UG-R22 Curriculum
With effective from 2022-23

Biotechnology

Scheme of Instruction and Syllabi of
B.Tech I to IV Semester of
Four Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.
E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in
Phone No. : 040-24193276 / 277 / 279

SCHEME OF INSTRUCTION AND SYLLABI

OF

B.TECH I to IV SEMESTERS

FOR

BIOTECHNOLOGY

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

(R–22 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++)

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

E-Mail: principal@cbit.ac.in; Website: www.cbit.ac.in;

Phone Nos.: 040-24193276 / 277 / 279

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
DEPARTMENT OF BIOTECHNOLOGY

INSTITUTE VISION AND MISSION

VISION

To be centre of excellence in technical education and research

MISSION

To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION

VISION

To excel in education, research and entrepreneurship in various fields of Biotechnology for contribution to the evolving needs of the society

MISSION

1. To provide an excellent educational experience to the undergraduate students of Biotechnology through quality teaching and advanced curriculum with roots into the fundamentals, that enables students to become leaders in their chosen field of Biotechnology
2. To provide vibrant learning and research environment that enables students to focus on lifelong learning to transform into entrepreneurs, and renowned researchers
3. To instil the spirit of innovation and creativity in young minds through participation in International and National level conferences/hackathons combined with a deep awareness of ethical responsibilities to profession and society

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

The Biotechnology department is dedicated to graduating engineers who,

1. Will demonstrate successful careers in industry through scientific thinking, interpreting, analysing experimental results and pursue higher education and research in reputed national and international institutes.
2. Will demonstrate leadership and initiative to advance professional and organizational goals with a commitment to ethical standards of profession, teamwork, and respect for diverse cultural background
3. Will be involved in lifelong /self-learning to keep abreast with the constantly evolving technologies for establishing start-ups and becoming successful entrepreneurs.
4. Will be committed to creative practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.

PROGRAM SPECIFIC OUTCOMES (PSOS):

Students should be able to

1. Apply the concepts of Biotechnology in the fields of health care, agriculture, biofuels, food industry and other relevant areas
2. Demonstrate adequate proficiency of good lab practices by adopting standard operating protocols and illustrate independent, safe and accurate handling of the biotechnology lab equipment

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(In line with AICTE Model Curriculum with effect from AY 2022-23)

SEMESTER – I

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/D		CIE	SEE	
THEORY									
1	22MTC03/ 22BTC01	Mathematics-I / Basics of Biology-I	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC01	Problem Solving and Programming	2	1	0	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3	-	50	Nil	1.5
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC37	Robotics & Drones Lab	0	2	2	-	100	Nil	3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
TOTAL			**10**	**5**	**13**		**460**	**390**	**21.5**

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

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: This course aims to

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: After completion of this course, student 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.

CO-PO ARTICULATION MATRIX

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

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 neighbourhoods, 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.

22BTC01

BASICS OF BIOLOGY - I
(FOR MPC STREAM OF BIOTECH)

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

COURSE OBJECTIVES: This course aims to

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

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

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	0	0	0	0	0	0	0	0	1	0	2	0	0
CO2	1	0	0	0	0	2	1	0	0	1	0	1	1	0
CO3	1	0	0	0	0	2	2	0	0	1	0	1	2	0
CO4	1	0	0	0	0	2	2	0	0	1	0	2	2	0
CO5	1	0	0	0	0	2	1	0	0	1	0	2	2	0

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 De 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 tissues (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).

22CYC01

CHEMISTRY
(BIOTECH)

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

COURSE OBJECTIVES: This course aims to

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: After completion of this course, students 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.

CO-PO ARTICULATION MATRIX

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
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

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_2^+, N_2 , O_2 , O_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, and – 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 (cistrans) 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 nanomaterials and general applications, basic chemical methods of preparation- Solgel 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., 46th edition (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).

22EEC01

BASIC ELECTRICAL ENGINEERING

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

COURSE OBJECTIVES: This course aims to

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.

CO-PO ARTICULATION MATRIX

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
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

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, and 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, 2013

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: This course aims 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 this course, students will 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.

CO-PO ARTICULATION MATRIX

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
CO1	3	1	1	-	1	-	-	-	-	-	-	1
CO2	3	1	1	-	1	-	-	-	-	-	-	1
CO3	3	1	1	-	1	-	-	-	-	-	-	1
CO4	3	1	1	-	1	-	-	-	-	-	-	1
CO5	3	1	1	-	1	-	-	-	-	-	-	1
CO6	3	1	1	-	1	-	-	-	-	-	-	1

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, "Programming for Problem Solving", First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna 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 Eric Matthes, No Starch Press.
5. "Programming in Python", R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM COURSES:

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.
3. https://www.coursera.org/specializations/python-3-programming

22CYC02

CHEMISTRY LAB
(BIOTECH)

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

COURSE OBJECTIVES: This course aims to

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 theoritical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: After completion of this course, students 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.

CO-PO ARTICULATION MATRIX

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	2	-	-	2	2	-	-	-	-	2	2	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2	2	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2	2	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2	2	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2	2	2

LIST OF EXPERIMENTS:

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.
3. Kogilavani, Kongu Engineering College.

22MBC02

COMMUNITY ENGAGEMENT

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

COURSE OBJECTIVES: This course aims 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 completion of this course, student will be able to After the completion of this Course, Student will be able to:
1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

MODULE I APPRECIATION 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.

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

MODULE IV 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).

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: This course aims to
1. Master the fundamentals of writing Python scrips.
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 this course, students will 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.

CO-PO ARTICULATION MATRIX

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
1	3	2	1	-	-	-	-	-	-	-	-	1	3	3	1
2	3	3	2	2	3	-	-	-	-	-	-	1	3	3	1
3	2	3	3	2	3	-	-	-	-	-	-	1	3	3	1
4	2	3	3	2	2	-	-	-	-	-	-	1	3	3	1
5	2	3	3	3	3	-	-	-	-	-	-	1	3	3	1
6	2	3	3	3	3	-	-	-	-	-	-	1	3	3	1

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 List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations.

TEXT BOOKS AND REFERENCES:
1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna 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 Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

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.
3. https://www.coursera.org/specializations/python-3-programming.

22MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

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

COURSE OBJECTIVES: This course aims 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 dynamitic 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

COURSE 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.

COURSE ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P0 10	PO 11	PO 12
CO1	3	2	1	1	1	2	1	1	1	2	2	2
CO2	2	3	1	2	3	1	1	1	1	2	2	1
CO3	2	2	2	2	2	1	1	1	1	2	2	2
CO4	2	2	1	2	2	2	1	1	1	2	2	2
CO5	1	1	1	1	1	3	3	3	1	3	3	3

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 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/

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

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

COURSE OBJECTIVES: This course aims to

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: After completion of this course, student will be able 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.

CO-PO ARTICULATION MATRIX

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
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

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 (A)

(In line with AICTE Model Curriculum with effect from AY 2022-23)

B.TECH. BIOTECHNOLOGY

SEMESTER – II

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/D		CIE	SEE	
THEORY									
1	22MTC06/ 22BTC02	Mathematics-II/Basics of Biology-II	3	1	0	3	40	60	4
2	22PYC07	Physics	3	0	0	3	40	60	3
3	22CEC01	Engineering Mechanics	3	1	0	3	40	60	4
4	22EGC01	English	2	0	0	3	40	60	2
PRACTICAL									
5	22PYC10	Physics Lab	0	0	3	3	50	50	1.5
6	22EGC02	English lab	0	0	2	3	50	50	1
7	22MEC01	CAD and Drafting	0	1	3	3	50	50	2.5
8	22MEC38	Digital Fabrication Lab	0	0	3	3	50	50	1.5
TOTAL			**11**	**3**	**11**	**24**	**360**	**440**	**19.5**

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

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

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: This course aims to
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: After completion of this course, student 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.

CO-PO ARTICULATION MATRIX

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	2	-	-	-	-	-	-	-	1	1	-
CO 2	2	2	2	2	-	-	-	-	-	-	-	2	1	-
CO 3	2	2	2	2	-	-	-	-	-	-	-	2	1	-
CO 4	3	3	3	3	-	-	-	-	-	-	-	2	1	-
CO 5	3	3	3	3	-	-	-	-	-	-	-	1	1	-

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.

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: This course aims to
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: After completion of this course, student will be able to
1. Identify the basic structure, function of various animal cell organelles, level of organization and types of tissues in animals.
2. Explains nomenclature and the animal kingdom classification with its characteristic features.
3. Explain and identify the lifecycles, diseases, treatment and preventive measures of human pathogens.
4. Outline population ecology, various biotic and abiotic environmental factors of ecosystem.
5. To give an insight on genes, chromosome, blood grouping system and gene expression.

CO-PO ARTICULATION MATRIX

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

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; *Entamoeba histolytica*, *Plasmodium vivax*, *Ascaris lumbricoides* and *Wuchereria bancrofti*. 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 factors 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.

22PYC07

PHYSICS
(BIOTECH & CHEMICAL)

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

COURSE OBJECTIVES: This course aims to
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: After completion of this course, 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

CO-PO ARTICULATION MATRIX

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

UNIT I

Wave Optics: Huygen's principle–Superposition of waves –Interference of light by splitting of wave front 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, 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.

22CEC01

ENGINEERING MECHANICS

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

COURSE OBJECTIVES: This course aims to
1. Understand the resolution of forces and to obtain resultant of all force systems,
2. Understand equilibrium conditions of static loads for smooth and frictional surface
3. Analyse simple trusses for forces in various members of a truss
4. Obtain centroid, centre of gravity for various regular and composite areas and bodies
5. Obtain Moment of inertia for various regular and composite areas and bodies and also to obtain Mass moments of inertia of elementary bodies

COURSE OUTCOMES: After completion of this course, 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,

CO-PO ARTICULATION MATRIX

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

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

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 aims to
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 completion of this course, student 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

CO-PO-PSO ARTICULATION MATRIX

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
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

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.

22PYC10

PHYSICS LAB
(BIOTECH & CHEMICAL)

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

COURSE OBJECTIVES: This course aims to

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: After completion of this course, 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

CO-PO ARTICULATION MATRIX

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

LIST OF 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.

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 aims to

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 completion of this course, student 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.

CO-PO-PSO ARTICULATION MATRIX

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
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

LIST OF 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

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: This course aims to
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.

COURSE 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

CO-PO ARTICULATION MATRIX

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

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

22MEC38

DIGITAL FABRICATION LAB

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

COURSE OBJECTIVES: This course aims 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.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO ARTICULATION MATRIX

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

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. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
   B. 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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(In line with AICTE Model Curriculum with effect from AY 2023-24)

B. TECH BIOTECHNOLOGY

SEMESTER-III

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	22CSC35	Data Structures Using Python	2	-	-	3	40	60	2
2	22BTC03	Process Principles and Reaction Engineering	3	-	-	3	40	60	3
3	22BTC04	Biochemistry	3	-	-	3	40	60	3
4	22BTC05	Microbiology	3	-	-	3	40	60	3
5	22BTC06	Cell and Molecular Biology	3	-	-	3	40	60	3
6	22BTC07	Genetics	3	-	-	3	40	60	3
7	22CEM01	Environmental Science	2	-	-	2	-	50	Non-credit
	PRACTICALS								
8	22CSC36	Data Structures Using Python Lab	-	-	2	3	50	50	1
9	22BTC08	Biochemistry Lab	-	-	3	3	50	50	1.5
10	22BTC09	Microbiology Lab	-	-	3	3	50	50	1.5
11	22BTI01	MOOCs/Internship - I	3-4 weeks / 90hrs			-	-	50	2
Total			**20**	**-**	**6**		**390**	**610**	**23**
Clock hours per week: 26									

L: Lecture D: Drawing T: Tutorial P: Practical /Project Seminar/Dissertation
CIE - Continuous Internal Evaluation SEE - Semester End Examination

22CSC35

DATA STRUCTURES USING PYTHON

(Common to Biotech, Chemical, Civil and Mechanical Engineering)

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

COURSE OBJECTIVES: This course aims to

1. Introduce object-orientation concepts in python.
2. Get familiarized with asymptomatic analysis of various functions and implement different sorting techniques.
3. Introduce the linear data structures and their implementation.
4. Introduce and implement non-liner data structures.
5. Get acquainted with various string functions and hash functions.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand Classes, Objects, linear data structures, nonlinear data structures, time complexity.
2. Use python packages to work with datasets.
3. Implement sorting, searching algorithms and analyse their performance.
4. Build optimal solutions using linear and nonlinear data structures, hashing.
5. Apply pattern matching algorithms for real time problems.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	1

UNIT I

Overview of Python, Concept of Class, and objects;
NumPy: The Basics of NumPy Arrays, Aggregations;
Pandas: Pandas Objects, Data Indexing and Selection;
Visualisation: Simple Line Plots, Simple Scatter Plots, Histograms, Binnings, and Density

UNIT II

Introduction: Data Structures, Abstract Data Types, Algorithm, Analysis of Algorithms, Running Time Analysis, Commonly Used Rates of Growth, Big O Notation, Omega Notation, Theta Notation, Guidelines for Asymptotic Analysis
Sorting: Introduction, Classification of Sorting Algorithms, Selection Sort, Merge Sort, Quick Sort, Radix sort, Comparison of Sorting Algorithms

UNIT III

Linked Lists: Linked List ADT, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists;
Stacks: Stack ADT, Applications;
Queues: Queue ADT, Applications

UNIT IV

Trees: Introduction, Binary Trees, Types of Binary Trees, Properties of Binary Trees, Binary Tree Traversals, Binary Search Trees (BSTs);
Graph: Introduction, Applications of Graphs, Graph Representation, Graph Traversals

UNIT-V

String Algorithms: Introduction, String Matching Algorithm, Brute Force Method, String Matching with Finite Automata, KMP, Tries

Hashing: Hash Table ADT, Components of Hashing, Hash Table, Hash Function, Load Factor, Collisions, Collision Resolution Techniques, Separate Chaining, Open Addressing, Comparison of Collision Resolution Techniques

TEXT BOOKS:

1. Narasimha Karumanchi,"Data Structures and Algorithmic Thinking With Python", Career Monk Publications, 2016
2. Tony Gaddis, “Starting out with Python”, 4th Edition, Global Edition, Pearson Education Limited, 2019
3. Jake Vander Plas, “Python Data Science Handbook”, OReilly, 2017

SUGGESTED READING:

1. Wes McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython”,2nd Ed, OReilly, 2018
2. Michael T.Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2013.
3. Kenneth A. Lambert, "Fundamentals of Python: Data Structures”, CengageLearning, 2018.

Online Resources:

1. https://visualgo.net/en
2. https://jakevdp.github.io/PythonDataScienceHandbook/
3. https://www.coursera.org/specializations/data-structures-algorithms3.
4. https://nptel.ac.in/courses/106/106/106106182/
5. https://www.cs.usfca.edu/~galles/visualization/Algorithms
6. https://www.edx.org/course/algorithms-and-data-structures

22BTC03

PROCESS PRINCIPLES AND REACTION ENGINEERING

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

COURSE OBJECTIVES: This course aims to

1. The course aims to impart knowledge of the basic chemical engineering principles and techniques used in analyzing a biochemical process.
2. The course aims to provide the students with an understanding of how to represent experimental data in graphical form.
3. This course also aims to enable the students to evaluate material balances in different units.
4. The course aims at enabling the students to learn calculations regarding enthalpy and heat of reactions
5. The course aims to impart knowledge of homogenous reactions and enhance skills to formulate and analyze different types of reaction kinetics used in biochemical engineering.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Grasp the fundamentals of physical variables, dimensions, units, equations with dimensional homogeneity, and measurement conventions, fostering their ability to apply these principles in practical engineering scenarios.
2. Analyze and present experimental data using graphs, including understanding errors, significant figures, statistics, and logarithmic coordinate graphs, while following proper data plotting procedures.
3. Confidently compute material balances for biotech processes, applying principles to real cases along with recycle, by-pass, and purge streams.
4. Solve enthalpy-related challenges in non-reactive and reactive scenarios, and apply energy balance concepts to practical cases within biotechnology processes
5. To predict growth kinetics and analyze reaction kinetics for biological systems.

CO-PO ARTICULATION MATRIX

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

UNIT I

Introduction to Engineering calculations: Physical variables, Dimensions, and Units: Substantial and Natural variables, Equations with and without Dimensional Homogeneity, Units and conversions; SI and MKS system of Units; Measurement conventions, Density, Specific gravity, and Specific volume. Concentration units for pure components, Moles, Chemical composition, Temperature, Pressure, Standard conditions, and Ideal gases; Ideal gas law, Definition of Stoichiometry.

UNIT II

Presentation and Analysis of Data: Presentation and Analysis of Data, Errors in Data and Calculations, Significant Figures, Types of Error, Statistical Analysis, Presentation of Experimental Data, Data Analysis, Graph Paper with Logarithmic Coordinates, General Procedures for Plotting Data.

UNIT III

Material balances: Law of conservation of mass, Types of material balance problem, Simplification of the general mass balance equation, Procedure for material balance calculations, material balance worked examples; Continuous filtration, batch mixing, Continuous fermentation, Xanthum gum production. Material balances with recycle, By-pass, and Purge streams.

UNIT IV

Energy Balances: Basic Energy concepts, General energy balance equations, Enthalpy calculation procedures, Enthalpy Change in Non-Reactive Processes, Procedure for Energy-Balance Calculations without reaction, Enthalpy Change Due to Reaction, Heat of Reaction for Processes with Biomass Production, Fermentation energy balance equation worked examples (Ethanol fermentation and Citric acid production.

UNIT V

Homogenous reactions: Basic reaction theory, Reaction; thermodynamics, Yield, Rate, Kinetics, Effect of temperature on reaction rate. Calculation of Reaction rates from experimental data; Average rate –Equal Area method. Mid-point slope method. General reaction kinetics for biological systems; Zero order and first-order kinetics, Michaelis - Menten Kinetics. Cell Growth Kinetics; Batch growth, balanced growth, Effect of Substrate concentration. Growth kinetics with Plasmid Instability, Plasmid instability in batch culture.

TEXT BOOKS:

1. Pauline M. Doran, 2013, Bio-process Engineering Principles, 2nd Edition, Academic Press.
2. Hougen and Watson K M and Ragatz R A, 1959, Chemical Process Principles, 2nd Edition, Wiley.
3. Bhatt B I and S M Vora, Stoichiometry**,** 2006, 4th edition, Tata McGraw Hill.
4. Chemical Reaction Engineering, Octave Leven Spiel, 3rd Edition, Wiley.

SUGGESTED READINGS:

1. David M. Himmelblau, James B. Riggs, “Basic Principles and Calculations in Chemical Engineering”, 8/e, Prentice Hall, 2012.
2. James E Bailey, David F Ollis, “Biochemical Engineering Fundamentals: Solutions Manual” McGraw-Hill Education, 1979.
3. Harvey W Blanch, Douglas S Clark “Biochemical Engineering”, 1st Edition, 1997

22BTC04

BIOCHEMISTRY

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

COURSE OBJECTIVES: This course aims to

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

COURSE OUTCOMES: After completion of this course, student 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 nucleic acids.

CO-PO ARTICULATION MATRIX

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

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, anaplerotic 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 Deoxyribonucleotides; Degradation of Purine and Pyrimidine Nucleotides.

TEXT BOOKS:

1. David Lee Nelson and Michael M. Cox, Lehninger, "Principles of Biochemistry", 6th Edition, W.H. Freeman, 2013
2. Eric E.Conn, Paul K. Stumpf, George Bruening, Roy H. Doi, "Outlines of Biochemistry", 5th Edition, John Wiley and Sons, 2006.

SUGGESTED READINGS:

1. Donald Voet and Judith G. Voet, "Biochemistry", 4th edition, John Wiley & Sons, New York, 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.

22BTC05

MICROBIOLOGY

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

COURSE OBJECTIVES: This course aims to
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: After completion of this course, student will be able to
1. Relate the contribution of various scientists in the development of microbiology
2. Classify microorganisms based on their characteristics
3. Apply the concept of culturing microorganisms aseptically
4. Explain various ecological aspects of microorganisms like diversity, distribution, specific interactions, and the effect that they have on ecosystems
5. Illustrate the mechanisms for the propagation of infectious diseases caused by the microorganism

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	0	0	1	1	2	1	3	0	1	0	3	2	2
CO2	1	0	0	1	2	2	1	0	1	1	0	3	3	3
CO3	1	1	0	1	1	2	1	1	1	0	0	3	3	3
CO4	1	0	0	0	1	2	0	0	1	1	0	3	3	3
CO5	1	0	0	2	2	2	0	1	1	1	0	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 their formation.

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 cell mass).

UNIT IV

Microbial Ecology: Terrestrial Environment: Soil microflora, Aquatic Environment: Microflora of Freshwater & Marine habitats, Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity. Microbe–Microbe Interactions Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Biocontrol agents, key nutrient cycles: Carbon, Nitrogen, and Sulphur. Overview of metagenomics.

UNIT-V

Microbiology and 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) and related case studies.

TEXT BOOKS:

1. Gerard Tortora, Berdell Funke, Christine Case, Derek Weber, Warner Bair Pearson, Microbiology: An Introduction; 13th edition (January 8, 2018)
2. Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Brock Biology of Microorganisms, Publisher: Benjamin-Cummings Pub Co; 13th edition (17 December 2010)

SUGGESTED READINGS:

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 Macmillan Limited, 1999.

22BTC06

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: This course aims to

1. The student is made to understand the basics of cell biology i.e., the concept of cellular organelles and their functions.
2. Students are taught the structure of the cytoskeleton, and how it maintains the cell structure integrity.
3. The student is made to understand the basics of molecular biology and the central dogma of the genetic material

COURSE OUTCOMES: After completion of this course, student will be able to

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

1. Recognize the structure and functions of cell organelles.
2. Interpret the knowledge of the transport of metabolites and cell cycle checkpoints 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.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	0	0	1	1	2	1	3	0	1	0	3	2	3
CO2	1	1	0	1	1	2	1	0	1	1	0	3	2	3
CO3	1	1	0	1	1	2	1	1	1	0	0	3	1	3
CO4	1	0	0	0	1	2	0	0	1	1	0	3	2	3
CO5	1	0	0	2	2	2	0	1	1	1	0	3	3	3

UNIT I

Cell Structure, Organelles, and their Functions: Cell structure and organization in bacteria, plants, and animal cells; structure and functions of the cell wall, lysosomes, ribosomes, Golgi complex, peroxisomes, glyoxysomes, mitochondria, plastids, endoplasmic reticulum, vacuoles, centrioles; cytoskeleton - composition, structure, and functions of microtubules, microfilaments and intermediate filaments; nucleus, its ultra-structure, (nuclear envelope, nucleoplasm, chromatin fibers).

UNIT II

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

UNIT III

Organization, Replication, Damage and Repair of DNA: Structure of DNA–Watson and Crick's model; 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; unidirectional, bi-directional and rolling circle replication; DNA damage and repair: Types of DNA damages- deamination, alkylation, pyrimidine dimers; DNA Repair mechanisms- photo reactivation, Excision repair & mismatch repair.

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 of RNA - (rRNA, mRNA, tRNA, snRNA), prokaryotic and eukaryotic transcription. Processing of tRNA, rRNA, mRNA splicing; the 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 a 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 Hausman, "The cell: A molecular approach", 6th edition, Sinauer Associates, 2013.
2. Gerald Karp, "Cell and Molecular Biology": concepts and experiments, 6th edition, John Wiley & Sons, 2009.
3. David Freifelder, "Molecular Biology," 2nd edition, Narosa Publication, 2007.

SUGGESTED READINGS:

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

22BTC07

GENETICS

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

COURSE OBJECTIVES: This course aims to
1. To enable students to understand the basic 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 maternal inheritance and quantitative genetics.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Estimate 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 the linkage and crossing-over mechanism.
4. Categorize sex determination, the chromosomal basis of genetic disorders, and sex-linked genes.
5. Illustrate maternal inheritance genotypic frequencies in a population and categorical data analysis.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	0	0	1	0	2	1	1	1	1	1	1	1	1
CO2	2	0	0	1	1	0	1	1	0	1	1	1	2	2
CO3	1	1	0	1	0	0	1	1	1	0	1	1	2	2
CO4	1	0	1	0	0	2	1	1	1	1	1	1	2	2
CO5	2	1	1	1	2	0	1	0	1	1	1	1	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.

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. Gardner, E. J., Simmons, M. J., Snustad, D. P. and Snustad, "Principles of Genetics", 8th edition, John Wiley and Sons, Inc. 2008.
2. Singh, B.D. "Genetics - 3rd edition", Kalyani Publications, 2004.
3. Snustad, D. Peter, Simmons Michael, "Principles of Genetics" 6th edition, John Wiley& Sons publication, 2011.

SUGGESTED READINGS:

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", 5th Rev Edition (2nd Reprint), Rastogi Publications, 2018.

22CEM01

ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

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

COURSE OBJECTIVES: This course aims to

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
3. To enable the students become aware of pollution of various environmental segments including their causes, effects, and control measures. To create awareness about environmental legislations in the context of national conventions.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
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 framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

CO-PO ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	3	-	-	-	-	1	-	1
CO2	1	-	-	-	-	-	2	1	-	-	-	1	-	1
CO3	1	-	-	-	-	-	2	1	-	-	-	1	-	1
CO4	1	-	-	-	-	1	2	1	-	-	-	1	-	1
CO5	1	-	-	-	-	1	2	1	-	-	-	1	-	1
Average	1	-	-	-	-	1	2.2	1	-	-	-	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

22CSC36

DATA STRUCTURES USING PYTHON LAB

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

COURSE OBJECTIVES: This course aims to

1. To introduce data structures in python.
2. To familize with visualization techniques and tools in python.
3. To implement ADT for linear and nonlinear structures.
4. To analyze the performance of sorting and searching techniques.
5. To gain knowledge on applying data structures in real world problems.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Demonstrate Classes, Objects, linear data structures, nonlinear data structures.
2. Store, retrieve and visualize datasets using Python built-in packages.
3. Evaluate the performance of sorting and searching techniques.
4. Build optimal solutions using linear data structures, nonlinear data structures and hashing.
5. Apply pattern matching algorithms for real time problems.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	1

LIST OF EXPERIMENTS:

1. Demonstration of class and objects.
2. Read a dataset, describe, visualize and provide inference.
3. Implement the Sorting algorithms: Selection Sort, Merge Sort, QuickSort, RadixSort.
4. Implementation of Search: Linear Search, Binary Search
5. Define Singl eLinked List ADT: Insertions, Deletions, Display, Detection of Loops,
6. Define Doubly Linked List ADT and perform all standard operations.
7. Define Stack and Queue ADTs and implement standard operations
8. Applications of Stacks and Queues.
9. Implementation of Binary Search Tree: Insertion, Deletion, Traversal
10. Implementation of Graph traversal techniques.
11. Implementation of Hashing.

TEXTBOOK:

1. Narasimha Karumanchi,"Data Structures and Algorithmic Thinking With Python",Career Monk Publications, 2016
2. Jake Vander Plas, Python Data Science Handbook, OReilly, 2017

SUGGESTED READING:

1. Michael T. Goodrich, Roberto Tamassia,Michael H. Goldwasser,"Data Structure and Algorithms in Python", Wiley, 2013.
2. Kenneth A. Lambert, "Fundamentals of Python: Data Structures", Cengage Learning, 2018.
3. Narasimha Karumanchi, "Data Structures and Algorithms for GATE", Career Monk Publications,2011
4. Wes McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython", 2nd Ed, OReilly, 2018

WEB RESOURCES:

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms

22BTC08

BIOCHEMISTRY LAB

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

COURSE OBJECTIVES: This course aims to
1. Students will learn laboratory safety and standard operating procedures.
2. Students will learn how to estimate and analyze different biomolecules.

COURSE OUTCOMES: After completion of this course, student 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 amino acids 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.

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	2	2	2	2	1	0	3	2	1	3	2	3
CO2	1	1	1	2	2	2	2	0	3	2	0	3	1	3
CO3	2	1	1	2	2	2	2	0	3	2	1	3	1	3
CO4	1	2	2	2	1	3	2	0	3	2	1	3	2	3
CO5	1	1	1	2	2	2	2	0	3	2	1	3	1	3

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 Carbohydrates by Anthrone method.
6. Estimation of sugars from the given sample by DNS method. (Structured enquiry)
7. Estimation of Amino acids 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. (Open-ended)

SUGGESTED READING:
1. David, T. Plummer, “An introduction to Practical Biochemistry”, 3rd edition, Tata McGraw Hill, 1988.
2. Beedu Shashidhar Rao, Vijay Deshpande, “Experimental Biochemistry – A student companion”, Anshan Pub, 2006.

22BTC09

MICROBIOLOGY LAB

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

COURSE OBJECTIVES: This course aims 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: After completion of this course, student 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 the nomenclature of microorganisms based on their metabolic activity

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2	0	2	2	1	0	3	1	1	3	2	2
CO2	1	0	1	0	2	2	2	0	3	2	0	3	3	3
CO3	2	1	1	0	2	2	1	0	3	2	1	3	3	3
CO4	1	2	2	0	1	2	2	0	3	2	1	3	3	3
CO5	1	1	1	0	2	2	2	0	3	2	1	3	3	3

LIST OF EXPERIMENTS:
1. Calibration of Microscope and Measurement of Microorganisms-Micrometer.
2. Staining and Identification of Microorganisms: 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, Pour plate.
6. Antibiotic tests- Disc diffusion method, minimum inhibitory concentration.
7. Biochemical tests- IMIVC test, Catalase, Coagulase test, Gelatinase test, Oxidase.
8. Factors affecting bacterial growth and study of the 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 READINGS:
1. Microbiology: Laboratory Theory and Application 4th Edition Michael J. Leboffe, Burton E. Pierce Morton Publishing Company; 4th edition (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.

22BTI01

MOOCS/INTERNSHIP – I

PLEASE REFER ANNEXURE OF R22 RULE BOOK

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(In line with AICTE Model Curriculum with effect from AY 2023-24)

B. TECH BIOTECHNOLOGY

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	22MTC11	Engineering Mathematics for Biotechnologists	3	1	-	3	40	60	4
2	22BTC10	Fermentation Technology	3	-	-	3	40	60	3
3	22BTC11	Immunology & Immunotechnology	3	-	-	3	40	60	3
4	22BTC12	Instrumental Methods in Biotechnology	3	-	-	3	40	60	3
5	22BTC13	Thermodynamics for Biotechnologists	3	-	-	3	40	60	3
6	22BTC14	Introduction to Anatomy and Physiology of Humans	3	-	-	3	40	60	3
7	22EGM01	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	Non-credit
	PRACTICALS								
8	22BTC15	Fermentation Technology Lab	-	-	2	2	50	50	1
9	22BTC16	Immunology Lab	-	-	2	2	50	50	1
10	22BTC17	Instrumentation Lab	-	-	2	2	50	50	1
Total			**20**	**1**	**6**	**-**	**390**	**560**	**22**
Clock hours per week: 27									

L: Lecture D: Drawing T: Tutorial P: Practical /Project Seminar/Dissertation
CIE - Continuous Internal Evaluation SEE - Semester End Examination

22MTC11

ENGINEERING MATHEMATICS FOR BIO-TECHNOLOGISTS

(For Bio-Technology)

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

COURSE OBJECTIVES: This course aims to

1. To discuss solutions of higher order differential equations.
2. To form PDE and solve Linear and Nonlinear equations.
3. To discuss differentiability of complex functions.
4. To evaluate Complex integrals.
5. To learn Numerical solution algebraic and transcendental equations.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Solve the higher order linear differential equations.
2. Solve Linear and Non-linear Partial differential equations.
3. Determine the analytic functions.
4. Expand functions by using Taylor's and Laurent's series and Complex integrals by using Cauchy Theorems.
5. Solve Nonlinear algebraic and transcendental equations.

CO-PO ARTICULATION MATRIX

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

UNIT I

Differential Equations of Higher Order: Higher order linear differential equations with constants coefficients, Method to find complementary functions, Particular Integral when $x=e^{ax}$, Sinax, Cosax, $e^{ax}v(x)$, $x^m v(x)$, Solutions of Cauchy-Euler differential equations, Method of Variation of Parameters.

UNIT II

Partial Differential Equations: Formation of Partial Differential Equations, Linear Equations of First Order (Lagrange's Linear Equations), Solution of First Order Nonlinear Partial Differential Equations (Standard forms) and Charpit's method. Solutions by method of separation of variables, Solution of one dimensional wave equation and its applications.

UNIT III

Complex Differentiation: Limit, Continuity and Derivative of complex function, Cauchy- Riemann equations in Cartesian coordinates (without proof), Analytic functions, Harmonic functions, Conjugate Harmonic functions Construction of Analytic function by Milne -Thompson method

UNIT IV

Complex Integration: Complex line integral, Cauchy's theorem, Cauchy's integral formula (without Proof), Series of Complex Terms: Taylor's series, Laurent's series, Singularities of analytic functions: Isolated Singularity, Removable singularity Pole, Essential singularity Residues, Residues theorem. (Without proof)

UNIT V

Numerical Methods: Solution of Algebraic and Transcendental equations: Bisection method, Regular Falsi method and Newton - Raphson Method, Numerical solutions of first order Ordinary differential equations: Euler's method and Runge-kutta method of 4th order.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. 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.

SUGGESTED READING:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley publishers, 2015.
2. "Introductory Methods of Numerical Analysis" Fifth edition, PHI learning PVT Ltd, 2012.

22BTC10

FERMENTATION TECHNOLOGY

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

COURSE OBJECTIVES: This course aims to

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

COURSE OUTCOMES: After completion of this course, student will be able to

1. Gain knowledge on diverse fermentation processes, the historical development of the industry, industrial applications, and emerging trends
2. Understand about controlling process parameters, media formulation in bioprocesses, and solid-state processes.
3. Determine the volumetric mass transfer coefficient and factors affecting the same in aerobic fermentation
4. Apply the knowledge of scale-up and scale-down techniques in fermenters and determine cell growth and sterilization kinetics
5. Apply the knowledge of different bioreactors like airlift, fed-batch, batch, and continuous in bioreactors while evaluating their performances in bioprocesses industries.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	1	1	0	0	2	3	0	0	1	0	3	2	2
CO2	2	2	1	3	3	0	3	0	3	1	0	3	2	2
CO3	2	2	0	1	1	0	0	0	0	0	0	3	2	2
CO4	2	2	0	1	0	0	0	3	0	0	0	3	2	2
CO5	2	2	2	1	0	2	3	0	2	1	0	3	2	2

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 with reference to *Penicillium chrysogenum*; Transfer of inoculums from seed tank to Fermenter.

UNIT II

Basic Design of the Fermenter and Media: General requirements of fermentation processes, Basic design, and construction of fermenter and ancillaries, 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, KLa values; Other Factors affecting the values of mass transfer coefficients in fermentation vessels.

UNIT IV

Selection, Scale-up, Operation and Control of Fermenters: Introduction, Scale up and its difficulties: Some considerations on aeration, agitation, and heat transfer, scale up and scale down. Bioreactor control and Instrumentation: Instrumentation for measurements and control of the parameters in active fermentation viz. pH, Temperature, DO, Foam and. Pressure

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. airlift, fluidized, batch, packed bed, Bubble column, trickle bed reactors.

TEXT BOOKS:

1. Pauline M. Doran, "Bioprocess Engineering Principles", Academic Press, 1995
2. Stanbury PF, Whitaker A, and Hall S J, "Principles of Fermentation Technology" 2nd edition, Elsevier, 2013.
3. Shuler M and Kargi F, Bioprocess Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 2002

SUGGESTED READINGS:

1. Bailey JE and Ollis DF, "Biochemical Engineering Fundamentals", 2 edition, McGraw-Hill, 1986
2. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering" 1 edition, CRC, 1997.

22BTC11

IMMUNOLOGY AND IMMUNOTECHNOLOGY

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

COURSE OBJECTIVES: This course aims to
1. Students learn about the basic components and responses of the Immune system.
2. Knowledge of the structure of antigens and antibodies and the processing of antigens.
3. Students understand the significance of the complement system and hypersensitivity
4. The immunological basics for diseases are taught to the students.
5. Importance of antigen and antibody interactions.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Identify immune system components and how they work in a coordinated way.
2. Differentiate the structure of antigen-antibody and the methods of processing antigen.
3. Analyze the immune system-related underlying causes of hypersensitivity and complement systems.
4. Desribe the immune system-related diseases, medical complications, and prevention of diseases.
5. Apply the principles of immunological techniques in the development of medical diagnostic kits.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1	2	2	2	2	2	1	1	1	0	3	2	3
CO2	2	1	1	2	2	3	2	3	0	2	0	3	1	3
CO3	1	1	1	1	2	3	2	3	0	1	0	3	1	3
CO4	1	2	1	2	3	3	2	3	2	2	2	3	2	2
CO5	3	2	1	2	3	3	2	3	3	2	2	3	1	2

UNIT I

Immune System: Introduction to immunity; types of immunity – innate and adaptive immunity, humoral and cell-mediated immune response; hematopoiesis; 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 - Structure, Properties; Processing and Presentation of Antigen: Antigen–immunogenicity and antigenicity, factors influencing immunogenicity; haptens and adjuvants, 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 no peptide antigen.

UNIT III

The Complement System and Hypersensitivity: Complement system – components, function, activation (classical and alternative pathway); Types and Mechanism of 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); immunoprophylaxis (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, immune electrophoresis, RIA, ELISA, western blotting, immunofluorescence, FACS.

TEXTBOOKS:

1. Jenni Punt, Sharon Stanford, Patricia Jones, Judith A Owen., "Kuby Immunology", 8th edition, WH Freeman, 2018.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, "Roitt's Essential Immunology", 13th edition, Wiley-Blackwell, 2017.

SUGGESTED READING:

1. Kenneth Murphy, Casey Weaver "Janeway's Immunobiology", 9th edition, Garland Science, 2016.
2. Abdul K. Abbas, Andrew H. Lichtman, Shiv Pillai, "Cellular and Molecular Immunology", 10th edition, Elsevier, 2021.
3. Sunil Kumar Mohanty, K. Sai Leela, "Textbook of Immunology", 2nd edition, Jaypee Brothers Medical Publishers, 2014.

22BTC12

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: This course aims to
1. Types of analytical methods, instruments used for analysis, and the importance of microscopy
2. Types of instruments used for isolation of Bimolecular and Subcellular organelles
3. Types of chromatographic techniques
4. Charge-based separation techniques
5. The principles and applications of spectroscopic methods

COURSE OUTCOMES: After completion of this course, student will be able to
1. Explain the instrumental errors and working of different microscopes.
2. Describe various techniques to isolate cellular components and products.
3. Compare various techniques in the purification of cellular products.
4. Illustrate various electrophoresis techniques to isolate DNA/Protein from a mixture.
5. Explain the working of various spectroscopic instruments.

CO-PO ARTICULATION MATRIX

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	2	2	2	1	1	1	0	3	2	3
CO2	2	1	1	2	2	3	2	1	0	1	0	3	1	3
CO3	0	0	1	1	2	2	0	2	0	1	0	3	1	3
CO4	1	1	1	1	2	3	2	3	2	1	2	3	2	2
CO5	3	2	1	2	3	2	2	3	3	2	2	3	1	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 the Bright field. Darkfield, fluorescent, and electron microscopy.

UNIT II

Instruments For Isolation Techniques: Cell disruption by the French press, Sonification, freeze-thaw technique; use of liquid N_2 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 subcellular organelles and Biomolecules. Determination of molecular weight and purity of Biomolecules by analytical ultra-centrifugation.

UNIT III

Basic Chromatographic Techniques: Partition chromatography, Counter current distribution, adsorption chromatography: Paper, TLC& GLC. Methods based on size: Gel permeation chromatography, principle, application-Molecular weight determination. Affinity chromatography, application & technique for purification of proteins and nucleic acids. Principle and application of Ion exchange chromatography, use of ion exchange- cation& anion exchangers.

UNIT IV

Charge-Based Separation Techniques: Electrophoresis: Migration of charged molecules in electric field-moving boundary, paper, cellulose acetate, starch gel electrophoresis, SDS PAGE, Determination of molecular weight, pH, and salt gradients for elution of proteins, amino acids, 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 gel electrophoresis.

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 (2012 Edition)
2. Keith Wilson and John Walker, "Principles and Techniques of Biochemistry and Molecular Biology", 6th edition, Cambridge University Press, 2005.
3. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India, 2012.

SUGGESTED READING:

1. S. Malathi, Pallavi Mangesh Patil, Sunil Kumar, 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 (2015 Edition)
3. GW Ewing, "Instrumental Methods of Chemical Analysis", 4th edition, McGraw-Hill, 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", Thomson Brooks/Cole, 2004.

22BTC13

THERMODYNAMICS FOR BIOTECHNOLOGISTS

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

COURSE OBJECTIVES: This course aims to

1. The course aims at providing the students with knowledge about 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 with the knowledge to perform stoichiometric and energetic analysis of cell growth and product formation

COURSE OUTCOMES: After completion of this course, student will be able to

1. Comprehensively analyze heat and work effects within closed systems and cyclic processes.
2. Learn about the limitations of the First Law of Thermodynamics, the qualitative aspects of the Second Law, entropy calculations for ideal gases, and the application of Maxwell relations and residual properties.
3. Calculate partial molar properties in binary systems, comprehend chemical potential, Raoult's and Henry's laws, and apply correlations to evaluate activity coefficients, enabling them to analyze solution thermodynamics effectively.
4. Calculate vapor-liquid equilibria in binary systems and understand the fundamentals of chemical reaction equilibria.
5. Understand metabolic pathway energetics, energy coupling via ATP and NADH, analyze cell growth energetics, explore microbial growth thermodynamics, and apply energy balance equations to aerobic cultures in cell culture processes.

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	1	2	2	2	2	0	0	2	0	3	3	3
CO2	2	2	1	2	2	2	2	0	0	3	0	3	2	3
CO3	2	2	1	2	2	2	2	0	0	2	1	3	2	1
CO4	2	2	1	2	2	2	2	0	0	2	1	3	2	1
CO5	2	2	1	2	2	2	2	0	0	2	0	3	2	3

UNIT I

Introduction To Thermodynamics: System Definition and Classification of the 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 coordinate** –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", Universities Press, 2004.

SUGGESTED READING:

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

22BTC14

INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS

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

COURSE OBJECTIVES: This course aims to

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

COURSE OUTCOMES: After completion of this course, student will be able to

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

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	0	1	1	1	2	2	1	1	1	0	2	1	1
CO2	1	0	1	0	1	2	2	1	1	1	0	2	1	1
CO3	1	0	1	1	1	2	2	1	1	2	0	1	1	1
CO4	1	0	1	1	1	2	2	1	1	2	0	2	1	1
CO5	0	0	1	1	1	2	2	1	1	2	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 the human body and their general roles; Homeostasis; Types of endocrine glands, Anatomy and physiology of pituitary, thyroid, pancreas.

UNIT II

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

UNIT- III

Anatomy and Physiology of Excretory System, Circulatory System, and Respiratory System: 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, the 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, 2019
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 edition, 2013.
2. Anthony A. Goodman – "Understanding the Human Body - An Introduction to Anatomy and Physiology"-The Teaching Company, 2004

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/B.Tech - Common to all branches)

Instruction	2 L Hours per week
Duration of SEE	2 Hours
Semester End Examination	50 Marks
CIE	-
Credits	0

PREREQUISITE: Basic Awareness of Indian Constitution and Government.

COURSE OBJECTIVES: This course aims to
1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

COURSE OUTCOMES: After successful completion of the course the students will be able to
1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	-	1	-	-	1	1	1	1	-	-	-	-	--
CO 2	-	-	2	-	-	3	2	2	1	-	-	-	3	1
CO 3	-	-	1	-	-	1	1	-	-	-	-	-	-	-
CO 4	-	-	1	-	-	1	1	-	-	-	-	-	2	-
CO 5	-	-	2	-	-	3	2	1	1	-	-	-	2	1

UNIT I

Constitutional History and Framing of Indian Constitution

East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

UNIT II

Fundamental Rights, Duties and Directive Principles of State Policy

The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

UNIT III

Union Government and its Administration

Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

UNIT IV

Union Legislature and Judiciary

Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

Unit-V

Local Self Governments

Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

TEXT BOOKS:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Akademy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, Reprinted in 2022.

SUGGESTED READING:

1. .D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

22BTC15

FERMENTATION TECHNOLOGY LAB

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

COURSE OBJECTIVES: This course aims to

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

COURSE OUTCOMES: After completion of this course, student will be able to

1. Describe the importance of media and other rheological parameters during the fermentation process
2. Analyze the difference between batch and fed-batch processes
3. Demonstrate the preparation of media and its optimization using the statistical techniques
4. Estimate the growth kinetics of microorganisms.
5. Determine the volumetric mass transfer coefficient in fermentation.
6. Perform fermentation for the production of a metabolite.

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	3	0	3	0	2	2	2	3	3	0	2	2	2
CO2	2	3	0	3	0	2	2	2	3	3	0	2	2	2
CO3	2	3	2	3	3	2	2	2	3	3	0	2	2	2
CO4	2	3	2	3	0	2	2	2	3	3	0	2	2	2
CO5	2	3	0	3	0	2	2	2	3	3	0	2	2	2

LIST OF EXPERIMENTS:

1. Bioreactor instrumentation and its control
2. Study of Batch Fermentation Process using *E. Coli*
3. Study of Fed-Batch Fermentation Process using *E. Coli*
4. Study of rheological parameters in the fermentation broth
5. Study of whole cell/enzyme immobilization and determine its activity (Open-ended)
6. Estimation of Specific growth rate and doubling time of a microorganism
7. Substrate utilization and product formation kinetics
8. Estimation of Monod parameters and determine the growth kinetics (Structured)
9. Media optimization by using Plackett-Burman design (Structured)
10. Production of citric acid by *Aspergillus niger* and its estimation by titrimetric method
11. Determination of KLa by Sulphite oxidation method

SUGGESTED READINGS:

1. Bioprocess Engineering Principles" by Pauline M. Doran
2. Bioprocess Engineering: Basic Concepts" by Michael L. Shuler, Fikret Kargı, Matthew DeLisa

22BTC16

IMMUNOLOGY LAB

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

COURSE OBJECTIVES: This course aims to
1. Students can identify the significance of blood grouping and cells.
2. Students learn the applications of agglutination reactions.
3. Students learn the applications of Precipitation reactions.
4. Students learn about the types of Immunoelectrophoresis.
5. Students learn to prepare the diagnostic kits.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Classify the blood groups, cells, and predict the diseases.
2. Demonstrate bacterial agglutination reactions
3. Measure the concentration of antigens and serotypes by using precipitation reactions.
4. Interpret the concentration of the analytes using electrophoretic techniques.
5. Analyze the importance of ELISA techniques.

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	1	1	2	3	3	2	3	2	2	1	3	2	3
CO2	2	3	1	2	3	2	2	3	3	2	1	3	2	3
CO3	2	2	1	2	3	3	2	3	2	3	2	3	2	3
CO4	1	1	2	2	3	3	2	3	2	1	1	3	1	3
CO5	2	1	1	2	3	2	2	3	1	2	2	3	1	3

LIST OF EXPERIMENTS:
1. ABO Blood grouping and identification of Rh typing,
2. Total and differential count of RBC & WBC by micropipette method. (Structured enquiry)
3. Isolation and microscopic visualization of T cells and B cells.
4. Erythrocyte sedimentation rate.
5. WIDAL test.
6. VDRL tests.
7. Radial immunodiffusion test.
8. Ouchterlony double diffusion for Antigen Antibody Patterns.
9. Immunoelectrophoresis.
10. Rocket Immunoelectrophoresis.
11. Enzyme-Linked Immunosorbent Assay for antigen capture and antibody capture. (Open-ended)

SUGGESTED READINGS:
1. Arti Nigam, Archana Ayyagari, “Lab Manual in Biochemistry, Immunology, and Biotechnology”, Tata McGraw Hill Education, 2007.
2. S. Ramakrishna and K. N. Sulochana, “Manual of Medical Laboratory Techniques”, 1st edition, Jaypee Brothers Medical Publishers, 2012.

22BTC17

INSTRUMENTATION LAB

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

COURSE OBJECTIVES: This course aims to
1. Understand the basic concepts for the operation of pH and spectrophotometer.
2. Estimate the micro and macro molecules by using chromatography techniques.
3. Separate the biomolecules with the application of different methods of electrophoresis.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Apply the instrumentation techniques to their real-life applications
2. Demonstrate the preliminary identification of biomolecules by partition chromatography method
3. Design the experiment to find the molecular weight of an unknown protein
4. Examine the analytes by using a UV-Visible spectrophotometer, Conductivity meter, Nephelometer, and flame photometer
5. Justify their results on the separation of biomolecules by differential centrifugation methods.

CO-PO ARTICULATION MATRIX

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	1	1	2	3	3	2	3	2	2	1	3	3	3
CO2	1	2	0	2	3	2	2	3	3	1	1	3	3	3
CO3	1	2	1	2	3	2	2	3	2	2	1	3	3	3
CO4	1	1	2	2	3	3	2	3	1	1	1	3	3	3
CO5	2	1	1	2	3	2	2	3	1	1	2	3	3	3

LIST OF EXPERIMENTS:
1. The calibration of the pH meter and measurement of pH for different solutions
2. Estimation of Ascorbic acid by colorimetric assay
3. Estimation of unknown samples by using a conductivity meter
4. Estimation of different macromolecules by visible spectrophotometer
5. Verification of Lambert - Beers law by UV -VIS spectrophotometer
6. Estimation of proteins and nucleic acids by UV method
7. Estimation of turbidity using Nephelometer
8. The separation of different macromolecules by Thin layer chromatography (Structured enquiry)
9. The separation of different macromolecules by paper chromatography (Open-ended)
10. The separation of different macromolecules by SDS-PAGE
11. Estimation of minerals by Flame photometry
12. Estimation of Thiamine and Riboflavin by Fluorimetry
13. Preparation of Standard curve using UV-VIS & Flame Photometry
14. Fractionation of Plasma Proteins by Electrophoresis
15. Membrane protein extraction by differential centrifugation

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Inline with AICTE Model Curriculum with effect from AY 2023-24

LIST OF OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF BIOTECHNOLOGY

S. No	Subject Code	Subject Name
1	22BTO01	Biology For Engineers
2	22BTO02	Biomaterials For Engineers
3	22BTO03	Bioterrorism And National Security
4	22BTO04	Bioinformatics
5	22BTO05	Cognitive Neuroscience

22BTO01

BIOLOGY FOR ENGINEERS
(Open Elective)

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

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to
1. Understand the milestones reached by the human in the field of biology.
2. Understand the human body and its parts.
3. Understand the human anatomy and medical devices.
4. Understand types of advanced therapies.
5. Understand the treatment of toxic pollutants in the environment.
6. Understand genome sequencing and NGS.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Appraise the values of Biology in classical and modern time
2. Develop modern instruments related to the skeletal, nervous, and circulatory system
3. Apply the concept of respiratory, excretory, and assisted reproductive processes for developing related instruments
4. Illustrate the modern interdisciplinary tools related to medical biotechnology and bioremediation
5. Summarize the basic knowledge about nucleic acids, proteins, and their sequencing

CO-PO ARTICULATION MATRIX

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

***The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction to Biology: Classical Vs Modern Biology; Importance of Biological Science and Historical Developments; Origin of Life, Urey Miller Experiment, Spontaneous Generation Theory; Three Domains of Life; Principle and Applications of Microscope (Light and Electron Microscope), Prokaryotic and Eukaryotic Cell-Structure and their differences.

UNIT II

Human Anatomy and Functions-I: Human organ systems and their functions; Skeletal System-Bones, Tendon, Ligaments, principle and applications in knee replacement; Nervous System - Structure of Brain, Spinal Cord, Neuron, Neurotransmitters, Synapse, Alzheimer's - a case study, principle, and applications of Imaging Techniques (CT & MRI scans); Circulatory System - Heart structure and functions, principle and applications of cardiac devices (Stent and Pacemaker), Artificial heart, blood components, and typing, hemocytometer.

UNIT III

Human Anatomy and Functions-II: Respiratory Systems - Lung structure and function, principle, and applications of Peak Flow Meter, ECMO (Extra Corporeal Membrane Oxygenation); Excretory Systems-Kidney structure and function, principle and applications of Dialysis; Prenatal diagnosis; Assisted reproductive techniques- IVF, Surrogacy.

UNIT IV

Medical Biotechnology and Bioremediation: Cells of Immune System, Etiology of cancer, Cancer treatment (Radiation Therapy); Stem Cells and its Clinical applications; Scaffolds and 3D printing of organs; Biosensors and their applications; Parts of bioreactor and its types; Bioremediation.

UNIT - V

Bioinformatics: Nucleic acid composition, Genetic Code, Amino acid, Polypeptide, Levels of protein structure, Homolog, Ortholog and Paralog, Phylogenetics, Genome Sequencing, Human Genome Project, Next generation sequencing.

TEXT BOOKS:

1. Champbell, N.A., Reece, J.B., Urry, Lisa, Cain, M, L., Wasserman, S.A., Minorsky, P.V., Jackson, R.B., "Biology: A global approach", Pearson Education Ltd, Edition 11, 2017.
2. Shier, David, Butler, Jackie, Lewis, Ricki., "Hole's Human Anatomy & Physiology"., McGraw Hill 2012.

SUGGESTED READING:

1. Bernard R. Glick, T. L. Delovitch, Cheryl L. Patten, "Medical Biotechnology", ASM Press, 2014.

22BTO02

BIOMATERIALS FOR ENGINEERS
(Open Elective)

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

PREREQUISITES: Undergraduate First-year basic concepts of physics and chemistry are required

COURSE OBJECTIVES: This course aims to
1. To learn the types and trends of Biomaterials.
2. To recognize the procedures for manufacturing of Metallic Biomaterials.
3. To be aware of the types of ceramic Biomaterials.
4. To elaborate on the detailed features of polymer and composite Biomaterials.
5. To learn the applications of Biomaterials.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Explain the types and properties of Biomaterials.
2. Compare the techniques for the manufacture of metallic Biomaterials and their use in the healthcare industry.
3. Outline the physiological properties and various techniques for the manufacture of ceramic biomaterials.
4. Illustrate the preparation of the polymer and composite Biomaterials.
5. Apply the different types of Biomaterials in the health industry.

CO-PO ARTICULATION MATRIX

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

***The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction to Biomaterials: Introduction and importance of biomaterials; Types of biomaterials: metallic, ceramic, polymeric, and composite biomaterials; Future trends in biomaterials.

UNIT II

Metallic Biomaterials: Properties of metallic biomaterials; Stainless steels; CoCr alloys; Ti alloys; Corrosion of metallic implants; Manufacturing of implants. Dental implants and their biocompatibility

UNIT III

Ceramic Biomaterials: Properties of ceramic biomaterials; Classification according to the physiological response of ceramic biomaterials: bioinert, bioactive, and bioresorbable ceramics; Deterioration of ceramics; Bioceramic manufacturing techniques

UNIT IV

Polymeric and composite biomaterials: Polymerization and basic structure; Polymers used as biomaterials; Properties of polymeric and composite biomaterials; Sterilization; Surface modifications for improving biocompatibility; Surface-protein interactions.

UNIT-V

Applications of Biomaterials: Applications of biomaterials in tissue engineering; Drug delivery; Biosensing; Diagnostics.

TEXT BOOKS:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E An Introduction to Materials in Medicine, (Elsevier Academic Press, ISBN: 0-12-582463-7), 2002.
2. 2. J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications. CRC Press. 2002. ISBN: 0849314917
3. K.C. Dee, D.A. Puleo and R. Bizios. An Introduction to Tissue-Biomaterial Interactions. Wiley 2002. ISBN: 0-471-25394-4.

REFERENCE BOOKS:

1. T.S. Hin (Ed.) Engineering Materials for Biomedical Applications. World Scientific. 2004. ISBN 981-256-061-0
2. Rolando (Ed.) Integrated Biomaterials Science. Springer. 2002. ISBN: 0-306-46678-3.

22BTO03

BIOTERRORISM AND NATIONAL SECURITY
(Open Elective)

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

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to

1. Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.
2. To provide students with an in-depth characterization of different forms of bioterrorism, agroterrorism, and surveillance.
3. To define bioterrorism and forensics, the law and bioterrorism, and to present a sociological perspective on biodefense and bioterrorism
4. To provide students with contacts with faculty members, health care providers, and industry experts as a resource for information on biological threats.

COURSE OUTCOMES: After completion of this course, student will be able to

Exposure to threats to national security, methods to tackle them and support law enforcement & health agencies to handle them.

1. Evaluate different types of bioterrorism challenges.
2. Assess various categories of agents for bioterrorism.
3. Illustrate the various aspects of a bioweapon and associated case studies.
4. Apply the techniques for the detection of bioterrorism.
5. Summarize key national and international legal principles and sources that address bioterrorism

CO-PO ARTICULATION MATRIX

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

*** The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Terrorism and Bioterrorism: Definition and Historical perspective of Bioterrorism, Traditional terrorists & New terrorists (Nuclear, chemical, and radiological weapons), Agroterrorism, Bio surveillance & Bio diagnostics.

UNIT II

Types of Bioterrorism Agents: Primary classes of Microbes-bacteria, viruses, and other Agents. and their mechanism as terrorists in living systems. High-priority agents (Ebola virus), Moderate-priority agents (Brucellosis, Q fever), Low-priority agents (Yellow fever virus, Hantavirus)

UNIT III

Bio-weapons and Techniques: Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity-Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF. Genetically Engineered Microbes

UNIT IV

Prevention and Control of Bioterrorism: Surveillance and detection, Detection equipment and sensors, Novel Detections Methods for Bioagents, Industrialized Production of a Vaccine for a Bioagent, Biosecurity in the Food Industry

UNIT-V

Bioterrorism Management: Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control, and industry Support-Microbial forensics. Role of National and International Organizations in Prevention and Control of Bioterrorism

TEXT BOOKS:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press, 1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

REFERENCE BOOKS:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

22BTO04

BIOINFORMATICS
(Open Elective)

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

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to
1. To provide elementary knowledge in biology and 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, Sequence analysis, data mining, sequence alignment, and phylogenetics
3. To learn methods for determining the predicting gene and protein

COURSE OUTCOMES: After completion of this course, student will be able to
1. Explain the basic concepts of biology and bioinformatics
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree
5. Describe the methods used for gene and protein structure prediction

CO-PO ARTICULATION MATRIX

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

*** The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction And Basic Biology: Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Genome sequencing, Human Genome Project; Impact of Bioinformatics on allied fields of study.

UNIT II

Biological Databases: Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniport, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

UNIT III

Sequence Analysis and Data Mining: Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA, and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text Mining Tools

UNIT IV

Sequence Alignment and Phylogenetic: Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith-Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of the tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

UNIT-V.

Macromolecular Structure Prediction:

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbour methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modelling, threading and fold recognition, ab initio prediction.

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", 5th edition, PHI Learning Private Limited, New Delhi, 2022

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
3. JiXiong, "Essential Bioinformatics", Cambridge University Press, 2006

22BTO05

COGNITIVE NEUROSCIENCE
(Open Elective)

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

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to
1. Understanding the brain effects that give rise to our abilities to perceive, act and think
2. Gain skills on the way that cognition is associated with neural activity
3. Compare and contrast the organization and function of numerous systems within the brain

COURSE OUTCOMES: After completion of this course, student will be able to
1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand the brain's neurotransmitter system.
3. Understanding the brain's methods gives rise to behavior whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.
5. Understand the feedback system and brain disorders.

CO-PO ARTICULATION MATRIX

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

The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table

UNIT I

Introduction to neuroscience: Outline of neuroanatomical; Neurogenesis, migration Axon path-finding; cell death; Role of neural activity in development; Membranes and membrane potentials.

UNIT II

Action potential: Conductance mechanisms; Chemical and electrical transmission; Postsynaptic potentials; neural integration; Energy consumption in the brain; Attention; Methods jigsaw; Executive Control; Evolution/development; Sheep's brain dissection.

UNIT III

Neurotransmitter systems: Visual information processing; Visual cortex; Visual plasticity; critical periods; Somatosensory system; Pain; Chemoreception; Auditory system; Spinal mechanisms; Brain mechanisms.

UNIT IV

Human and Animal Memory: Pattern completion and separation; LTP and synapses; Spatial cognition; Social cognition; Cellular mechanisms of neural plasticity.

UNIT-V

Feedback System and Brain Disorders: Endocrine systems; feeding behavior, Stress, Addiction, Depression, Schizophrenia, Alzheimer's, Huntington's disease, Parkinson's disease.

TEXT BOOKS:

1. Principles of Neural Science, 6th Edition (2021) Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell, McGraw Hill.
2. Principles of Cognitive Neuroscience, 2nd Edition (2013) Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff. Sinauer Associates, Inc.
3. Mark Bear, Brian Connors, and Michael Paradiso (2007) Neuroscience: Exploring the Brain. 3rd ed. Baltimore: Lippincott, Williams & Wilkins.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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1979

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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