion, Somatic hybridization and its applications.

UNIT-III

Molecular Farming & Industrial Products: In vitro production of short-chain and long-chain fatty acids; Industrialenzymes; Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems, Precursor feeding (elicitation), and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV

Plant Genetic Engineering - I Techniques: Agrobacterium-mediated gene transfer; Plant vectors and their use in genetic manipulation; Direct gene transfer methods: electroporation, microinjection, particle bombardment, and chemical methods. Marker-free transgenics and environmental, social and legal issues associated with transgenic plants.

UNIT-V

Plant Genetic Engineering - II Productivity and Safety Regulations: Transgenics in crop improvement: Biotic Stress resistance: Herbicide, Insect, Disease, virus, etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutritional quality, storage, and longer shelf life. Edible vaccines and Nutraceuticals; Environmental impact and gene flow.

Text Books:

1. Bhojwani SS and Razdan, "Plant Tissue Culture Theory and Practice", Elsevier Science, 2004.
2. Chawla HS, "Introduction to Plant Biotechnology", 4th edition, Oxford and IBH Publishers, 2002.

Suggested Reading:

1. Nigel G Halford, "Plant Biotechnology: Current and future applications of genetically modified crops", John Wiley & Sons Ld. 2006
2. Surabh Bhatia, Kiran Sharma, RandhirDahiya and, TanmoyBera, "Modern Applications of Plant Biotechnology in Pharmaceutical Sciences", Elsevier publication, Academic press, 2015.

Text Books:

BIOSTASTICS
(For Bio-Technology only)

Instruction	3 L +1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Learn the language and core concepts of probability theory.
2. Understand basic principles of Random variable and probability distributions
3. Understand the concept of Statistical Inference
4. Understand the construction of fitting of linear curves.
5. Learn the methods for analyzing one way classification of data.

Course Outcomes: On the successful completion of this course, the student shall be able to

1. Use basic counting techniques to compute probability
2. Compute conditional probabilities using Bayes Theorem
3. Analyze the probability function using statistical averages
4. Distinguishing the data using different methods of hypothesis
5. Analyze the data using analysis of variance technique

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	2	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	2	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-

UNIT-I

Basic Statistics: Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution, Measures of central tendencies, Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance, Measures of dispersion, Skewness, Kurtosis-Boweyls coefficient, Karl Pearson's coefficient of skewness- correlation-Lines of regression.

UNIT-II

Probability: Classical approach- Axiomatic approach of probability, Basic theorems addition and product theorem, conditional probability, Baye's theorem.

UNIT-III

Probability Distributions: Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties. Probability function-Moment generating function (mgf), Cumulant generating function(cgf) Discrete Distributions- Binomial distribution, Poison distribution-their Expectation, variance, mgf, cgf Continuous distributions: Normal Distribution- mean, variance, m.g.f and c.g.f. Properties of Normal curve. Exponential Distribution, Expectation variance, m.g.f and c.g.f.

UNIT- IV

Inferencial Statistics: Parameter and Statistic, Tests of significance, tests of significance for large samples. Tests of significance for single proportion, and difference of proportions. Tests of significance for single mean and difference of means. Small sample test, t-test for single mean and differences of Means. F-test for equality of two population variances.

UNIT-V

Hypothesis Testing: Testing of many proportions-χ^2 – test independent of attributes-r x c-tables. Analysis of variance-CRD.

Text Books:

1. S.C.Gupta and Dr.V.K.Kapoor, "Fundamentals of Applied Statistics", tenth edition, Publishers: Sultan Chand & Sons,2005
2. P.S.S Sunder Rao and J.Richard,"Introduction to Bio-Statistics and Research Methods" fifth edition, PHI Learning Pvt. Ltd.2012.

Suggested Reading:

1. Mahajan, "Methods in Bio-Statistics",Japee Brothers Publishers, 2002.
2. A.K.Sharma ,"Text Book of Bio-Statistics"; Discovery Publishing House, 2005.
3. S.C.Gupta and Dr.V.K.Kapoor,"Fundamentals of Mathematical Statistics: A Modern Approach", tenth edition, Publishers: Sultan Chand & Sons,2005.

INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS

Text Books:

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Student gets an overview of the human body tissues and endocrine system.
2. The various organs associated with skeletal, muscular, digestion and excretion is taught.
3. Heart structure and functioning is detailed, including the gaseous exchange occurring through the respiratory system.
4. Knowledge of Spinal cord, the associated nerves and the different sense organs are imparted.
5. Reproductive anatomy and physiology is explained.

Course Outcomes:

At the end of the course the students are able to

1. Outline the structure of Human body and explain the structure and function of endocrine glands
2. Discuss the anatomical structures and the physiological functions of Skeletal, Muscular and digestive systems.
3. Explain the anatomical structures and the physiological functions of excretory, circulatory and respiratory system.
4. Describe the anatomical structures and the physiological functions of nervous system and other sensory systems.
5. Discuss the anatomical structures and the physiological functions of reproductive system and physiology of blood

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO2	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO3	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO4	1	0	0	0	0	2	0	0	0	1	0	1	1	1
CO5	1	0	0	0	0	2	0	0	0	1	0	1	1	1

UNIT-I

Introduction to Anatomical Terms and Endocrine Glands: Definition of Anatomy and Physiology; Major types of Human tissues. Various systems of human body and their general roles; Homeostasis; Types of endocrine glands, Anatomy and physiological of pituitary, thyroid, pancreas.

UNIT-II

Anatomy and Physiology of Skeletal, Muscular and Digestive System: Structure and function of bones, Bone cells - osteoblasts, osteocytes, and osteoclasts; Structure and function of muscles, Histology of Muscle Fibers, Sarcomere; Digestive system- organs and functions; role of liver and pancreas.

UNIT- III

Anatomy and Physiology of Excretory Systems, Circulatory and Respiratory Systems: Excretory system-kidney and urinary bladder, physiology of excretory system- urine formation; Circulatory system- anatomy of heart, heartbeat, blood circulation Anatomy of blood vessels- arteries and veins. Respiratory system-anatomy of lungs and mechanism of respiration.

UNIT-IV

Anatomy and Physiology of Nervous System and Other Sensory Systems: Nervous system- peripheral and autonomous nervous system; Spinal nerves and Cranial nerves, transmission of nerve impulse, reflex arc. Special senses- eye, ear, tongue and nose.

UNIT-V

Anatomy and Physiology of Reproductive System and Blood Physiology: Mechanism of blood oxygenation, Blood pressure recording and regulating techniques, Reproductive system- male and female reproductive organs and physiology. Menstrual cycle

Text Books:

1. Cinnamon VanPutte, Jennifer Regan, Andrew Russo, Rod Seeley Trent Stephens, Philip Tate "Seeley's Anatomy and Physiology" 12th edition, McGraw Hill education
2. Elaine N. Marieb "Essentials of Human Anatomy and Physiology", 8th Edition, Pearson Education, New Delhi 2006

Suggested Reading:

1. Eric Widmaier, Hershel Raff, Kevin "Vander's Human Physiology: The Mechanisms of Body Function" McGraw-Hill Science/Engineering/Math; 13th edition2013.
2. Anthony A. Goodman – "Understanding the Human Body_ An Introduction to Anatomy and Physiology"-The Teaching Company (2004)

20EG M02 **With effect from the Academic year 2022-23**

INDIAN TRADITIONAL KNOWLEDGE

Instruction	2 L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	No credit

Prerequisite: Knowledge on Indian Culture

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes: After completion of this course, students will be able to:

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient, medieval and modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, Introduction to Mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health

Text Books:

1. Kapil Kapoor, **Text and Interpretation: The Indian Tradition,** ISBN: 81246033375, 2005
2. Samskrita Bharati, **Science in Samskrit**, ISBN-13: 978-8187276333, 2007
3. Satya Prakash, **Founders of sciences in Ancient Indi**a, GovindramHasanand, ISBN-10: 8170770009, 1989
4. Brajendranath Seal, **The Positive Sciences of the Ancient Hindus**, MotilalBanarasidass, ISBN-10: 8120809254, 1915
5. KanchaIlaiah, Turning the Pot, Tilling the Land: Dignity of Labour in Our Times

Suggested Readings:

1. Swami Vivekananda, Caste, Culture and Socialism, AdvaitaAshrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, Religion and Culture, AdvaitaAshrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor,Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn,ISBN: 978-0143426158, 2016
5. Swami Vivekananda, The East and the West, AdvaitaAshrama, Kolkata 9788185301860
6. Srivastava R.N., Studies in Languages and Linguistics, Kalinga Publications ISBN-13: 978-8185163475
7. SubhashKak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama, IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. Examinations in ancient India, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsi dass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020
12. Shashi Tharoor, The Hindu Way
13. Amartya Sen, Argumentative Indian

SWAYAM/Nptel:

1. History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
2. Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
3. Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
4. Language and Society - https://nptel.ac.in/courses/109/106/109106091/
5. Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
6. Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
7. Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

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Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075

20BTC22

FLUID MECHANICS AND HEAT TRANSFER LAB

Instruction	2P Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. This lab course is designed to understand the mechanics of fluid flow, analysis of various processes viz., Flow measuring devices (Venturimeter, Mouthpiece, and Triangular notch.) and heat exchangers.

Course Outcomes:

At the end of the course the students are able to

1. Calculate the coefficient of discharge of different flow measuring devices and Reynold's Number based on the distinction between the types of flow.
2. Determine the friction losses in pipe fittings & verify Bernoulli's Theorem.
3. Predict the Thermal conductivity of homogeneous wall insulating powder under steady stat e conditions.
4. Determine the heat transfer coefficient in Natural and Forced convection using PIN FIN apparatus.
5. Predict the emissivity of a non -black surface.
6. Calculate the overall heat transfer coefficient for parallel flow and counter flow in a Double pipe heat exchanger.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	2	0	1	0	0	2	0	3	3	3
CO2	2	1	1	2	2	2	1	0	0	2	0	3	2	3
CO3	2	1	1	2	1	0	0	0	0	2	0	2	2	1
CO4	2	1	1	2	1	2	1	0	0	2	0	3	2	1
CO5	2	1	1	2	1	2	1	0	0	2	0	3	3	3
CO6	2	1	1	2	2	2	1	0	0	2	0	3	3	2

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

1. Determination of discharge coefficient for orifice meter and venturimeter and their variation with Reynolds number.(CO1)
2. Determination of discharge coefficient for Mouth piece for constant head method and time of fall method(CO 1)
3. Determination of weir meter constant K for v-notch and rectangular notch (CO 1)
4. Calibration of rotameter and study of variation of flow rate with tube to float diameter (CO 1)
5. Determination of viscosity of different fluids (CO 1)
6. Determination of friction losses in pipe fittings (CO 2)
7. Determination of Reynold's Number based on the types of flow. (CO 2)
8. Verification of Bernoulli's Theorem (CO 2)
9. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions. (CO 3)
10. Determination of heat transfer coefficient in Natural convection.(CO 4)
11. Determination of heat transfer coefficient in forced convection.(CO 4)
12. Determination of emissivity of non black surface.(CO 5)
13. Determination of Overall heat transfer coefficient for parallel flow in a double pipe heat exchanger.(CO 6)
14. Determination of Overall heat transfer coefficient for counter flow in a double pipe heat exchanger.(CO 6)

Suggested Reading:

1. WLMcCabeandJCSmith,"UnitoperationsinChemicalEngineering",6th edition,McGrawHillIntl.Ed, 2005

20BT C23 **With effect from the Academic year 2022-23**

GENETIC ENGINEERING LAB

Instruction	2P Hoursper week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To know the isolation and analysis of DNA.
2. To know the incision of DNA by using the restriction endonucleases.
3. To learn the amplification DNA by polymerase chain reaction
4. To understand the cloning strategies of DNA.
5. To know about DNA sequencing and expression of recombinant protein from transformed bacterial cultures.

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate the isolation and visualization of nucleic acids. (Expt. 1,2,3)
2. Characterize the DNA by restriction digestion and restriction mapping. (Expt. 4,5)
3. Plan different steps involved in cloning strategies of DNA (Expt. 6,7,8,9,10)
4. Perform the polymerase chain reaction. (Expt. 11)
5. Analyze the DNA Sequencing and recombinant protein by using SDS PAGE (Expt. 12,13)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO2	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO3	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO4	1	1	0	1	1	2	1	2	2	1	0	2	2	2
CO5	1	1	0	1	1	2	1	2	2	1	0	2	2	2

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

1. Isolation of genomic DNA
2. Isolation of plasmid DNA
3. Visualization of Genomic and Plasmid DNA on Agarose gels
4. Restriction digestion
5. Restriction mapping(Structured Experiment)
6. Gel elution.
7. DNA ligation.
8. Preparation of competent cells.
9. Genetic transformation and screening for recombinant bacterial cells.
10. Blotting techniques- southern blotting.
11. Amplification of DNA fragments by Polymerase Chain Reaction (PCR).
12. DNA sequencing- Sanger's Method
13. Analysis of Recombinant Proteins using SDS-PAGE (Open ended experiment)

Suggested Reading:

1. Green MR and Sambrook J, "Molecular Cloning-A laboratory manual", Vol I, II and III, Cold spring \ Harbor Laboratory Press, 2012

PLANT BIOTECHNOLOGY LAB 20BTC24

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture
2. Develop their skills in plant tissues culture techniques in horticultural/medicinally important plants.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using Agrobacterium strains.

Course Outcomes:

At the end of the course, the students are able to

1. Prepare plant tissue culture medium for in vitro studies.(Expt 1,2)
2. Execute the protocols for Surface sterilization, Organ culture, and Callus induction using various explants.(Expt 3,4,5,10)
3. Develop in vitro techniques for micropropagation of meristem /nodal explants of horticulture and medicinal plants.(Expt. 6,7,8,9)
4. Demonstrate the Protoplast isolation from various plant tissues using enzymatic methods. (Exp.11)
5. Develop a system for genetic transformation in plants using Agrobacterium strains (Expt 12)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	1	-	-	-	-	-	-	1	-	2
CO2	1	1	-	1	1	-	-	-	-	-	-	1	-	2
CO3	1	1	-	1	1		2	-	-	-	-	-	2	3
CO4	1	1	-	-	-	2	-	-	-	-	-	1	-	2
CO5	1	1	-	-	1	-	2	1	-	1	-	2	2	3

Atleast 10 experiments to be conducted from the following list of experiments.

LIST OF EXPERIMENTS

1. Preparation of MS Stock solutions
2. Preparation of MS Plant Tissue Culture Media (Structured enquiry)
3. Surface sterilization
4. Callus induction from a mature embryo/ leaf/ root/anther. etc.
5. Cell suspension cultures initiation and establishment
6. Organogenesis and Embryogenesis
7. Meristem tip culture for production of virus-free plants
8. Micropropagation of horticultural/medicinally important plants(Open ended experiment)
9. Root induction and acclimatization of in vitro plantlets
10. Production of synthetic seeds.
11. Protoplast isolation (demo)
12. Agrobacterium-mediated gene transfer: induction of Hairy roots

Text Books:

1. H. Jones and John M. Walker, "Plant Gene Transfer and Expression Protocols: Methods in Molecular Biology, 49, Humana Press, 1996.
2. J. G. Chirikjian, Biotechnology: Theory and Techniques (Plant Biotechnology, Animal Cell Culture and Immunobiotechnology), Jones & Bartlett Publishers, U.K., 1996.

INDUSTRIAL / RURAL INTERNSHIP-II

Instruction	3-4 week
Duration of Internship	90 Hours
SEE	50 Marks
Credits	2

Schedule for the internship schedules will be given in a flexible manner according to the availability opportunities. The minimum and maximum requirement regarding Internship duration and credits is given in Table-1

Table 1: Internship Frame work

Schedule	Activities	Duration	Credits
Summer / Winter vacation (4^{th}/ 5^{th} Semester)	Industrial / Govt. /NGO / MSME/ Rural Internship/ Innovation/ Entrepreneurship/ NSQF level 3, 4,5	3-4 weeks or 90 hrs	2 Credits

INTERNSHIP GUIDELINES:

a) Student's Diary/Daily Log: The students should record the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. Students shall be ready to show the diary to the Industry supervisor or the Faculty Mentor at any point of time. Failing to produce the same, Intern may be debarred for the remaining period of his/her internship. Daily diary needs to be submitted to Faculty Mentor at the end of Internship along with the attendance record and an evaluation sheet duly signed and stamped by the industry. Daily diary is evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary/log
- Adequacy & quality of information recorded
- Drawing, sketches, and data recorded.
- Thought process and recording techniques used
- Organization of the information

b) Internship Report: At the end of the internship, each student should prepare a comprehensive report to indicate what he/she observed and learned in the training/internship period. It should be signed by the internship supervisor. The report will be evaluated by the Industry Supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

EVALUATION OF INTERNSHIP:

The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the range of 1 to 10 where 1-Unsatisfactory; 10-Excellent)
b) Evaluation by faculty supervisor on the basis of site visit(s) or periodic communication (15 marks)
c) Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (25 marks))

Evaluation through Seminar presentation/Viva-Voce at the institute: Students will give a seminar based on his/her training report, before an Expert Committee constituted by the concerned department as per the norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology
Scheme of Instructions of VI Semester of B. Tech Bio-Technology as per AICTE ModelCurriculum2022-23
B.Tech (Bio-Technology)

SEMESTER VI

S.No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Durati on of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	20BTC25	Bioseparation Engineering	3	-	-	3	40	60	3
2	20BTC26	Bioinformatics and Computational Biology	3	-	-	3	40	60	3
3	20MBC01	Engineering Economics and Accountancy	3	-	-	3	40	60	3
4	20BTC27	Animal Biotechnology	3	-	-	3	40	60	3
5	20BTC28	Mass transfer Operations	3	-	-	3	40	60	3
6		**Professional Elective – II**	3	-	-	3	40	60	3
	PRACTICALS								
7	20BTC29	Bioseparation Engineering Lab	-	-	2	3	50	50	1
8	20BTC30	Bioinformatics and Computational Biology Lab	-	-	2	3	50	50	1
9	20BTC31	Animal Biotechnology Lab	-	-	2	3	50	50	1
10	20EGCO3	Employability Skills	-	-	2	3	50	50	1
11	20BTC32	Mini Project	-	-	1				1
Total			**18**	**0**	**9**				**23**
Clock Hours Per Week – 27									

L: Lecture **T: Tutorial** **P: Practical**

CIE – Continuous Internal Evaluation **SEE – Semester End Examination**

Professional Elective-II (Medical Biotechnology stream)	
20BT E06	Virology
20BT E07	Medical Biotechnology
20BT E08	Pharmaceutical Biotechnology
20BT E09	Cancer biology

Dept. of Bio-Technology

20BT C25 **With effect from the Academic year 2022-23**

BIOSEPARATION ENGINEERING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane-based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilization.

Course Outcomes:

At the end of the course the students are able to

1. Outline the key aspects of downstream processing of biotechnological process and develop process design for bio products.
2. Distinguish the various techniques of cell disruption and unit operations for separation of bio products.
3. Compare and contrast various membrane separation processes.
4. Interpret application of various chromatographic process for separation of bio products.
5. Analyze various product finishing techniques and case studies of important bio products

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO2	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO3	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO4	2	2	2	3	1	0	3	0	3	0	0	2	3	3
CO5	2	2	2	3	1	0	3	0	3	0	0	2	3	3

UNIT-I

Role of Downstream Processing in Biotechnology: Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Case study from a recent literature: Process design criteria for bio products and downstream process economics.

UNIT-II

Primary Separation and Recovery Processes: Cell Disruption methods for intracellular products- Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT-III

Product Enrichment Operations: Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and organic solvents; Adsorption processes.

UNIT-IV

Product Purification: Chromatographic separations- Principles, Classification, General description of column chromatography: GC and HPLC; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes.

UNIT-V

Finishing techniques: Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers, Lyophilization: principles and applications; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Sivasankar B, J M Asenjo, Separation processes in Biotechnology, Marcel-Dekker, 1993.
2. Keith Wilson, John Walker, John M. Walker, Principles and Techniques of Practical Biochemistry 5th edition Cambridge University Press, 2000.

Suggested Reading:

1. Noorala bettu Krishna Prasad, Downstream Process Technology by PHI publications.

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Gandipet, Hyderabad-500 075.

20BT C26 **With effect from the Academic year 2022-23**

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To provide elementary knowledge in bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases and sequence alignment.
3. To learn methods for determining the order of the nucleotide and predicting gene.
4. To aid in understanding structural bioinformatics and the Human genome project.
5. To understand the evolutionary relationship among organisms.

Course Outcomes:

At the end of the course, the students are able to

1. Explain various types of biological databases used for the retrieval and analysis of the information
2. Identify the methods used for sequence alignment and construction of the phylogenetic tree
3. Discuss genome sequencing and gene prediction tools.
4. Describe biochemical databases and protein structure prediction tools
5. Demonstrate docking methods for Identification of lead molecules

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	0	0	1	0	0	1	0	1	1	1
CO2	1	1	0	1	1	0	1	0	0	1	0	1	1	1
CO3	1	0	0	1	1	0	1	0	0	1	0	1	1	1
CO4	1	0	0	1	1	0	1	0	0	1	0	1	1	1
CO5	1	1	0	1	1	0	2	0	0	1	0	1	1	1

UNIT-I

Introduction to Bioinformatics and Biological Databases: Bioinformatics - Scope, and application of Bioinformatics; Biological databases - types of biological database, file formats for biological sequence (NCBI, EMBL, SWISSPROT, FASTA); Information retrieval from biological Databases. Sequence database search- FASTA, BLAST, various versions of BLAST and FASTA; Amino acid substitution matrices - PAM and BLOSUM.

UNIT-II

Sequence Alignments and Phylogenetic Analysis: Sequence Alignment - Local, Global alignment; Methods of pair-wise sequence alignment; Multiple Sequence alignment methods. Concept of evolutionary trees; Methods of Phylogenetic analysis, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis.

UNIT-III

Genome Sequencing and Gene Prediction: DNA sequencing, Genome Mapping; Genome sequencing, cDNA sequencing, Genome Sequence Assembly and tools; Genome Annotation; Human genome project; Basis of Gene Prediction, Gene Prediction Methods in Microbial genomes and eukaryotes, Other Gene Prediction Tools.

UNIT-IV

Structural Bioinformatics and Biochemical Databases: Protein structure basics, protein structure classification, visualization and comparison, protein secondary structure prediction, and protein tertiary structure prediction; Introduction to Biochemical databases – KEGG, BRENDA, MMDB

UNIT-V

Molecular Docking: Methods of Docking – Flexible and Rigid Docking, Applications and limitations of docking, Docking algorithms – Genetic algorithm, QSAR overview and its significance in Docking,

Text Books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005.
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rd edition, PHI Learning Private Limited, New Delhi,2010.

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication,2001.
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009.

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The Objectives of the Course are:

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes: After Completion of the Course, Student will be able to:

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

UNIT-I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

UNIT-II

Demand and Supply Analysis: Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III

Production and Cost Analysis: Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns; Internal and External Economies of Scale.Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features, Price Output Determination under Perfect Competition, Monopoly and Monopolistic Competition; Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Book-Keeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments. Ratio Analysis.

UNIT-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

Text Books:

1. Mehta P.L.,"Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 11th Edition, 2013.

Suggested Readings:

1. Panday I.M. "Financial Management", 11th edition, VikasPublishing House, 2015.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of a.India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

UNIT-V

ANIMAL BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Students are expected to understand the techniques used for animal cell culture.
2. Students will learn various steps involved in the establishment of primary culture, maintenance and scale-up of animal cells.
3. Students will know about the measurement of cell viability & cytotoxicity and cell death.
4. Students are expected to know about stem cells and their applications.
5. Students will know about IVF and embryo transfer, cloning and gene transfer methods for the generation of transgenic animals and their applications.

Course Outcomes:

At the end of the course, the students are able to

1. Explain the animal cell culture requirements and techniques.
2. Outline the establishment maintenance and scale-up of animal cell culture.
3. Discuss Stem cells and their applications and procedure for measurement of cell viability and cytotoxicity and cell death.
4. Explain various methods for IVF and embryo transfer, cloning and generation of transgenic animals and their applications.
5. Outline various applications of animal biotechnology.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1		2	1	2	1	2		2	1	3	3	3
CO2	1	1	1	2	1	2	1	1		2	1	3	2	3
CO3	1		1	3	1	3	1	3		2	1	3	3	2
CO4	1			2	1	3	1	2		2	1	3	2	3
CO5	2	1	1	3	1	3	2	3	1	2	1	3	3	3

UNIT-I

Animal Cell Tissue Culture: History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; Laboratory facilities for animal tissue culture; Aseptic techniques; the substrate on which cells grow; Treatment of substrate surfaces; Culture media for cells and tissues.

UNIT-II

Primary Culture and Cell Lines: Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines; Cell transformation; Bioreactors for animal cell culture; Scaling-up of animal cell culture.

UNIT-III

Stem Cells, Cell Viability and Toxicity: Stem cells, types of stem cells, embryonic stem cells and their applications; Measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, Necrosis.

UNIT-IV

Embryo Transfer, Cloning and Transgenic Animals: Artificial insemination, in vitro fertilization and embryo transfer; Cloning of animals - Reproductive cloning, Therapeutic cloning; Gene transfer or Transfection methods; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT-V

Applications of Animal Biotechnology: Application of animal cell culture; Mammalian cell products; viral vaccines produced from animal cell cultures. Three-dimensional culture; Tissue engineering.

Text Books:

1. Ian Freshney, R., "Culture of Animal Cells: A manual of basic technique and specialized applications" Seventh edition, John Wiley and Sons, 2016.
2. John Masters, "Animal Cell Culture: A practical approach" OUP Oxford, 2000.
3. Gupta P.K., "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint, 2013.

Suggested Reading:

1. Srivastava, A.K., Singh, R.K., Yadav, M.P., "Animal Biotechnology" Oxford & IBH Publishing Co. Pvt. Ltd., 2005.
2. Ranga, M.M., "Animal Biotechnology", 3 reprint, Agrobios, India, 2010.

UNIT-V

MASS TRANSFER OPERATIONS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To provide the students with knowledge about various unit operations such as absorption, distillation, extraction, leaching.
2. To give insight about various membrane separation processes such as adsorption, Ion-exchange, dialysis and the application of these unit operations in commercial aspects of biotechnology.

Course Outcomes:

At the end of the course the students are able to

1. Predict the rate of molecular diffusion in solids, liquids and gases.
2. Determine the number of trays needed for separation by Distillation.
3. Determine the number of trays needed for separation by Extraction and Leaching.
4. Calculate the rate and time of drying in constant head and falling rate methods.
5. Write the principles and application of membrane separation processes and understand the types of adsorbents.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	0	2	0	0	2	0	3	3	3
CO2	2	2	1	2	2	3	2	0	0	2	1	3	2	3
CO3	2	2	1	2	2	3	2	0	0	2	1	2	2	1
CO4	2	2	1	2	2	3	2	0	0	2	0	3	2	1
CO5	2	2	1	2	2	3	2	0	0	2	0	3	2	3

UNIT-I

Principles of Mass Transfer: Introduction to Mass transfer and Diffusion, Molecular diffusion in Gases, Molecular diffusion in Liquids, Molecular diffusion in Biological solutions and gels, Molecular diffusion in Solids, Inter phase mass transfer and Mass transfer coefficients. **Gas-Liquid operations:** Equilibrium relations between phases, Mass transfer between phases, Choice of solvent for absorption, Single stage and multi stage co current and counter current operations, Estimation of Mass transfer coefficient, packed columns and plate columns.

UNIT-II

Principles of VLE for Binary System: Phase rule and Raoul's law, Boiling point diagrams and x-y plots, Relative volatility, Flash distillation, Differential distillation, Simple steam distillation. Distillation with reflux and McCabe - Thiele method. Special Cases for rectification using McCabe - Thiele; Stripping column distillation, Enriching Column distillation, Rectification with direct steam injection, Rectification with single side stream.

UNIT-III

Liquid-Liquid Extraction and Leaching: Introduction to Extraction process: Equilibrium relations in extraction, Analytical and graphical solutions for single and multistage operations co-current and counter current operations without reflux. Equipment for liquid-liquid extraction: mixer settlers for extraction, Plate and Agitated Tower Contactors for Extraction, Packed and spray Extraction towers. Introduction to leaching process: Equilibrium diagrams for leaching, analytical and graphical solutions for single and multi-stage counter current operations.

UNIT-IV

Basic Concepts in Drying of Process Materials: Methods of drying, Equipment for drying; Free moisture content of materials; Concept of bound and unbound moisture content of biological materials; Rate of drying curves; Calculation methods for constant-rate & falling rate drying methods; Freeze drying of biological materials.

UNIT-V

Adsorption And Membrane Separation Process: Theory of adsorption, Industrial adsorbents, Adsorption equilibria, Frendlich equation-single and multiple operations- processing variables and adsorption cycles; Introduction and Types of Membrane separation process: Principles of ion exchange. Dialysis, Gas permeation membrane processes, types of membranes and permeability's for separation of gases, Introduction to types of flow in gas permeation.

Text Books:

1. C J Geankoplis, "Transport Processes in chemical Operations", 4th edition, Prentice Hall India, 2004
2. Robert E Treybal, "Mass Transfer operations", 3rd edition. McGraw-Hill, 1981
3. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7th Edn., McGraw Hill Book Co., New York, 2004.

Suggested Reading:

1. Jaime Benitez, "Principles and Modern Applications of Mass Transfer Operations", 2nd edition, 2009.
2. J M Coulson and J F Richardson, "Chemical Engineering", Vol-II, 3rd edition, Pergamom Press.

UNIT-V

VIROLOGY
(Professional Elective -II)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course objectives:

Students are made to understand the following concepts during their course of time:

1. To learn the morphology and genetics of viruses.
2. To recognize the procedures for cultivation of plant & animal viruses.
3. To be aware of the characterization of viruses.
4. To elaborate the detailed features of plant viruses and bacteriophages.
5. To earn the lifecycles of animal viruses and development of vaccines.

Course out comes:

By the end of the course the students are able to

1. Explain classification, morphology of viruses.
2. Compare the techniques for cultivation of plant & animal viruses.
3. Outline various characterization techniques for detection of viruses.
4. Illustrate the structural, functional and disease control measures of plant viruses.
5. Describe the classification, pathogenesis of animal viruses and therapeutic strategy for vaccine development.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	2	3	3	2	0	2	1	2	3	3
CO2	1	1	1	2	2	0	2	2	0	2	0	2	3	3
CO3	1	1	2	2	2	3	2	2	0	1	0	2	3	3
CO4	1	1	1	2	2	3	2	1	0	1	0	2	3	3
CO5	1	2	2	2	3	3	3	2	0	2	1	2	3	3

UNIT-I

Introduction to Virology: Brief outline of discovery of Viruses; Properties of Viruses; Morphology of Viruses- Structure, Capsid Architecture, Envelopes and peplomers; Chemistry of Viruses- Viral Proteins, Genome- Structure and Types; Study of sub viral agents- Brief account on Diseases caused by Viroids- PSTV,Cadang- cadang; Prions-Scrape, Creutzfeld t-jakob; Satellite viruses.

UNIT-II

Cultivation of Viruses: General methods of cultivation of viruses- in embryonated eggs, cultivation of animal and plant viruses; cultivation of bacteriophages, Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity.

UNIT-III

Characterization of viruses: Characterization of viruses-Electron microscopy, X-ray crystallography, sedimentation analysis. Enumeration of viruses By electron microscopy, plaqueassay,acid end point method, Haemagglutininassay; Detection of viruses-By serological characterization, detection of viral antigen, detection of viral nucleic acid; chemical determination, UltrastructureandlifecyclesofBacteriophages-Ml3,T4andlambda.

UNIT-IV

Plant Viruses: Taxonomy; Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control, bio pesticides with examples.

UNIT-V

Animal viruses: Taxonomy; Detailed structure and brief account on life cycles of RNA viruses- Polio, Influenza, Rotavirus, Corona viruses: Covid 19andHIV;Ultrastructureandbrief account on lifecycles of DNA viruses- Vaccina,SV40 and Hepatitis Virus; Viral vaccines-types and preparation of conventional vaccines.

Text Books:

1. Dimmock NJ and Primrose SB, "Introduction to Modern Virology", 4th edition, Blackwell Scientific Publications, 1994.
2. Matthews REF"Fundamentals of Plant Virology". Academic Press, San Diego, 1992.

Suggested Readings:

1. CarterJ and SaundersV "Virology: Principles and Applications" John Wiley and Sons ltd, 2007.
2. Morag C,TimburyM,Chrchill Livingstone, "Medical Virology", London,1994.

MEDICAL BIOTECHNOLOGY
(Professional Elective -II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the scope and importance of medical biotechnology
2. To understand the differences between the normal cells and cancer cells and various diagnostic methods used in cancer detection.
3. To gain the in-depth knowledge about the clinical applications of stems cells & tissue engineering.
4. The course aims at providing knowledge about the working principles and types of advanced materials used in medical field.
5. To learn current molecular therapies and bio ethical issues.

Course Outcomes:

At the end of the course the students are able to

1. Outline the various diagnosis and treatment of Cancer.
2. Explain the concepts of Stem cell therapy and Tissue engineering.
3. Discuss the principle and applications of biomedical devices and molecular diagnostics.
4. Classify the molecular therapies and bioethical issues.
5. Classify the molecular therapies and bioethical issues.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	1	1	2	0	1	2	0	1	0	3	3	3
CO2	1	1	2	2	2	2	1	3	0	2	0	3	3	3
CO3	1	1	1	1	2	3	1	3	0	2	0	2	3	3
CO4	1	1	1	2	2	0	1	0	0	2	0	1	3	3
CO5	1	0	0	2	2	3	0	3	0	2	0	2	3	3

UNIT-I

Introduction to Medical Biotechnology: Introduction, scope and importance of medical biotechnology; The genetic basis of the disease; chromosomal disorders; single gene disorders-modes of inheritance, Thalassemia,sicklecellanaemia,cysticfibrosis,Taysachsdisease,Fragile–X-syndrome;polygeneticdisorders;Alzheimersdisease, Type-1diabetisandmitochondrialdisorders (neurological disorders).

UNIT-II

Medical Oncology: Cancer types; Normal cells vs. cancer cells; cancer genetics; oncogenes and their proteins; tumor suppressor genes and their functions, diagnosis of cancer, Treatment of cancer; Radiation therapy, chemotherapy.

UNIT-III

Stem Cell Treatment and Tissue Engineering: Cellular therapy, stem cells- definition, types, properties and uses of stem cells; sources of embryonic and adult stem cells; Induced Pluripotent Stem cells, concept of tissue engineering; role of scaffolds;clinicalapplicationsofstemcells;stemcellbankingandethical issues.

UNIT-IV

Biomedical Instrumentation, Molecular Diagnostics and Biomarkers: Concepts in Biomaterials; principle, properties of Biomaterials and applications of different types of biomedical devices; pacemakers, drug coated stents, knee replacement implants, dental implants, prosthetics), molecular diagnostics by DNA approaches(Taq MAN approach, RT-PCR, Applications of biosensors in medicine. Cellular imaging, in vivo imaging of the biomarkers of the disease, epigenetic markers, fluid-based biomarkers, imaging-based biomarkers (PET, MRI).

UNIT-V

Molecular Therapeutics and Bioethical Issues: Types of molecular therapies; protein therapy by recombinant Monoclonal Antibodies, Enzymes (DNase-1,Alpha-1antitrypsin), Lactic acid bacteria by Leptin, antisense therapy, recombinant vaccines; Bioethical issues in IVF, surrogacy and cloning technologies.

Text Books:

1. JudithPongracz, MaryKeen, "MedicalBiotechnology", illustratededition, Elseiverhealthsciences, 2009.
2. BernardRGlick, CherylL.Patton, TerryL.Delovitch,"Medicalbiotechnology",1st edition,ASMpress, 2013.

Suggested Readings:

1. Truepenny, Emerys"ElementalMedicalGenetics", 14thedition, ChurchillLivingstone,2012.
2. R.J.B.King, Robins,"Cancerbiology",3rd edition,PrenticeHall, 2006.

UNIT-V

PHARMACEUTICAL BIOTECHNOLOGY

(Professional Elective -II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the origin, scope, and importance of pharmaceutical biotechnology.
2. To learn ADME properties of drugs, pharmacokinetics, pharmacodynamics, and drug deliverysystems.
3. To understand the materials and formulations of pharmaceuticals.
4. To learn the collection, processing, and storage of blood and plasma substitutes
5. To gain knowledge about pharmaceutical products and their use in the treatment of infectiousdiseases.

Course Outcomes:

At the end of the course, the students are able to

1. Summarize the fundamentals of biopharmaceuticals.
2. Explain the ADME properties of drugs, pharmacokinetics, pharmacodynamics, and drug deliverysystems.
3. Outline the different manufacturing procedures of drugs.
4. Discuss the blood and plasma substitutes.
5. Describe the therapeutic activity of drugs used for treating diseases

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	2	2	1		1	1	1	2	3	1
CO2	2	2	1	2	2	2	1		1	1	1	2	3	2
CO3	2	2	3	3	3	2	1		1	1	1	3	3	3
CO4	2	2	1	2	2	2	1		1	1	1	2	3	3
CO5	2	2	2	3	2	2	1		1	1	1	3	3	2

UNIT-I

Fundamentals of Biopharmaceuticals: Pharmaceutical Biotechnology: Definition, Scope, and Importance. Human protein replacements, Biosimilar (insulin analog), Therapeutic agents for human diseases: Tissue Plasminogen activator, Interferon, Recombinant vaccines, Clinical Trails and Regulations (Basic), History and development of Pharma covigilance.

UNIT-II

Biopharmaceutics and Pharmacokinetics: ADME properties- Physiochemical properties of Drug Absorption, Distribution, metabolism (Biotransformation), bioavailability, and Excretion. Pharmacokinetics and Pharmacodynamics. Basic considerations: Drug receptors, Drug interactions, Surgical supplies, Oral, Parenteral, Transdermal, Ophthalmic, Intravaginal, and Intrauterine Drug Delivery systems.

UNIT-III

The Drug Manufacturing Practices: Good manufacturing practices and facilities for drug production. Types of Tablets and capsules. Materials and Formulations for Manufacture of Tablets, Capsules. Excipients and its ideal properties, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols.

UNIT-IV

Blood and Plasma Substitutes: Collection, processing, and storage of whole human blood, concentrated human RBC, dried human plasma, Human plasma protein fraction, Dried human serum, Human fibrinogen, Human thrombin, Human Normal Immunoglobulin, Plasma substitutes- Ideal requirements, PVP, Dextran 40,controlofBloodproducts,Transfusionproducts, Blood and Plasma based bioproducts, Blood based and plasma-based Biomarkers.

UNIT-V

Pharmaceutical Products: Fundamentals of Therapeutic categories such as Analgesics, Antipyretic, Anti-inflammatory drugs, Anesthetics, Antacids, Alkaloids, Glycosides, Anti-neoclassic drugs, Biologicals (Immunizing agents and allergenic extracts), Anti-histamines, Electrolytes, and Diuretics, Chemotherapy of Tuberculosis and Urinary tract infections.

Text Books:

1. Purohit SS, Kakrani HN, and Saluja AK., "Pharmaceutical Biotechnology", Student Edition Jodhpur,2003.
2. Brahmankar, D.M., Sunil, B. Jaiswals - Biopharmaceutics & Pharmacokinetics a Treatise, 2nd edition, M.K. Jain Publication, Delhi,2009.
3. Cooper and Guns, "Pharmaceutics", CBS publishers, 1989.

Suggested Reading:

1. David B Troy and Paul Beringer, "Remington's: The Science and Practice of Pharmacy", Vol 1 and 2, LippincotWilliams & Wilkins Publications, 2006.
2. Tripathi, K.D. "Essentials of Medical pharmacology", Jaypee Brothers Medical Publishers 6th Edition, John Wiley, New

UNIT-V

CANCER BIOLOGY
(Professional Elective -II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the fundamentals of cancer biology.
2. To know the importance of physical and chemical carcinogens and their effects on cell cycle.
3. To learn the Molecular aspects of cell cycle control.
4. To learn the theories of metastasis, diagnosis and treatment of cancer.
5. To understand the principles of cancer pharmacology

Course Outcomes:

At the end of the course the students are able to

1. Summarize the etiology of cancer.
2. Explain the principles and mode of action of physical and chemical carcinogens.
3. Discuss the molecular genetics of cancer.
4. Outline the cancer metastasis, diagnosis and different forms of therapy
5. Describe the principles of cancer pharmacology.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	0	2	0	0	0	2	0	1	3	2
CO2	1	0	0	0	0	2	0	0	0	2	0	1	3	2
CO3	1	0	0	0	0	2	0	0	0	2	0	2	2	1
CO4	1	1	0	0	1	2	1	0	0	2	0	2	3	3
CO5	1	1	0	0	1	2	1	0	0	1	0	2	3	2

UNIT-I

Fundamentals of Cancer Biology: Introduction to cancer, origin and classification of different cancers, Hall marks of cancer, Cell cycle control, Regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitor. Two-Hit Hypothesis, Tumor suppressor genes. Case studies for carcinoma ex: breast cancer and stomach cancer, Diet and cancer.

UNIT-II

Principles of Carcinogenesis: Classical theory of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Laboratory chemicals induces carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT-III

Principles of Molecular Cell Biology of Cancer: Retroviruses and Oncogenes, Activation of proto-oncogenes to oncogenes. Identification of Oncogenes, Growth factor and Growth factor receptors (RTK's) that are oncogenes, signalling pathways in cancer (MAPK, WNT pathway).

UNIT-IV

Cancer Metastasis and Diagnosis: Seed & Soil theory, heterogeneity of metastatic phenotype, Metastatic cascade, clinical significance of invasion: angiogenesis and EMT, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion), cancer stem cells. Diagnosis of cancers, Advances in Cancer detection (Biomarkers technology and nanotechnology).

UNIT-V

Principles of Cancer Therapy: Different forms therapy- conventional therapy-Chemotherapy, Radiation therapy and immunotherapy, Advances in Cancer therapy – personalized, targeted therapies and Thermo therapy. Classification of antineoplastic drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. Introduction to cell and Molecular biology of cancer, Franks and Teich, Oxford medical Publications,2002.
2. Introduction to Cancer Biology, Robin Hesketh, Cambridge University Press, 2012.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rdedition, Prentice Hall, USA. 2003.
4. Molecular Biology of Cancer. Lauren Pecorina, 4th edition. Oxford University Press – 2016

Suggested Reading:

1. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garland Science. 2013
2. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Textbook readings; primary literature; in-class discussion. The Molecular Biology of Cancer: A Bridge from Bench to Bedside. Stella Pelengaris, Mike Khan -2nd Edition - 2013

UNIT-V

BIOSEPARATION ENGINEERING LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. To design protocol for separation of bioproduct based on characteristics

Course Outcomes:

At the end of the course the students are able to

1. Evaluate various techniques for cell disruption, filtration and separation of bioproducts. (Expt: 1-8,13)
2. Analyze the optimum protein precipitation technique. (Expt: 9)
3. Demonstrate chromatographic separation process for a given compound. (Expt: 10,11,12)
4. Apply a strategy for final product purification/ polishing of a bioproduct. (Expt: 14)
5. Develop methods for determining enzyme activity. (Expt: 15)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO2	2	2	1	2	1	3	2	0	2	0	0	2	3	3
CO3	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO4	2	2	1	2	1	0	2	0	2	0	0	2	3	3
CO5	1	2	1	2	1	0	2	0	2	0	0	2	3	3

At least 10 experiments to be conducted from the following list of experiments.

List of Experiments:

1. Cell Disruption of microorganism by Enzymatic method
2. Cell Disruption of plant cells / animal cells by Physical methods (Temperature or Osmolysis)
3. Cell Disruption of microorganism by Ultrasonication method
4. Separation of biomolecules by Aqueous two-phase extraction.
5. Separation of solids from liquid by Sedimentation and Centrifugation
6. Separation of microorganisms from fermentation broth by Microfiltration or ultra-filtration.
7. Separation of solute particles by Dialysis.
8. Separation of protein by Ammonium Sulphate Precipitation (Structured expt)
9. Isolation and quantification of protein from milk by Isoelectric Precipitation.
10. Separation of biomolecules by Gel Exclusion Chromatography.
11. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
12. Purification of proteins by Affinity Chromatography.
13. Separation of a binary mixture by simple distillation.
14. Purification of bio products by drying or crystallization
15. Estimation of Alpha amylase activity (open ended expt)

Suggested Readings:

1. David Plummer, "An introduction to Practical Biochemistry" 3rd edition, John Wiley & Sons
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith John Walker John Walker, Cambridge University Press; 6 edition(2005).
3. Laboratory Manual in Biochemistry By J. Jayaraman, Kunthala Jayaramanj, New Age International

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objective:

1. To provide practical instructions to the students on using the specific databases and learn how to use these resources on their own and analyze the output.

Course Outcomes:

At the end of the course, the students are able to

1. Retrieve the information from biological databases (Expt. 1,2)
2. Utilize BLAST, FASTA and other online tools (Expt. 3, 4)
3. Use online sequence alignment tools and construction of evolutionary tree by phylogenetic analysis (Expt. 5,6,7)
4. Predict gene and protein structure and design primers and construct restriction map. (Expt. 8, 9, 10, 11)
5. Retrieve macromolecular structures and perform docking of a ligand to its target (Expt 12, 13)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO2	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO3	1	1	0	1	1	0	0	0	0	1	0	2	1	1
CO4	1	1	0	2	1	0	0	0	0	1	0	2	1	1
CO5	1	1	0	2	2	0	0	0	0	1	0	2	1	1

Atleast 10 experiments to be conducted from the following list of experiments.

List of Experiments:

1. Searching Bibliographic databases for relevant information.
2. Sequence retrieval from DNA and protein databases.
3. BLAST services.
4. FASTA services.
5. Pair-wise comparison of sequences (Local and global alignment).
6. Multiple Sequence Alignment.
7. Evolutionary studies/ Phylogenetic Analysis.
8. Identification of Genes in Genomes.
9. NCBI ORF Finder.
10. Restriction Mapping (Structured enquiry)
11. Primer Design (Open-ended experiment)
12. Protein Databank retrieval and visualization.
13. Molecular docking with Auto docking Vina

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication,2001.

ANIMAL BIOTECHNOLOGY LAB

Instruction	2 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Students are expected to understand the sterility and aseptic conditions necessary for animal cell culture.
2. Students will learn various steps involved in maintenance and culture of animal cells.
3. Students will know about measurement of cell viability & cytotoxicity and cell death.

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate aseptic culture techniques and preparation of animal cell culture media. (Expt. 1, 3, 4)
2. Identify and enumerate animal cells by using microscopic techniques. (Expt. 2, 8)
3. Apply animal cell culture techniques to the establishment of primary culture. (Expt. 5, 6, 7)
4. Evaluate cell viability and cytotoxicity of animal cell culture. (Expt. 9, 10)
5. Perform the maintenance and preservation of animal cells. (Expt.11, 12, 13)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	3	2	3	1	3	-	3	1	3	2	3
CO2	2	1	-	2	2	3	1	3	-	3	1	3	3	3
CO3	2	1	-	3	2	-	1	1	-	3	1	3	2	3
CO4	1	-	-	2	2	3	1	3	-	1	1	2	3	3
CO5	1	1	-	3	2	3	1	3	-	3	1	3	3	3

Atleast 10 experiments to be conducted from the following list of experiments".

List of Experiments

1. Maintaining sterility and aseptic techniques within the animal biotechnology lab.
2. Microscopic visualization of Human Buccal Epithelial cells. (structured enquiry)
3. Separation of serum from whole blood.
4. Preparation of cell culture growth media
5. Primary culture of chicken embryo fibroblast culture.
6. Isolation of Hepatocytes from Chicken liver cells
7. Enumeration and counting of animal cells using a Haemocytometer.
8. Staining and microscopic visualization of adherent animal cells.
9. Evaluation of cell viability/cytotoxicity in animal cells.
10. Cell viability of cells using trypan blue dye. (Open ended experiment)
11. Trypsinization or subculture of the adherent cell line.
12. Cryopreservation of animal cells
13. Monitoring and trouble shooting of microbial contamination in animal biotechnology lab. (Open ended experiment)

Text Books:

1. Ian Freshney, R., "Culture of Animal Cells: A manual of basic technique and specialized applications" Seventh edition, John Wiley and Sons, 2016.
2. John Masters, "Animal Cell culture: A practical approach" OUP Oxford, 2000.
3. Gupta P.K., "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint, 2013

20EG CO3 **With effect from the Academic year 2022-23**

EMPLOYABILITY SKILLS

Instruction	2 P Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives: To help the students

1. Learn the art of communication; participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: By the end of the course**,** the students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

UNIT–I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT–II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence.

Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language -

Preparing an Effective PPT

UNIT–III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management- Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT –IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT –V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. LeenaSen, “Communication Skills”, Prentice-Hall of India, 2005
2. Dr.ShaliniVerma, “Body Language - Your Success Mantra”, S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , “Objective English”, 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
5. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989

MINI PROJECT

CIE	50 Marks
Credits	1

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 50 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 50 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 30 Marks

With effect from the Academic Year 2022-23

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology

Scheme of Instructions for VII Semester of B.Tech Bio-Technology as per AICTE Model Curriculum 2021-22

B.Tech (Bio-Technology)

SEMESTER-VII

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1	18BT C26	Downstream Processing	3	-	-	3	30	70	3
2	18BT C27	Plant Biotechnology	3	-	-	3	30	70	3
3	18MT C08	Biostatistics	3	-	-	3	30	70	3
4		**Core Elective V**	3	-	-	3	30	70	3
5		**Open Elective II**	3	-	-	3	30	70	3
	PRACTICALS								
6	18BT C28	Downstream Processing Lab	-	-	3	3	25	50	1.5
7	18BT C29	Tissue Culture Lab	-	-	3	3	25	50	1.5
8	18BT C30	Project Part 1	-	-	4	-	50	-	2
Total			**15**	**-**	**10**	**-**	**250**	**450**	**20**
Clock Hours Per Week – 25									

L: Lecture T:Tutorial P:Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Core Elective V	
18BT E13	Animal Biotechnology
18BT E14	Cancer Biology
18BT E15	Computer Applications in Bioprocess
18BT E16	Principles of data analytics

Open Elective II	
	Block chain technologies
18CS O04	Basics of Data Science Using R
18EG O01	Technical Writing
18EE O05	Waste Management

Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075

With effect from the Academic Year 2021-22

18BT C26

DOWNSTREAM PROCESSING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilisation.

Course Outcomes:

At the end of the course the students are able to

1. Explain the key aspects of downstream processing from both a technical and economic perspective.(BL 2)
2. Describe the various techniques of cell disruption and unit operations for separation of insoluble(BL 1)
3. Compare and contrast various membrane separation processes (BL 4)
4. Interpret application of various chromatographic process for separation of bioproducts (BL 5)
5. Analyze various case studies involving high throughput and low value , Low throughput and high value products (BL 4)

UNIT-I

Role Of Downstream Processing In Biotechnology: Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Process design criteria for bioproducts; Downstream process economics.

UNIT-II

Primary Separation And Recovery Processes: Cell Disruption methods for intracellular products-Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT-III

Product Enrichment Operations: Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and

organic solvents; Adsorption processes.

UNIT-IV

Product Purification: Chromatographic separations- Principles, Classification, General description of column chromatography; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes

UNIT-V

Finishing techniques: Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers, Lyophilization: principles and applications; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Sivasankar B, J M Asenjo, Separation processes in Biotechnology, Marcel-Dekker, 1993.
2. Keith Wilson, John Walker, John M. Walker, Principles and Techniques of Practical Biochemistry 5th edition Cambridge University Press, 2000.

Suggested Reading:

1. Nooralabettu Krishna Prasad, Downstream Process Technology by PHI publications.

18BT C27

With effect from the Academic Year 2021-22

PLANT BIOTECHNOLOGY

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

The aim of the course is to

1. Enable the students to understand explicitly the basic concepts and applications of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for production of secondary metabolites in in vitro using plant cell and tissue culture.
4. To understand the methods of gene transfer in plants for production of Transgenics.
5. To understand the various strategies and sources of trangenes for crop improvement.

Course Outcomes:

At the end of the course the students are able to

1. Describe the theoretical concepts behind establishment of in vitro techniques.
2. Explain the importance and applications of various in vitro techniques.
3. Identify methods used for the production of plant secondary metabolites in in vitro at commercial scale.
4. Analyze the appropriate vectors and gene transfer methods for production of Transgenics.
5. Outline the strategies for the production of transgenics for crop improvement and safety regulations.

UNIT-I

Introduction To Plant Tissue Culture: Introduction to cell and tissue culture: History, Totipotency, Plasticity, Cell Theory, Tissue culture media (composition, preparation); Sterilization techniques; Callus and cell suspension culture; Organogenesis and Embryogenesis and their applications.

UNIT-II

Tissue Culture In Crop Improvement: Micropropagation of virus-free plants; Somaclonal variation; Haploids in plant breeding; Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion, Somatic hybridization and its applications.

UNIT-III

Molecular Farming & Industrial Products: In vitro production of short chain and long chain fatty acids; Industrial enzymes; Edible vaccines. Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems, Precursor feeding (elicitation) and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV

Plant Genetic Engineering - I Techniques: Agrobacterium mediated gene transfer; Plant vectors and their use in genetic manipulation; Direct gene transfer methods: electroporation, microinjection, particle bombardment and chemical methods.

UNIT-V

Plant Genetic Engineering - II Productivity and Safety Regulations: Transgenics in crop improvement: Biotic Stress resistance: Herbicide, Insect, Disease, virus etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutritional quality, storage, longer shelf life. Environmental impact and gene flow.

Text Books:

1. Bhojwani SS and Razdan, "Plant Tissue Culture Theory and Practice", Elsevier Science, 2004.
2. Chawla HS, "Introduction to Plant Biotechnology", 4th edition, Oxford and IBH publishers, 2002.

Suggested Reading:

1. Nigel G Halford, "Plant Biotechnology : Current and future applications of genetically modified crops", John Wiley & Sons Ld. 2006
2. Surabh Bhatia, Kiran Sharma, Randhir Dahiya and, Tanmoy Bera, "Modern applications of Plant Biotechnology in Pharmaceutical Sciences", Elsevier publication, Academic press, 2015.

with effect from the Academic Year 2021-22

18MT C08
Bio-Statistics

(For Bio-Technology only) Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. Learn the language and core concepts of probability theory.
2. Understand basic principles of Random variable and probability distributions
3. Understand the concept of Statistical Inference
4. Understand the construction of fitting of linear curves.
5. Learn the methods for analyzing one way classification of data.

Course Outcomes: On the successful completion of this course, the student shall be able to
1. Compute counting techniques to Statistical Methods
2. Recite conditional probabilities using Bayes Theorem
3. Define and classify discrete and continuous Random Variables and Probability Distributions
4. Calculate confidence intervals and illustrate parameter estimation
5. Test the classification for analyzing the data

UNIT-I: DISCRIPTIVE STATISTICS: Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution, Measures of central tendencies, Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance, Measures of dispersion, Skewness, Kurtosis-Boweyls coefficient, Karl Pearson's coefficient of skewness- correlation-Lines of regression- applications of Bio-technology.
UNIT-II: PROBABILITY: Classical approach- Axiomatic approach of probability, Basic theorems addition and product theorem, conditional probability, Baye's theorem- applications to Biotechnology.
UNIT-III: PROBABILITY DISTRIBUTIONS: Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties. Probability function-Moment generating function (mgf), Cumulant generating function(cgf) and Characteristic function C(t).Discrete Distributions-Binomial distribution, Poison distribution-their expectation, mgf, cgf and C(t) Continuous distributions: Normal Distribution- mean, variance, m.g.f and c.g.f. Properties of Normal distribution.
UNIT- IV: INFERENCIAL STITISTICS -I: Estimation-Hypothesis-Testing of Hypothesis-Types of Errors. Testing the single sample mean (σ-known), Testing of single sample mean (σunknown), Testing the single sample proportion, single sample variance, Testing the differences between two means, two proportions and two variances. Testing of n-proportions-2-test.
UNIT-V: INFERENCIAL STITISTICS –II: Testing of many proportions-2-test independent of attributes-r x c-tables. Analysis of variance-CRD.

Text Books:
1. P.S.S Sunder Rao and J.Richard, "Introduction to Bio-Statistics and Research Methods" fifth edition, PHI Learning Pvt. Ltd.2012.
2. S.C.Gupta and Dr.V.K.Kapoor, "Fundamentals of Applied Statistics", tenth edition, Publishers: Sultan Chand & Sons,2005

Suggested Reading:
1. Mahajan, "Methods in Bio-Statistics",Japee Brothers Publishers, 2002.
2. A.K.Sharma ,"Text Book of Bio-Statistics"; Discovery Publishing House, 2005.
3. S.C.Gupta and Dr.V.K.Kapor, "Fundamentals of Mathematical Statistics: A Modern Approach", tenth edition, Publishers: Sultan Chand & Sons, 2005.

With effect from the Academic Year 2021-22

18BT E13

ANIMAL BIOTECHNOLOGY
(Core Elective-V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Students are expected to understand the techniques used for animal cell culture.
2. Students will learn various steps involved in the establishment of primary culture, maintenance and scale up of animal cells.
3. Students will know about measurement of cell viability & cytotoxicity and cell death.
4. Students are expected to know about stem cells and their applications.
5. Students will know about IVF and embryo transfer, cloning and gene transfer methods for generation of transgenic animals and its applications.

Course Outcomes:

At the end of the course the students are able to

1. Explain the animal cell culture requirements and techniques.
2. Outline the establishment maintenance and scale up of animal cell culture.
3. Discuss about Stem cells and their applications and procedure for measurement of cell viability and cytotoxicity and cell death.
4. Explain various methods for IVF and embryo transfer, cloning and generation of transgenic animals and their applications.
5. Outline various applications of animal biotechnology.

UNIT-I

Animal Cell Tissue Culture: History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; Laboratory facilities for animal tissue culture; Aseptic techniques; the substrate on which cells grow; Treatment of substrate surfaces; Culture media for cells and tissues.

UNIT-II

Primary Culture and Cell Lines: Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines; Cell transformation; Bioreactors for animal cell culture; Scaling-up of animal cell culture.

UNIT-III

Stem Cells, Cell Viability and Toxicity: Stem cells, types of stem cells, embryonic stem cells and their applications; Measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, Necrosis.

UNIT-IV

Embryo Transfer, Cloning and Transgenic Animals: Artificial insemination, in vitro fertilization and embryo transfer; Cloning of animals - Reproductive cloning, Therapeutic cloning; Gene transfer or Transfection methods; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT-V

Applications of Animal Biotechnology: Application of animal cell culture; Mammalian cell products; viral vaccines produced from animal cell cultures. Three dimensional culture; Tissue engineering.

Text Books:

1. Ian Freshney, R., "Culture of Animal Cells: A manual of basic technique and specialized applications" Seventh edition, John Wiley and Sons, 2016.
2. John Masters, "Animal Cell culture: A practical approach" OUP Oxford, 2000.
3. Gupta P.K., "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint, 2013.

Suggested Reading:

1. Srivastava, A.K., Singh, R.K., Yadav, M.P., "Animal Biotechnology" Oxford & IBH Publishing Co. Pvt. Ltd., 2005.
2. Ranga, M.M., "Animal Biotechnology", 3 reprint, Agrobios, India, 2010.

With effect from the Academic Year 2021-22

18BT E14

CANCER BIOLOGY
(Core Elective-V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To understand the fundamentals of cancer biology.
2. To know the importance of physical and chemical carcinogens and their effects on cell cycle.
3. To learn the Molecular aspects of cell cycle control.
4. To learn the theories of metastasis, diagnosis and treatment of cancer.
5. To understand the principles of cancer pharmacology

Course Outcomes:
At the end of the course the students are able to

1. Summarize the etiology of cancer.
2. Explain the principles and mode of action of physical and chemical carcinogens.
3. Discuss the molecular genetics of cancer.
4. Outline the cancer metastasis, diagnosis and different forms of therapy
5. Describe the principles of cancer pharmacology.

UNIT-I

Fundamentals Of Cancer Biology: Definition and hall marks of cancer, Cell cycle control, regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitors, Mutations that cause changes in signal molecules, Effects on receptor, Tumor suppressor genes, Different forms of cancer(Case studies for carcinoma ex: breast cancer and stomach cancer), Diet and cancer.

UNIT-II

Principles Of Carcinogenesis: Natural History of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT-III

Principles Of Molecular Cell Biology Of Cancer: Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes, Activation of proto oncogens to oncogens.

UNIT-IV

Cancer Metastasis And Treatment: Metastasis, Classic theory of tumor Metastasis, Clinical significance of invasion, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion). Diagnosis of cancers, Advances in Cancer detection (Biomarkers technology and nanotechnology), Different forms of therapy- Chemotherapy, Radiation therapy and immunotherapy. , Advances in Cancer therapy

UNIT-V

Principles Of Cancer Pharmacology: Pharmacokinetics and pharmacodynamics of antineoplastic drugs. Metabolism of anticancer drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. FranksLMandN.M.Teich, "Introduction to Cellular and Molecular Biology of Cancer", 2nd edition, Oxford Medical Publications, 1991.
2. Raymond W. Ruddon "Cancer Biology", 3rd edition, Oxford University Press, USA1995.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rdedition, Prentice Hall,USA. 2003.

Suggested Reading:

1. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.
2. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garlan

With effect from the Academic Year 2021-22

18BT E15

COMPUTER APPLICATIONS IN BIOPROCESS

(Core Elective-V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in software development processes, Algorithm design and Process Models.
2. The course is designed to give an understanding on obtaining. solutions of differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
3. This course aims at providing an insight into the solution of set of simultaneous equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods.
4. The aim of the course is also to give the students an understanding of obtaining solutions of numerical methods.

Course Outcomes:

At the end of the course student are able to

1. Distinguish between different process models
2. Formulate process models leading to set of ordinary differential equations and solution procedures numerical methods.
3. Formulate process models leading to set of linear simultaneous equations and solution procedures.
4. Formulate process models leading to transcendental and polynomial equations and solution procedures.
5. Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets and optimize biochemical process.

The Programs are to be written in C" only

UNIT-I

Computers and Software: Computing environments, the software development processes, Algorithm design,

Program composition, Quality Control, Documentation, Storage and •Maintenance, Software strategy. Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state and Dynamic models, Continuous and Discrete models, Empirical models. Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, biochemical kinetic rate expressions,

thermodynamic relations. Review on "C" Language Fundamentals.

UNIT-II

Function Approximation: Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and RungeKuttamethods.

UNIT-III

Formulation of Process Models : Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

UNIT-IV

Process Models Leading to Transcendental and Polynomial Equations:
Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bisection, Reguli-falsi, Newton Raphson, Richmond, Muller's and Bairstow methods

UNIT-V

Process Optimization : Nature and organization, basic concepts and elements of Optimization, Scope and hierarchy of optimization, Essential features and general procedure of optimization problems and applications of optimization , single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods.

Text Books:

1. DR. B.S. Grewal, Higher engineering mathematics Khanna publishers, 1998.
2. Steven C. Chapra and Raymond P Canale, Numerical methods for Engineers 2nd edition,MCGraw Hill International edition,1988.

Suggested books:

1. Henry R. Bungay Computer Applications in Bioprocessing Volume 70 Springer, 2000.
2. Edger T.E., and Himmelbau D.M., “Optimization of chemical processes”, McGraw Hill international edition, 1988 3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, 1998.

With effect from the Academic Year 2020-21

18BT E16

PRINCIPLES OF DATA ANALYTICS
(Core Elective V)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Students were made to understand about the concepts of Statistical methods for designing experiments, collection of data and estimating the probability
2. Students were taught about design of experiments, about null and alternate hypothesis and decision making
3. Students were made aware of how to understand the relationship between the given data and predictive analytics
4. Students were taught the concepts of identification of differences in given data by analysis of variance and multivariate analysis
5. Students are enlightened about the concepts of clustering of the biological data, dimensionality reduction to represent entire data

Course Outcomes

At the end of the course, the students are able to

1. Students gains knowledge how to collect data and also apply appropriate method for statistical analysis.
2. Students would learn how to make proper decisions by understanding the results derived out of the statistical analysis performed.
3. Students would learn how to build relationships between the parameters in the given data and also would learn how to predict the future outcomes.
4. Students would learn the basic differences between the obtained data and can judge about the possible causative factors responsible for the given cause.
5. Students can use these concepts such as clustering and PCA in handling the data obtained from next generation sequencing and can learn about the genotypes and phenotypes.

Unit I

Introduction: Scientific method; Experiments and other tests; Data, observations and variables; Probability; Probability distributions

Estimation: Samples and populations; Common parameters and statistics; Standard errors and confidence intervals for the mean; Methods for estimating parameters; Resampling methods for estimation; Bayesian inference – estimation.

Unit II

Hypothesis testing: Statistical hypothesis testing; Decision errors; Multiple testing; Combining results from statistical tests; Bayesian hypothesis testing
Graphical exploration of data: Exploratory data analysis; Analysis with graphs; Transforming data; Standardizations; Outliers; Censored and missing data;

Unit III
Correlation and regression: Correlation analysis; Linear models; Linear regression analysis; Smoothing; Power of tests in correlation and regression; Multiple linear regression analysis; Regression trees; Nonlinear models
Design and power analysis: Sampling; Experimental design; Power analysis; Analysis of variance-Single factor (one way) designs, Factor effects, ANOVA diagnostics and Robust ANOVA

Unit IV
Analyzing frequencies: Single variable goodness-of-fit tests; Contingency tables; Log-linear models;
Multivariate analyses: Multivariate data; Distributions and associations; Linear combinations, eigenvectors and eigenvalues; Multivariate distance and dissimilarity measures; Multivariate graphics; Multivariate analysis of variance (MANOVA); Discriminant function analysis

Unit V
Principal components and correspondence analysis-Principal components analysis; Factor analysis; Correspondence analysis; Canonical correlation analysis; Redundancy analysis
Multidimensional scaling and cluster analysis: Multidimensional scaling; Classification; Scaling (ordination) and clustering for biological data
Presentation of results: Presentation of analyses; Layout of tables; Displaying summaries of the data; Error bars

Text books:
1. Experimental Design and Data Analysis for Biologists; Gerry P. Quinn & Michael J. Keough; Cambridge University Press
2. Beckerman, Childs & Petchey (2017) Getting started with R: An introduction for Biologists (2nd edition).Oxford University press.

With effect from the Academic Year 2021-22

BLOCK CHAIN TECHNOLOGIES
(Open Elective II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Outcome

1. Student is made to understand about the concept of distributed systems, block chain technology
2. Student will understand about the what is cryptocurrency, its components and use
3. Student will understand the importance of bitcoin as an alternate for real currency, about its nature of transfer and other concepts
4. Student will understand the why to use hyperledger and its importance
5. Student will understand how implementation of blockchain technology will improve science and health sector

Unit I:

Introduction: Overview of distributed system; introduction to Blockchain; Properties of Blockchain; Evolution of Blockchain

Cryptocurrency And Blockchain: Anonymity and Pseudonymity in Cryptocurrency; Programmable Money; Hash Functions and Merkle Trees; Components of Blockchain Ecosystem; Cryptography and Consensus Algorithms; Types of Blockchain; Side Chains: another type of Blockchain; Blockchain Implementations; Blockchain Platforms

Unit II:

Bitcoin Platform: Bitcoin and its uses; Bitcoin Trading: Buying, selling and storing Bitcoins; Bitcoin Ecosystem; Structure of a Bitcoin Transaction; Scripting language in Bitcoin; Applications of Bitcoin script; Nodes in a Bitcoin Network

Bitcoin Mining: Bitcoin Economics; Bitcoin Mining and Types of Mining; Mining and Consensus; Assembling and selecting chains of blocks; Mining and the hashing race; Mining Pools

Unit III:

Introduction To Ethereum: What is Ethereum; Introducing Smart Contracts; Cryptocurrency in Ethereum; Mining in Ethereum; Consensus Mechanism in Ethereum; Platform Functions used in Ethereum; Technologies that support Ethereum; Ethereum Programming Language; Components for development of Ethereum DApps; Editors and tools; Frontend Development; Ethereum Test Networks; ERC Tokens

Basic Solidity : Introducing Solidity; Sample Code; Layout of Source File; Structure of a Contract; State Variables; Functions Types; Reference Types; Units; Special Variables and Functions; Expressions and Control Structures; Function Calls; Error Handling; Visibility for Functions and State Variables

Unit IV:

Hyperledger: Introduction to Hyperledger; Hyperledger architecture; Consensus; Hyperledger API and Application Model; Network Topology; Exploring Hyperledger frameworks; Business Network Deployment on Hyperledger Composer Playground; Setting up Development Environment using Hyperledger Composer; Introduction to Hyperledger Fabric; Creating Hyperledger Fabric Blockchain Network

Deploying Private Blockchain On MultiChain : What Is MultiChain; Privacy and Permissions in MultiChain; Mining in MultiChain; Multiple configurable Blockchains using MultiChain; Setting up a Private Blockchain

Unit V:

Blockchain in Science: Reproducibility Crisis; Clinical Trials; Reputation System; Pharmaceutical Drug Tracking-Prediction Markets and Augar

Blockchain in Health Care: Payer–Providers–Patient Model; Workflow-Hot Switching; Waste Management: Capital One, Ark Invest, and Gem

Text Books:

1. Mastering Bitcoin. Programming the Open Blockchain; Andreas M. Antonopoulos; O'Reilly, 2017
2. Bitcoin and Blockchain Security**;** Ghassan Karame, Elli Androulaki; Artech House, 2016.
3. Blockchain and Clinical Trial; Hamid Jahankhani et.al. Springer (2019)
4. Blockchain Enabled Applications; Vikram Dhillon et al, Apress (2019)

With effect from the Academic Year 2021-22

18CS O04

BASICS OF DATA SCIENCE USING R
(Open Elective II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: Probability and Statistics, basics of programming languages.

Course Objectives: The main objectives of this course are:

1. Understand R programming language.
2. Explore the programming skills needed to use R tool for statistical analysis of Biological data.
3. Analyze biological data.

Course Outcomes: On Successful completion of this course, student will be able to

1. Summarize the basics of R and in-built data visualization packages.
2. Describe the data analysis using Bayesian and stochastic modelling.
3. Relate gibbs, Z- sampling distributions and compare the binomial, chi-square, wilcoxon and Fisher's exact tests in hypothesis testing.
4. Explore the ANOVA in Regression analysis and classify the multivariate data.
5. Experiment with the biological data using R tool and apply clustering algorithms to biological data.
6. Identify R commands for data manipulation and database technologies for datasets of bioinformatics.

UNIT - I

Basics of R: Introduction, R features, setting up and exploring R environment, loading packages, types of data objects in R, working with R data objects, Controlling work space, importing files. **Programming with R:** Variables and assignment, operators, control structures, Functions-built-in, writing own functions, package creation.

UNIT - II

Data Analysis and Graphics: Data summary functions in R, Graphics technology in R, saving graphics, additional graphics packages. **Bayesian Data Analysis**: Need of Bayesian approach, Application of Bayes rule, Priors, Likelyhood functions, evaluating the posterior, Applications of Bayesial Statistics in Bioinformatics. **Stochastic Modeling**: Stochastic process and Markov Processes, Classification of Stochastic processes, modeling a DNA sequence with Markov Chain, Characteristics of Markov Chain.

UNIT - III

MCMC using Brugs: ABO blood type example. Gibbs sampling. **Statistical Inference:** Sampling distributions, Parameter estimation, interval estimation, bootstrapping, R packages for bootstrapping. **Hypothesis Testing**: Package ctest, Binomial test, comparing variances, Wilcoxon tests, Chi-Square test, Fisher's Exact tests, Likelihood Ratio tests.

UNIT - IV

ANOVA and Regression: ANOVA table, perforating ANOVA using R, graphical analysis of ANOVA comparison, Regression: Correlations, linear regression model, fitting and testing of regression model, generalization of the model. **Working with Multivariate Data:** Multivariate data, sample statistics, display of multivariate data, outliers and principal components. Classification of discriminate analysis- classification with two population and more than two populations, cross validation classification trees.

UNIT - V

Clustering methods: measures of dissimilarities, K-means clustering, K-Medoid clustering, Hierarchical clustering-Agglomerate and divisive. **R Packages:** Bio-conductor and Seqin R.
Data Technologies: R for Data manipulation, example, Database technologies, Bioinformatics resources on the WWW.

Text Books:

1. Kim Seefeld, Ernest Linder, "Statistics using R with Biological examples", 2007 (https://cran.r-project.org/doc/contrib/Seefeld_StatsRBio.pdf).
2. Robert Gentleman, "R Programming for Bioinformatics", 1st Edition, CRC Press, 2008.

Suggested Reading:

1. Arvil Cohhlan "A Little Book of R for Bioinformatics", Release 1.0, CC ver 3.0

Online Resources:

1. https://epdf.tips/r-programming-for-bioinformatics.html
2. https://epdf.tips/r-programming-for-bioinformatics.htmlhttps://www.cyclismo.org/tutorial/R/objectOriented.html
3. https://www.w3schools.in/r/object-oriented/

With effect from the Academic Year 2021-22

18EG O01

TECHNICAL WRITING
(Open Elective II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

The course will introduce the students to:

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:

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

1. Understand the channels of communication. Define nature and aspects of Technical communication
2. Compare and contrast technical communication to that of general communication. Construct error free sentences applying features of technical writing.
3. Analyze data, draw inferences to write Journal articles and conference papers. Compose business letters.
4. Evaluate data to draft technical reports and technical proposals.
5. Create a technical presentation by understanding the nuances of presentation skills. Prepare agenda and minutes of a meeting.

Unit I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.

Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.
Technical Articles: Nature significance and types of technical articles. Journal articles and Conference papers. Elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.
Technical Proposals: Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.
Technical Presentations : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Text Book:

1. Meenakshi Raman & Sangeeta Sharma, **"Technical Communications-Principles and Practice",** Oxford University Press, Second Edition, 2012.
2. 1. M Ashraf Rizvi, **"Effective Technical Communication",** Tata McGraw Hill Education Pvt Ltd, 2012.
3.

Suggested Reading:.

1. .Kavita Tyagi & Padma Misra, **"Basic Technical Communication",** PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, **"Business Correspondence and Report Writing",** Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills
4.

With effect from the Academic Year 2021-22

18EE O05

WASTE MANAGEMENT
(Open Elective II)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
1. To imbibe the concept of effective utilization of any scrap
2. To become familiar with the processes of all disciplines of engineering.

3. To learn the technique of connectivity from waste to utility.

Course Outcomes:
At the end of the course, the students are able to
1. Understand the various processes involved in allied disciplines of engineering

2. Infer the regulations of governance in managing the waste
3. Distinguish the nature of waste materials concerned to the particular branch of engineering
4. Explore the ways and means of disposal of waste material

5. Identify the remedies for the disposal of a selected hazardous waste material

UNIT-I
Introduction to waste management: Relevant Regulations Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules; biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules. Municipal Solid Waste Management – Fundamentals Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options.
UNIT-II
Hazardous Waste Management : Fundamentals Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects, Radioactive Waste Management – Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.
UNIT-III
Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation); ground water contamination and remediation
UNIT-IV
Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.
UNIT-V
Landfill design aspects: Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration
Text Books:
1. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.

2. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 1994

3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 1997

Suggested Readings:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L.Shah 1999, Prentice Hall.
2. Solid and Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & dist.

With effect from the Academic Year 2021-22

18BT C28

DOWNSTREAM PROCESSING LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

The course aims

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. To design protocol for separation of bioproduct based on characteristics

Course Outcomes:

At the end of the course the students are able to

1. Demonstrate chromatographic separation process for a given compound.(BL 1)
2. Apply a strategy for final product purification/ polishing of a bioproduct (BL 3)
3. Analyze the optimum protein precipitation technique (BL 4)
4. Evaluate various techniques for cell disruption and filtration(BL 5)
5. Develop methods for determining enzyme activity(BL 6)

List of Experiments:

1. Cell Disruption of microorganism using enzymatic method
2. Cell Disruption of plant cells / animal cells using physical methods
3. Liquid-liquid extraction.
4. Separation of solids from liquid by Sedimentation
5. Separation of microorganisms from fermentation broth by Microfiltration.
6. Separation of solute particles by Dialysis.
7. Separation of protein by Ammonium Sulphate Precipitation.(Structured expt)
8. Isolation and quantification of protein from milk by Isoelectric Precipitation.
9. Separation of biomolecules by Gel Exclusion Chromatography.
10. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
11. Purification of proteins by Affinity Chromatography.
12. Simple distillation- vapor liquid equilibrium.
13. Solid liquid extraction./Drying technique
14. Alpha amylase activity (open ended expt)

Text books:

1. David Plummer, “An introduction to Practical Biochemistry” 3rd edition, John Wiley &Sons
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith John Walker John Walker, Cambridge University Press; 6 edition(2005).
3. Laboratory Manual in Biochemistry By J. Jayaraman, KunthalaJayaramanj, New AgeInternational

With effect from the Academic Year 2021-22

18BT C29

TISSUE CULTURE LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	1.5

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture and Animal tissue culture.
2. Develop their skills in plant tissues culture techniques in horticultural/medicinally important plants.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using Agrobacterium strains.

Course Outcomes:

At the end of the course the students are able to

1. Prepare plant tissue culture medium for in vitro studies.
2. Execute the protocols for various plant tissue culture applications using cell suspension cultures.
3. Develop in vitro techniques for micropropagation of horticulture and medicinal plants.
4. Demonstrate the Protoplast isolation from various plant tissues using enzymatic method.
5. Develop a system for genetic transformation in plants using Agrobacterium strains

List of Experiments

1. Preparation of Plant tissue Culture Media
   - Preparation of MS stock solutions
   - Preparation of MS callus induction media
2. Surface sterilization
3. Callus induction from mature embryo.
4. Cell suspension cultures initiation and establishment
5. Organogenesis and Embryogenesis
6. Meristem tip culture for production of virus free plants
7. Micropropagation of horticultural/medicinally important plants (Open ended experiment)
8. Root induction and acclimatization of in vitro plantlets
9. Production of synthetic seeds. (Structured enquiry)
10. Protoplast isolation(demo)
11. Agrobacterium mediated gene transfer: induction of Hairy roots

Text Books:

1. H. Jones and John M. Walker, “Plant Gene Transfer and Expression Protocols: Methods in Molecular Biology, 49, Humana Press, 1996.
2. J. G. Chirikjian, Biotechnology: Theory and Techniques (Plant Biotechnology, Animal Cell Culture and Immuno biotechnology), Jones & Bartlett Publishers, U.K.,1996.

With effect from the Academic Year 2021-22

18BT C30

PROJECT: PART-1

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

The objective of Project Part -1 is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D.

The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminaryAnalysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: Max. Marks:50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

With effect from the Academic Year 2022- 23

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Department of Bio-Technology

Scheme of Instructions for VIII Semester of B.Tech Bio-Technology as per AICTE Model Curriculum 2021-22

B.Tech (Bio-Technology)

SEMESTER-VIII

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours Per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
	THEORY								
1		**Core Elective VI**	3	-	-	3	30	70	3
2		**Open Elective III**	3	-	-	3	30	70	3
	PRACTICALS								
3	18BT C31	Technical Seminar (On the latest trends and other than project)	-	-	2	-	50	-	1
4	18BT C32	Project Part II	-	-	20	Viva	100	100	10
Total			**6**	**-**	**22**	**-**	**210**	**240**	**17**
Clock Hours Per Week – 28									

L:Lecture T:Tutorial P:Practical

CIE – Continuous Internal Evaluation SEE - Semester End Examination

Core Elective VI	
18BT E17	Tissue Engineering
18BT E18	Immunodiagnostics
18BT E19	Genomics and Proteomics

Open Elective III	
18ME O04	Entrepreneurship
18CS O08	Open Source Technology
18CS O01	Python for Bioinformatics

Credit Summary for B. Tech Biotechnology									**TOTAL**
Semester	I	II	III	IV	V	VI	VII	VIII	**CREDITS**
Credits	20.5	21.5	20	20	21	20	20	17	**160**

Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075.

With effect from the Academic Year 2021-22

18BT E17

TISSUE ENGINEERING
(Core Elective-VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. To provide fundamental principles and elements of tissue engineering.
2. To get insight about the roles of cells, tissue organization and matrix in tissue engineering.
3. To learn the tissue culture techniques and scale up designs.
4. To learn the different biomaterials used for the fabrication of scaffolds.
5. To gain knowledge about the therapeutic applications of tissue engineering.

Course Outcomes:

At the end of the course students will be able to

1. Outline the concepts of tissue engineering, ethical issues, and future prospects
2. Illustrate the molecular mechanisms at tissue level and in cell matrix in tissue engineering.
3. Identify in vitro culturing techniques and scale up designs.
4. Classify the compatible biomaterials used for fabrication of scaffolds in Tissue engineering.
5. Summarize the therapeutic applications of tissue engineering.

UNIT-I

Introduction to Tissue Engineering: Basic definition of Tissue engineering; origin and history of Tissue Engineering, overview of its basic steps and its applications; General scientific issues, Ethical issues; current challenges and future prospective.

UNIT-II

Cells and Tissue Organization: Cells- cell growth and death; cell differentiation; Cells in tissues and organs. Cell to cell interactions; cell adhesion molecules (CAM) Organization of cells into higher ordered structures- Mesenchymal cells; EMT, Molecular mechanisms and control of EMT process. Tissues- Vascularity; angiogenesis; wound healing. Extra cellular matrix (ECM) – components.

UNIT-III

Functional Tissue Engineering: Cell and tissue culture- media; culture initiation; transformation and immortalization; validation; differentiation; maintenance of cells in vitro; cryopreservation. Stem cells in tissue engineering Bioreactors for tissue engineering- Bioreactor design requirements; Spinner flask bioreactors. Rotating-wall bioreactors, Compression bioreactors, Strain bioreactors, Hydrostatic pressure bioreactors, Flow perfusion bioreactors, Combined bioreactors

UNIT-IV

Biomaterials of Tissue Engineering: Scaffolds- fabrication; 3D scaffolds Biodegradable

polymers; synthetic polymers; hybrid of synthetic and biological polymers; prosthetic devices. Engineering biomaterials for tissue engineering.

UNIT-V

Applications of Tissue Engineering: Tissue replacement –crucial factors Skin grafting Bone tissue engineering; Cardiac tissue engineering; Neural tissue engineering; Vascular tissue engineering;

Text Books:

1. Robert. P. Lanza, Robert Langer & Vacanti, Principles of tissue engineering. Academic Press. 2nd edition2000.
2. B. Palsson, J.A. Hubbell, R. Plonsey & J.D. Bronzino. Tissue engineering. CRC Taylor & Francis 2000.

Suggested Reading:

1. Bernard Prish, Tissue engineering- Design, practice & reporting, Woodhead Publishing Ltd. Cambridge. UK 2009.
2. Atala O.P &Lanza.L, Methods of tissue engineering. Woodhead Publishing Ltd. Cambridge. UK. 2009.

With effect from the Academic Year 2021-22

18BT E18

IMMUNODIAGNOSTICS
(Core Elective VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To learn the basic principles, procedures and applications of immunodiagnostic tests.
2. To understand the principles and applications of immunodiagnostic test.
3. To learn the steps involved in the production, diagnosis and applications of monoclonal antibody.
4. To learn the development of prophylactic agents such as vaccines.
5. To learn the novel methods used for immunodiagnostics.

Course Outcomes:

At the end of the course students will be able to

1. Outline the principle, importance, scope, classification of immunodiagnostic tests and antigen antibody reaction
2. Explain the principles and application of immunodiagnostics tests for diagnosing various diseases
3. Discuss about the production of monoclonal antibodies for diagnosis, treatment and prevention of disease.
4. Describe various methods used for vaccine development.
5. Summarize the various novel techniques used in immunodiagnostics.

UNIT-I

Introduction to Immunodiagnostics: Principles of immunodiagnostic tests and their development; classification of immunodiagnostic tests; Immunodiagnostics importance and scope; the antigen antibody reaction; Selection and preparation of reagents; Assay design; Antibody engineering; Catalytic antibodies.

UNIT-II

Immunodiagnostics Techniques: Immunodiagnostics techniques – Precipitation, Immunoelctrophoresis, Agglutination, RIA, ELISA, Fluoroimmunoassay, Luminescent immunoassay, Immunofluorescence, Cell separation techniques, Western blotting.

UNIT-III

Hybridoma Technology: Hybridoma technique - choice of host for immunization and myeloma cells, choice of immunogen, preparation of antigen for immunization, growth of myeloma cell lines, preparation of cells for fusion, cell fusion, selection and screening of hybridoma, purification and application (biochemical research, clinical diagnosis and

treatment) of monoclonal antibodies.

UNIT-IV

Vaccines: Whole organism Vaccines; Subunit vaccines - Herpes Simplex virus, Foot and Mouth disease; Peptide vaccines - Foot and Mouth disease, Malaria; Live recombinant vaccines- Cholera, Salmonella; Vector vaccines - directed against viruses and bacteria; Purified vaccines, Conjugate polysaccharide vaccines; DNA vaccines; Antifertility vaccines.

UNIT-V

Novel Techniques in Immunodiagnostics: Imaging as an Immunodiagnostic Tool; Multicolor Flow Cytometry; Immunoglobulin and Free-light Chain Detection; Methods for Autoantibody Detection; Immunodiagnostic of Allergy; Multiplex Analysis of Cytokines; Immunomonitoring of Clinical Trials; Immunological Assays Used in Vaccine Clinical Trials.

Text books:

1. Edwards R, "Immunodiagnostics: A practical approach" Oxford University Press, 1999.
2. Rastogi SC, "Immunodiagnostics Principles and Practice" New Age Publishers, 1996.

Suggested Reading:

1. Shepherd, P., Dean C., "Monoclonal Antibodies: A Practical Approach" Oxford University Press, 2000.
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen., "Kuby Immunology" 8th edition, Macillan learning, 2018.
3. Ralph M Aloisi Lea, Principles of Immunology and Immunodiagnostics, Lea &Febiger, 1988.

With effect from the Academic Year 2021-22

18BT E19

GENOMICS AND PROTEOMICS
(Core Elective VI)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to understand the fundamentals of genome
2. Students are made to understand DNA sequencing and various DNA sequencing methods.
3. Students are enlightened about construction and screening of cDNA libraries.
4. Students are enlightened about the current methods existing in the field of genomics.
5. Students are made to understand the basics of proteomics, tools for proteomics and protein modifications

Course Outcomes:

At the end of the course the students are able to

1. Describe about genomes, types of genomes and the advanced techniques used for analyzing genome.
2. Explain about the methods of functional genomics.
3. Discuss about the various sequencing technology in genomics.
4. Describe the tools used for the characterization of proteins
5. Explain the about personalized medicines their uptake, action and metabolism.

UNIT-I

Structural Genomics: Overview of Genome - Types, analysis of genomes; comparative homologies; evolutionary changes; Genetic analysis: Linkage mapping and analysis, High resolution chromosome maps, Physical mapping, Hybrid mapping strategies, Sequence specific tags(SST), Sequence tagged sites(STS), FISH.

UNIT-II

Functional Genomics: Gene disruption and methods; DNA microarray and its Applications; Serial analysis of gene expression (SAGE); Genome wide association studies; Chip-Seq; RNA-Seq; Metagenomics.

UNIT-III

Next Generation Sequencing: Next generation sequencing - importance; Different sequencer platforms available; Methods of Sequencing; File formats; Data generation tools; Preprocessing of data and analysis.

UNIT-IV

Proteomics: Protein arrays: basic principles. Computational methods for identification of polypeptides from mass spectrometry. Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Protein-protein interactions: databases such as DIP, PPI server and tools for analysis of protein-protein interactions

UNIT-V

Metabolomics And Pharmacogenomics: Metabolomics - Basics; Pharmacogenomics - Basics, Diseased genes and their identification; Drug uptake and metabolism; Drug targets; Designer medicine; Genomics perspective of bioterrorism; Ethical and legal implications.

Text Books:

1. Sahai S, "Genomics and Proteomics-Functional and Computational Aspects", Plenum Publications, 1999.
2. Rastogi SC, Mendiratta N, Rastogi P, "Bioinformatics-Methods and Application, Genomics, Proteomics,and drug discovery", 2nd edition, Prentice Hall of India, New Delhi,2003.
3. Hunt SP, Levessy FJ, "Functional genomics" Oxford University Press, UK, 2000.

Suggested Reading:

1. Lieber DC, "Introduction to Proteomics, Tools for the new biology", Humana Press, UK, 2000.
2. Cendric Gondro, "Primer to Analysis of Genomic Data Using R", Springer, 2015.

With Effect from the Academic Year 2021 - 2022

18ME O04

ENTREPRENEURSHIP
(Open Elective III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
Student will understand

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

Outcomes:
At the end of the course, students will be able to:

1. Understand the concept and essence of entrepreneurship. **(BL-2)**
2. Identify business opportunities and nature of enterprise. **(BL-3)**
3. Analyze the feasibility of new business plan. **(BL-4)**
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects. **(BL-3)**
5. Use behavioral, leadership and time management aspects in entrepreneurial journey. **(BL-3)**

UNIT-I
Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Identification and characteristics of Entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, Conception and evaluation of ideas and their sources.

UNIT-II
Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-III
Business Plan: Introduction, Elements of Business Plan and its salient features, Business model canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary, Selection of Technology and Collaborative interactions.

UNIT-IV
Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden.

UNIT-V
Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 1997.
2. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, “Entrepreneurial Development”, S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication, 1994.
3. G.S. Sudha, “Organizational Behavior”, National Publishing House, 1996.

With Effect from the Academic Year 2021 - 2022

18CS O08

OPEN SOURCE TECHNOLOGY
(Open Elective III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: The main objectives of this course are:

1. Familiarity with Open Source Technologies.
2. Examples of OSS Projects, Advantages of Open Source.
3. Understand the principles, methodologies of OSS.
4. Understand the policies, licensing procedures and ethics of OSS.

Course Outcomes: On Successful completion of this course, student will be able to

1. Able to differentiate between Open Source and Proprietary software and Licensing.
2. Recognize the applications, benefits and features of Open Source Technologies.
3. Understand and demonstrate Version Control System along with its commands.
4. Gain knowledge to start, manage open source projects.
5. Understand and practice the Open Source Ethics.

UNIT – I

Introduction to Open Source: Open Source, need of Open Source, Open Source Principles, Open Source Standards Requirements for Software, OSS success, Free Software, Examples, Licensing, Free Software Vs. Proprietary Software, Public Domain software, History of free software, Proprietary Vs Open Source Licensing Model, use of Open Source Software.

UNIT – II

Fault Tolerant Design: **Principles and Open Source Methodology**- History, Open Source Initiatives, Open Standards Principles, Methodologies, Philosophy, Software freedom, Open Source Software Development, Licenses, Copyright vs. Copyleft, Patents, zero marginal cost, income-generation Opportunities, Internationalization.

UNIT – III

Case Studies: Apache, BSD, Linux, Mozilla Firefox, Wikipedia, Git, GNU CC, Libre Office.

UNIT – IV

Open Source Project: Starting and Maintaining an Open Source Project, Open Source Hardware, Open Source Design, Open Source Teaching (OST), Open Source Media, What Is A License, How to create your own Licenses. Important FOSS Licenses (Apache, BSD, PL, LGPL), copyrights and copy lefts, Patent.

UNIT – V

Open Source Ethics- Open Source Vs. Closed Source, Open Source Government, Ethics of Open Source,

Social and Financial Impact of Open Source Technology, Shared Software, Shared Source, Open Source as a Business Strategy.

Text Books:

1. Kailash Vadera, Bjhavesh Gandhi "Open Source Technology", University Science Press, 1st Edition, 2009.
2. Fadi P. Deek and James A. M. McHugh, "Open Source Technology and Policy", Cambridge University Press.

Suggested Reading:

1. Wale Soyinka, "Linux Administration- A beginner's Guide", Tata McGraw Hills.
2. Andrew M. St. Laurent, "Understanding Open Source and Free Software Licensing", O'Reilly Media.
3. Dan Woods, Gautam Guliani, "Open Source for the Enterprise", O'Reilly Media.
4. Bernard Golden, "Succeeding with Open Source", Addison-Wesley Professional.
5. Clay Shirky and Michael Cusumano, "Perspectives on Free and Open Source Software", MIT press.

With Effect from the Academic Year 2021 - 2022

18CS O01

PYTHON FOR BIOINFORMATICS
(Open Elective III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:
The main objectives of this course are:

1. Introduce Python with reference to bioinformatics.
2. Understanding of various algorithms useful for biological sequences.
3. Identification Python modules useful to analyse gene and Biological sequences

Course Outcomes: On Successful completion of this course, student will be able to

1. Understand the basics of Python Programming.
2. Develop applications using Python to solve problems.
3. Identify and use Python modules related to Biology.
4. Analyse biological and gene sequences using Python.
5. Understand advanced analysis techniques.
6. Formulate step-wise implementation of a python script for a given problem in bioinformatics

UNIT - I

Introduction to Python: Basics of Python, Python IDEs, Running Python programs, types and operations, Functions, modules, classes, Exceptions.

UNIT - II

Object-Oriented Programming, Modules: Object Oriented Programming, Threads, process, synchronization, databases and persistence, NumPy, SciPy, Image manipulation, Akando and Dancer modules.

UNIT - III

Biological Sequence Analysis: Biopython: Parsing DNA data files, Sequence Analysis, Dynamic Programming, Hidden Markov Model, Genetic Algorithms, Multiple Sequence Alignment, gapped alignment.

UNIT - IV

Advanced Analysis Techniques: Trees, Text Mining, Clustering, Self-Organizing Map, Principal Component Analysis and Numerical Sequence Alignment.

UNIT - V

Expression Analysis: Gene expression array analysis, Spot finding and Measurement, Spreadsheet Arrays and Data Displays, Applications with expression Alignment.

Text Books:

1. Jason Kinser, “Python for Bioinformatics”, Jones & Bartlett Publishers, 2nd Edition, 2013.
2. ReemaThareja “Python Programming”, Oxford Press, 2017.

Suggested Reading:

1. Mark Lutz, “Learning Python”, 3rd edition, O’Reilly, 2007.
2. Alex Martelli, David Ascher, “Python cookbook”, O’Reilly, 2002.

Online Resources:

5. http://www.biopython.org

With effect from the Academic Year 2021-22

18BT C31

TECHNICAL SEMINAR

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

With effect from the Academic Year 2021-22

18BT C32

PROJECT: PART-II

Instruction	10 Hours per week
CIE	100 Marks
SEE	100 Marks
Credits	10

The object of 'Project: Part-2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including teamwork;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
External and Internal	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society

Examiners together	20	Viva-Voce