JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in BIOTECHNOLOGY
I & II YEARS COURSE STRUCTURE & SYLLABUS (R25 Regulations)
Applicable from AY 2025-26 Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BT101BS/ BT102BS	Basic Mathematics/ Fundamentals of Biology	3	1	0	4
2.	PH102BS	Advanced Engineering Physics	3	0	0	3
3.	ME103ES	C Programming and Data Structures	3	0	0	3
4.	ME104ES	Engineering Mechanics	3	0	0	3
5.	EN105HS	English for Skill Enhancement	3	0	0	3
6.	PH106BS	Advanced Engineering Physics Lab	0	0	2	1
7.	CS107ES	C Programming and Data Structures Lab	0	0	2	1
8.	ME108ES	Engineering Workshop	0	0	2	1
9.	EN109HS	English Language and Communication Skills Lab	0	0	2	1
		Induction Program	-	-	-	-
		Total Credits	**15**	**01**	**08**	**20**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BT201BS	Mathematics – II for Biotechnology	3	0	0	3
2.	CH202BS	Applied Chemistry	3	0	0	3
3.	CS203ES	Python Programming	3	0	0	3
4.	EE204ES	Elements of Electrical and Electronics Engineering	3	0	0	3
5.	BT205ES	Cell Biology	3	0	0	3
6.	ME206ES	Engineering Drawing and Computer Aided Drafting	2	0	2	3
7.	CH207BS	Chemistry Lab for Engineers	0	0	2	1
8.	CS208ES	Python Programming Lab	0	0	2	1
9.	EE209ES	Elements of Electrical and Electronics Engineering Lab	0	0	2	1
		Total Credits	**17**	**00**	**08**	**21**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BT301BS	Mathematics – III for Biotechnology	3	0	0	3
2.	BT302PC	Biochemistry	3	0	0	3
3.	BT303PC	Microbiology	3	0	0	3
4.	BT304PC	Fluid Mechanics & Heat Transfer	3	0	0	3
5.	BT305PC	Genetics & Molecular Biology	3	0	0	3
6.	BT306BS	Mathematics – III for Biotechnology Lab	0	0	2	1
7.	BT307PC	Biochemistry and Microbiology Lab	0	0	2	1
8.	BT308PC	Fluid Mechanics & Heat Transfer Lab	0	0	2	1
9.	BT309PC	Molecular Biology Lab	0	0	2	1
10.	BT310SD	R Programming	0	0	2	1
		Total Credits	**15**	**0**	**10**	**20**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	BT401PC	Analytical Techniques in Biotechnology	3	0	0	3
2.	BT402PC	Genetic Engineering	3	0	0	3
3.	BT403PC	Chemical and Biochemical Thermodynamics	3	0	0	3
4.	BT404PC	Enzyme Engineering and Technology	3	0	0	3
5.	BT405PC	Artificial Intelligence and Machine Learning	2	0	0	2
6.	MS406HS	Innovation and Entrepreneurship	2	0	0	2
7.	BT407PC	Analytical Techniques & Enzyme Engineering and Technology Lab	0	0	2	1
8.	BT408PC	Genetic Engineering Lab	0	0	2	1
9.	BT409PC	Artificial Intelligence and Machine Learning Lab	0	0	2	1
10.	BT410SD	Industrial Biotechnology	0	0	2	1
11.	VA400HS	Indian Knowledge System	1	0	0	1
		Total Credits	**17**	**0**	**08**	**21**

Sustainable Development Goals (SDGs)

1. SDG 1: No Poverty
2. SDG 2: Zero Hunger
3. SDG 3: Good Health and Well-being
4. SDG 4: Quality Education
5. SDG 5: Gender Equality
6. SDG 6: Clean Water and Sanitation
7. SDG 7: Affordable and Clean Energy
8. SDG 8: Decent Work and Economic Growth
9. SDG 9: Industry, Innovation, and Infrastructure
10. SDG 10: Reduced Inequalities
11. SDG 11: Sustainable Cities and Communities
12. SDG 12: Responsible Consumption and Production
13. SDG 13: Climate Action
14. SDG 14: Life Below Water
15. SDG 15: Life on Land
16. SDG 16: Peace, Justice, and Strong Institutions
17. SDG 17: Partnerships for the Goals

BT101BS: BASIC MATHEMATICS

(for Bi.P.C Stream Students)

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Course Objectives:

To provide foundational knowledge and problem-solving skills in matrices, complex numbers, coordinate geometry, trigonometry, calculus, differential equations, and probability for engineering and applied sciences.

Course Outcomes: After completing the course, the students will be able to:

CO1 Understand and perform operations on matrices and solve polynomial equations using standard methods. (SDG 4)

CO2 Apply complex number operations and vector algebra concepts to solve geometric and engineering problems. (SDG 9)

CO3 Use trigonometric identities and partial fraction decomposition to simplify and solve mathematical expressions. (SDG 4)

CO4 Analyse and apply concepts of functions, differentiation, and integration to solve calculus problems. (SDG 4,9)

CO5 Solve first-order differential equations and apply basic probability concepts to analyse random events. (SDG 4,9)

UNIT - I: MATRICES AND THEORY OF EQUATIONS: Matrices: Introduction of matrix, order of matrix, types of matrices, (Row, Column, Zero, Rectangular, Square, Triangular, Diagonal, Scalar, Identity matrices) definitions with example. Addition, Difference, Multiplication of matrices with example problems, determinant, trace, inverse of matrix, Real matrices (symmetry, skew symmetry, orthogonal), (Without Proof). **Theory of Equations:** Definition of roots/Zeros of polynomial equations, relation between the roots and coefficients. Finding the roots of equation by standard methods.

UNIT - II: COMPLEX NUMBERS AND COORDINATE GEOMETRY: Complex Numbers: Introduction of complex numbers, addition, difference, multiplication and division of complex numbers, conjugate modulus of complex numbers, principal argument of complex number. **Coordinate Geometry:** Cartesian coordinate system, definition of vector and scalar, types of vectors, dot or scalar product, cross product of vectors/vector product and their properties.

UNIT - III: TRIGONOMETRY AND PARTIAL FRACTIONS: Trigonometry: Trigonometric ratios with their graphical representation. Compound angles, multiple and sub multiple angles, transformations, periodicity, inverse trigonometric functions, and hyperbolic function. **Partial Fractions:** Partial fractions of rational functions, decomposition of partial fractions, partial fractions of improper functions, (Without Proof).

UNIT - IV: DIFFERENTIAL AND INTEGRAL CALCULUS: Function: Definition of set, domain, co-domain, range of function, Types of functions, some standard functions and their properties, graphical representation, (polynomial function, modulus function, signal function, greatest in lager functions, fractional past function, exponential, logarithmic, trigonometric function) with example problems, odd and even functions. **Differentiation:** Definition of intervals, indeterminate forms, standard limits, definition of continuity with example problems, and discontinuity. Derivative rule for the addition, difference, product and division of two functions. **Integration:** Definition standard integrals, integration by the method of substitution, integration by parts, integration of addition, multiplication of two functions, definite integral, integration of even odd functions.

UNIT - V: DIFFERENTIAL EQUATIONS AND PROBABILITY: Differential equation: order and degree of a differential equation, formation of differential equation, various methods to find general solutions of first order and first-degree differential equation (variable separable).

Probability: Random experiment and events, Classical definition of probability, Axiomatic approach and addition theorem of probability, Independent and dependent events, multiplication theorem, (Without Proof).

TEXT BOOKS:

1. Handbook- Mathematics (Key notes, Terms, Definitions, Formulae) – Arihant Publications.

2. Basic Mathematics by Serge Lang, Springer.

REFERENCE BOOKS

1. Precalculus Mathematics in a Nutshell by George F. Simmons, Wipf and Stock / Originally.
2. Calculus Made Easy by Silvanus P. Thompson.
3. Schaum's Outline of Linear Algebra, Seymour Lipschutz (later editions co-authored with Marc Lipson), McGraw-Hill.
4. Schaum's Outline of Trigonometry, Frank Ayres & Robert E. Moyer.

BT102BS: FUNDAMENTALS OF BIOLOGY

B.Tech. I Year I Sem.

L	T	P	C
3	1	0	4

Course Objective: To acquire substantive knowledge of microbial, plants, animals and Human biology.

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

CO1 Apply the knowledge of biology to evaluate the beneficial and harmful effects of microorganisms on human health. (SDG 3,6)
CO2 Distinguish major phyla of plant kingdom. Acquire knowledge of economic importance of plants. (SDG 2,15)
CO3 Distinguish the major animal phyla and evaluate their effects on human health. (SDG 3,15)
CO4 Understand the functional inter relationships of the all the organ systems in human body. (SDG 3,12.13)
CO5 Analyze the functional coordination among all organs in the human body. (SDG 3,8,11,13)

UNIT- I: INTRODUCTION TO BIOLOGY: Diversity in biological systems, Kingdom systems of classification, General characters, brief account on ecology, morphology, nutrition, locomotion and reproduction, useful and harmful effects of Bacteria, Viruses, Algae, Fungi and Protozoans.

UNIT- II: BIOLOGY OF PLANTS: Classification of Plant Kingdom. Major Phyla: Bryophyta, Pteridophyta, Gymnosperm and Angiosperm. Concepts of Growth, Meristems, Development of different plant organs, Plant Growth Regulators, Economic Importance of Plants, Biology of Pests in relation to Rice, Cotton, Sugarcane and Groundnut, Photosynthesis – overview.

UNIT- III: BIOLOGY OF ANIMALS: Classification of Animal Kingdom, General Characters of Chordates and Non-chordates, Protozoan Parasites (*Plasmodium, Entamoeba histolytica*), Helminth parasites *(Taenia solium, Ascaris).*

UNIT- IV: HUMAN BIOLOGY I: Introduction to human body, Structure and function of Digestive, Respiratory and Circulatory systems.

UNIT- V: HUMAN BIOLOGY II: Structure and function of Nervous, Endocrine, Excretory and Reproductive systems.

TEXT BOOKS:

1. Introduction To Biology And Biotechnology by Vaidyanath K. , K. Patrap Reddy, BS publications, Second Edition
2. Basic Biotechnology, Second Edition, by Colin Ratledge and Bjorn Kristiansen, Cambridge University Press.

REFERENCE BOOKS:

1. Dr. C.C. Chatterjee, Human Physiology (11th Edition) Vol I and II, Medical Allied Agency, Kolkata.
2. H.G. Rehm and G. Reed, Biotechnology Volume 1 & 2.

PH102BS: ADVANCED ENGINEERING PHYSICS

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: 10+2 Physics

Course Objectives:

1. To study crystal structures, defects, and material characterization techniques like XRD and SEM.
2. To understand fundamental concepts of quantum mechanics and their applications in solids and nanomaterials.
3. To introduce quantum computing principles, quantum gates, and basic quantum algorithms.
4. To learn the properties and applications of magnetic and dielectric materials.
5. To explore the working and applications of lasers and fibre optics in modern technology.

Course Outcomes:

1. **CO1**: Analyze crystal structures, identify defects, and apply XRD and SEM techniques for material characterization.
2. **CO2**: Apply quantum mechanical principles to explain particle behaviour and energy band formation in solids.
3. **CO3**: Understand quantum computing concepts, use quantum gates, and explain basic quantum algorithms.
4. **CO4**: Classify magnetic and dielectric materials and explain their properties, synthesis, and applications.
5. **CO5**: Explain the principles of lasers and fibre optics and their applications in communication and sensing.

UNIT - I: Crystallography & Materials Characterization

Introduction: Unit cell, space lattice, basis, lattice parameters; crystal structures, Bravais lattices, packing factor: SC, BCC, FCC; Miller indices, inter-planar distance; defects in crystals (Qualitative): point defects, line defects, surface defects and volume defects. concept of nanomaterials: surface to volume ratio, X -ray diffraction: Bragg's law, powder method, calculation of average crystallite size using Debye Scherrer's formula, scanning electron microscopy (SEM): block diagram, working principle.

UNIT - II: Quantum Mechanics

Introduction, de-Broglie hypothesis, Heisenberg uncertainty principle, physical significance of wave function, postulates of quantum mechanics: operators in quantum mechanics, eigen values and eigen functions, expectation value; Schrödinger's time independent wave equation, particle in a 1D box, Bloch's theorem (qualitative), Kronig-Penney model (qualitative): E-k diagram, effective mass of electron, formation of energy bands, origin of bandgap, classification of solids, concept of discrete energy levels and quantum confinement in nanomaterials.

UNIT - III: Quantum Computing

Introduction, linear algebra for quantum computation, Dirac's Bra and Ket notation and their properties, Hilbert space, Bloch's sphere, concept of quantum computer, classical bits, Qubits, multiple Qubit system, quantum computing system for information processing, evolution of quantum systems, quantum measurements, entanglement, quantum gates, challenges and advantages of quantum computing over classical computation, quantum algorithms: Deutsch-Jozsa, Shor, Grover.

UNIT - IV: Magnetic and Dielectric Materials

Introduction to magnetic materials, origin of magnetic moment-classification of magnetic materials, hysteresis, Weiss domain theory of ferromagnetism, soft and hard magnetic materials, synthesis of ferrimagnetic materials using sol-gel method, applications: magnetic hyperthermia for cancer treatment, magnets for EV, Giant Magneto Resistance (GMR) device.

Introduction to dielectric materials, types of polarization (qualitative): electronics, ionic & orientation; ferroelectric, piezoelectric, pyroelectric materials and their applications: Ferroelectric Random-Access Memory (Fe-RAM), load cell and fire sensor.

UNIT - V: Laser and Fibre Optics

Introduction to laser, characteristics of laser, Einstein coefficients and their relations, metastable state, population inversion, pumping, lasing action, Ruby laser, He-Ne laser, CO_2 laser, semiconductor diode laser, applications: Bar code scanner, LIDAR for autonomous vehicle.

Introduction to fibre optics, total internal reflection, construction of optical fibre, acceptance angle, numerical aperture, classification of optical fibres, losses in optical fibre, applications: optical fibre for communication system, sensor for structural health monitoring.

TEXT BOOKS:

1. Walter Borchardt-Ott, *Crystallography: An Introduction*, Springer.
2. Charles Kittel, *Introduction to Solid State Physics*, John Wiley & Sons, Inc.
3. Thomas G. Wong, *Introduction to Classical and Quantum Computing*, Rooted Grove

REFERENCE BOOKS:

1. Jozef Gruska, *Quantum Computing*, McGraw Hill
2. Michael A. Nielsen & Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press.
3. John M. Senior, *Optical Fiber Communications Principles and Practice*, Pearson Education Limited.

Useful Links

- https://shijuinpallotti.wordpress.com/wp-content/uploads/2019/07/optical-fiber-communications-principles-and-pr.pdf
- https://www.geokniga.org/bookfiles/geokniga-crystallography_0.pdf
- https://dpbck.ac.in/wp-content/uploads/2022/10/Introduction-to-Solid-State-PhysicsCharles-Kittel.pdf
- https://www.thomaswong.net/introduction-to-classical-and-quantum-computing-1e4p.pdf
- https://www.fi.muni.cz/usr/gruska/qbook1.pdf
- https://profmcruz.wordpress.com/wp-content/uploads/2017/08/quantum-computation-and-quantum-information-nielsen-chuang.pdf

CS103ES: C PROGRAMMING AND DATA STRUCTURES

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

Course Outcomes:

1. Understand the various steps in Program development.
2. Explore the basic concepts in C Programming Language.
3. Develop modular and readable C Programs
4. Understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
5. Apply data structures such as stacks, queues in problem solving
6. To understand and analyze various searching and sorting algorithms.

UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development

Introduction to C Language – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output

Structure of a C Program – Operators, Bit-wise operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Statements.

UNIT - II

Statements – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Recursion.

Designing Structured Programs- Functions, basics, user defined functions, inter function communication, standard functions.

Arrays – Concepts, using arrays in C, inter function communication, array applications, two – dimensional arrays, multidimensional arrays.

UNIT - III

Pointers – Introduction, Pointers for inter function communication, pointers to pointers, compatibility,

Pointer Applications – Passing an array to a function, Memory allocation functions, array of pointers

Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion.

UNIT - IV

Derived types – The Typedef, enumerated types, Structures – Declaration, definition and initialization of structures, accessing structures, operations on structures, complex structures. Unions – Referencing unions, initializers, unions and structures.

Input and Output – Text vs Binary streams, standard library functions for files, converting file types, File programs – copy, merge files.

UNIT – V

Sorting- selection sort, bubble sort, insertion sort,

Searching-linear and binary search methods.

Data Structures – Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks-Operations, array and linked representations of stacks, stack applications, Queues-operations, array and linked representations.

TEXT BOOKS:

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

REFERENCE BOOKS:

1. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications.
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3 Programming in C – Stephen G. Kochan, III Edition, Pearson Education.
4. C for Engineers and Scientists, H. Cheng, McGraw-Hill International Edition
5. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education / PHI
6. C Programming & Data Structures, E. Balagurusamy, TMH.
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
8. C & Data structures – E V Prasad and N B Venkateswarlu, S. Chand & Co.

ME104ES: ENGINEERING MECHANICS

L	T	P	C
3	0	0	3

B.Tech. I Year I Sem.

Course Objectives: The objectives of this course are to

1. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
2. Perform analysis of bodies lying on rough surfaces.
3. Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
4. Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
5. Explain the concepts of work energy method and its applications to translation, rotation and plane motion and the concept of vibrations

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

1. Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion.
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration.

UNIT - I: Introduction to Engineering Mechanics

Force Systems: Basic concepts, Rigid Body equilibrium, System of Forces, Parallelogram law, Coplanar Concurrent Forces, Components of forces in Space, Resultant, Moment of Forces and its Application. Couples and Resultant of Force System: Equilibrium of Force Systems, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

UNIT - II: Friction and Centre of Gravity

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction. Motion of Bodies, Wedge friction, Screw jack and Differential Screw jack.

Centroid and Centre of Gravity: Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections, Centre of Gravity and its implications, Theorem of Pappus.

UNIT - III: Moment of Inertia

Definition, Area Moment of Inertia, Moment of inertia of Plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections. Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem.

Mass Moment of Inertia: Moment of Inertia of Masses, Radius of Gyration, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of composite bodies.

UNIT - IV: Dynamics of a Particle

Rectilinear motion, Plane curvilinear motion: Rectangular and Polar coordinates. Relative and constrained motion, Newton's law of motion for a particle (rectangular, path, and polar coordinates). Work -kinetic energy, power, potential energy. Impulse and momentum: Linear, Angular, Elastic Impact (Direct and oblique).

UNIT - V: Kinetics of Rigid Bodies

Introduction, Types of motion, Instantaneous centre of rotation in plane motion and simple problems, D' Alembert's principle and its applications in plane motion and connected bodies. Work-Energy Method: Work-Energy principle and its application in plane motion of connected bodies or Systems, Work energy Applied to particle motion, Kinetics of rigid body rotation.

TEXT BOOKS:

1. Singer's Engineering Mechanics – Statics and Dynamics, Reddy Vijay Kumar K. and J. Suresh Kumar. B.S Publications, 3rd Edition, Rpt. 2024.
2. Engineering Mechanics, Shames and Rao, Pearson Education, 1st Edition, 2005.

REFERENCE BOOKS:

1. Vector Mechanics for Engineers – Statics and Dynamics, Beer F.P and Johnston E.R Jr., Mc Graw Hill, 12th Edition, 2019.
2. Engineering Mechanics, Dumir P.C, Sengupta and Srinivas, Universities Press, 1st Edition, 2020.
3. Engineering Mechanics, Hibbeler R.C, Pearson, 14th Edition, 2017.
4. Engineering Mechanics, Arshad Noor, Zahid and Goel, Cambridge University Press,1st Edition, 2018.
5. Engineering Mechanics, Basudeb Bhattacharyya, Oxford University Press, 2nd Edition, 2014.

EN105HS: ENGLISH FOR SKILL ENHANCEMENT

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

INTRODUCTION

National Education Policy-2020 aims at preparing students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. It also emphasizes language study and promotion of languages through understanding and proper interpretation. English language is central to the educational eco system. The importance of language as medium of communication for personal, social, official and professional needs to be emphasized for clear and concise expression. Teaching and learning of receptive and productive skills viz., Listening, Speaking, Reading and Writing (LSRW) are to be taught and learnt effectively in the undergraduate Engineering programs. Learners should be encouraged to engage in a rigorous process of learning to become proficient users of English language by adopting a deeply focused and yet flexible approach as opposed to rote learning.

In this connection, suitable syllabus, effective pedagogy, continuous assessments and students' involvement result in productive learning. This course supports the latest knowledge and skill requirements and shall meet specified learning outcomes. The main objectives of English language teaching and learning as medium of communication and for promotion of cultural values are embedded in this syllabus. Efforts are being made in providing a holistic approach towards value-based language learning which equips the learner with receptive as well as productive skills.

The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed textbook for detailed study. The students should be encouraged to read the texts leading to reading comprehension. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material.

LEARNING OBJECTIVES: This course will enable the students to:

a. Improve their vocabulary.
b. Use appropriate sentence structures in their oral and written communication.
c. Develop their reading and study skills.
d. Equip students to write paragraphs, essays, précis and draft letters.
e. Acquire skills for Technical report writing.

COURSE OUTCOMES: Students will be able to:

a. Choose appropriate vocabulary in their oral and written communication.
b. Demonstrate their understanding of the rules of functional grammar and sentence structures.
c. Develop comprehension skills from known and unknown passages.
d. Write paragraphs, essays, précis and draft letters.
e. Write abstracts and reports in various contexts.

SYLLABUS: The course content / study material is divided into **Five Units.**

UNIT –I

Theme: **Perspectives**
Lesson on 'The Generation Gap' by Benjamin M. Spock from the prescribed textbook titled *English for the Young in the Digital World* published by Orient Black Swan Pvt. Ltd.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Words Often Misspelt - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing with Reference to Parts of Speech particularly Articles and Prepositions – Degrees of Comparison

Reading: Reading and Its Importance- Sub Skills of Reading – Skimming and Scanning.

Writing: Sentence Structures and Types -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing Precisely –Nature and Style of Formal Writing.

UNIT –II

Theme: **Digital Transformation**
Lesson on '*Emerging Technologies*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Reading Strategies-Guessing Meaning from Context – Identifying Main Ideas – Exercises for Practice

Writing: Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence – Linkers and Connectives - Organizing Principles in a Paragraph – Defining- Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence - Essay Writing - Writing Introduction and Conclusion.

UNIT –III

Theme: **Attitude and Gratitude**
Poems on '*Leisure'* by William Henry Davies and '*Be Thankful'* - Unknown Author from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-Skills of Reading – Identifying Topic Sentence and Providing Supporting Ideas - Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with CV/Resume –Difference between Writing a Letter and an Email - Email Etiquette.

UNIT –IV

Theme: **Entrepreneurship**
Lesson on '*Why a Start-Up Needs to Find its Customers First*' by Pranav Jain from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Standard Abbreviations in English – Inferring Meanings of Words through Context – Phrasal Verbs – Idioms.

Grammar: Redundancies and Clichés in Written Communication – Converting Passive to Active Voice and Vice-Versa.

Reading: Prompt Engineering Techniques– Comprehending and Generating Appropriate Prompts - Exercises for Practice

Writing: Writing Practices- Note Making-Précis Writing.

UNIT –V

Theme: **Integrity and Professionalism**
Lesson on '*Professional Ethics*' from the prescribed textbook titled *English for the Young in the Digital World* published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Technical Vocabulary and their Usage– One Word Substitutes – Collocations.

Grammar: Direct and Indirect Speech **-** Common Errors in English (Covering all the other aspects of grammar which were not covered in the previous units)

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) – Inferring the Meaning and Evaluating a Text- Exercises for Practice

Writing: ***Report Writing - Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Technical Report.***

Note: *Listening and Speaking skills which are given under Unit-6 in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.*

- (**Note**: As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech. First Year is* ***Open-ended****,* besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.)

TEXT BOOK:

1. Board of Editors. *2025. English for the Young in the Digital World.* Orient Black Swan Pvt. Ltd.

REFERENCE BOOKS:

1. Swan, Michael. (2016). *Practical English Usage.* Oxford University Press. New Edition.
2. *Karal, Rajeevan. 2023. English Grammar Just for You.* Oxford University Press. New Delhi
3. 2024. *Empowering with Language: Communicative English for Undergraduates.* Cengage Learning India Pvt. Ltd. New Delhi
4. Sanjay Kumar & Pushp Lata. 2022. *Communication Skills – A Workbook.* Oxford University Press. New Delhi
5. Wood,F.T. (2007). *Remedial English Grammar.* Macmillan.
6. Vishwamohan, Aysha. (2013). *English for Technical Communication for Engineering Students.* Mc Graw-Hill Education India Pvt. Ltd.

PH106BS: ADVANCED ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To provide practical exposure to advanced concepts in solid-state and modern physics.
2. To synthesize and study the physical properties of materials like semiconductors, ferromagnetic, and ferroelectric substances.
3. To perform semiconductor characterization using Hall effect and band gap experiments.
4. To explore the working principles of lasers and optical fibers through hands-on experiments.
5. To develop skills in data analysis, interpretation, and scientific reporting.

Course Outcomes:

1. **CO1:** Synthesize and analyze nanomaterials such as magnetite (Fe_3O_4) using chemical methods.
2. **CO2:** Determine key electrical, magnetic, and optical properties of semiconductors and other functional materials.
3. **CO3:** Characterize semiconductors using Hall effect and energy gap measurement techniques.
4. **CO4:** Demonstrate working knowledge of laser systems and optical fiber parameters through experimental study.
5. **CO5:** Apply scientific methods for accurate data collection, analysis, and technical report writing.

List of Experiments:

1. Synthesis of magnetite (Fe_3O_4) powder using sol-gel method.
2. Determination of energy gap of a semiconductor.
3. Determination of Hall coefficient and carrier concertation of a given semiconductor.
4. Determination of magnetic moment of a bar magnet and horizontal earth magnetic field.
5. Study of B-H curve of a ferro magnetic material.
6. Study of P-E loop of a given ferroelectric crystal.
7. Determination of dielectric constant of a given material.
8. Determination of Curie's temperature of a given ferroelectric material.
9. A) Determination of wavelength of a laser using diffraction grating.
   B) Study of V-I & L-I characteristics of a given laser diode.
10. A) Determination of numerical aperture of a given optical fibre.
    B) Determination of bending losses of a given optical fibre.

Note: Any 8 experiments are to be performed.

CS107ES: C PROGRAMMING & DATA STRUCTURES LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives: Introduce the importance of programming, C language constructs, program development, data structures, searching and sorting.

Course Outcomes:

1. Develop modular and readable C Programs
2. Solve problems using strings, functions
3. Handle data in files
4. Implement stacks, queues using arrays, linked lists.
5. To understand and analyze various searching and sorting algorithms.

List of Experiments:

1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
3. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a C program to find the roots of a quadratic equation.
5. Write a C program to find the factorial of a given integer.
6. Write a C program to find the GCD (greatest common divisor) of two given integers.
7. Write a C program to solve Towers of Hanoi problem.
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
9. Write a C program to find both the largest and smallest number in a list of integers.
10. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices
    ii) Multiplication of Two Matrices
11. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T.
14. Write a C program to count the lines, words and characters in a given text.
15. Write a C program to generate Pascal's triangle.
16. Write a C program to construct a pyramid of numbers.
17. Write a C program that uses functions to perform the following operations:
    i) Reading a complex number
    ii) Writing a complex number
    iii) Addition of two complex numbers
    iv) Multiplication of two complex numbers
    (Note: represent complex number using a structure.)
18.
    i. Write a C program which copies one file to another.
    ii. Write a C program to reverse the first n characters in a file.
    (Note: The file name and n are specified on the command line.)
19.
    i. Write a C program to display the contents of a file.
    ii. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

20. Write a C program that uses functions to perform the following operations on singly linked list.:
    i) Creation ii) Insertion iii) Deletion iv) Traversal

21. Write C programs that implement stack (its operations) using
    i) Arrays ii) Pointers

22. Write C programs that implement Queue (its operations) using
    i) Arrays ii) Pointers

23. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order i) Bubble sort ii) Selection sortiii)Insertion sort

24. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:
    i) Linear search ii) Binary search

TEXT BOOKS:

1. C Programming & Data Structures, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Let us C, Yeswanth Kanitkar
3. C Programming, Balaguruswamy.

ME108ES: ENGINEERING WORKSHOP

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Practical skill

Course Objectives:

1. To introduce students to basic manufacturing processes and workshop practices.
2. To provide hands-on training in carpentry, fitting, welding, sheet metal, and machining
3. To develop skills in using hand tools and measuring instruments.
4. To enhance safety awareness and proper handling of workshop equipment.
5. To build a foundational understanding of industrial production and fabrication.

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

1. Understand the basic manufacturing processes and operations.
2. Use hand tools and equipment safely and efficiently.
3. Perform basic operations in carpentry, fitting, welding, sheet metal work, and machining
4. Read and interpret workshop drawings
5. Develop teamwork, time management, and quality awareness in a workshop environment.

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

i. **Carpentry:** T- Lap Joint, Dovetail Joint, Mortise and Tenon Joint
ii. **Fitting:** V- Fit, Dovetail Fit and Semi- circular fit
iii. **Tin Smithy**: Square Tin, Rectangular Tray and Conical Funnel
iv. **Foundry**: Preparation of Green Sand Mould using Single Piece and Split Pattern
v. **Welding Practice:** Arc Welding and Gas Welding
vi. **House wiring**: Parallel and Series, Two-way Switch and Tube Light
vii. **Black Smithy**: Round to Square, Fan Hook and S- Hook

2. TRADES FOR DEMONSTRATION AND EXPOSURE:

Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

TEXT BOOKS:

1. Workshop Practice, B. L. Juneja, Cengage Learning India, 1st edition, 2015.
2. Workshop Practice Manual, K. Venkata Reddy, BS Publication,6th Edition, Rpt.2025.

REFERENCE BOOKS:

1. Workshop Manual, K. Venugopal, Anuradha Publications, 2012th edition, 2012.

EN109HS: ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

The **English Language and Communication Skills (ELCS) Lab** focuses on listening and speaking skills, particularly on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Listening Skills:

Objectives

1. To enable students develop their active listening skills
2. To equip students with necessary training in listening, so that they can comprehend the speech of people from different linguistic backgrounds

Speaking Skills:

3. To improve their pronunciation and neutralize accent
4. To enable students express themselves fluently and appropriately
5. To practise speaking in social and professional contexts

Learning Outcomes: Students will be able to:

1. Listen actively and identify important information in spoken texts
2. Interpret the speech and infer the intention of the speaker
3. Improve their accent for intelligibility
4. Speak fluently with clarity and confidence
5. Use the language in real life situations

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:

a. **Computer Assisted Language Learning (CALL) Lab which focusses on listening skills**
b. **Interactive Communication Skills (ICS) Lab which focusses on speaking skills**

The following course content is prescribed for the **English Language and Communication Skills Lab**.

Exercise – I

CALL Lab:

Instruction: Speech Sounds-Listening Skill - Importance – Purpose - Types- Barriers- Active Listening

Practice: Listening to Distinguish Speech Sounds (Minimal Pairs) **-** *Testing Exercises*

ICS Lab:

❖ **Diagnostic Test – Activity titled '*Express Your View'***

Instruction: Spoken and Written language - Formal and Informal English - Greetings - Introducing Oneself and Others

Practice: Any Ice-Breaking Activity

Exercise – II

CALL Lab:

Instruction: Listening vs. Hearing - Barriers to Listening

Practice: Listening for General Information - Multiple Choice Questions - *Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)*

ICS Lab:

Instruction: Features of Good Conversation – Strategies for Effective Communication

Practice: Role Play Activity - Situational Dialogues –Expressions used in Various Situations –Making Requests and Seeking Permissions – Taking Leave - Telephone Etiquette

Exercise - III

CALL Lab:

Instruction: Errors in Pronunciation – Tips for Neutralizing Mother Tongue Influence (MTI)
Practice: Differences between British and American Pronunciation –*Listening Comprehension Exercises*
ICS Lab:
Instruction: Describing Objects, Situations, Places, People and Events
Practice: Picture Description Activity – Looking at a Picture and Describing Objects, Situations, Places, People and Events *(A wide range of Materials / Handouts are to be made available in the lab.)*

Exercise – IV
CALL Lab:
Instruction: Techniques for *Effective* Listening
Practice: Listening for Specific Details - Listening - Gap Fill Exercises - *Listening Comprehension Exercises*
(It is essential to identify a suitable passage with exercises for practice.)
ICS Lab:
Instruction: How to Tell a Good Story - Story Star- Sequencing-Creativity
Practice: Activity on Telling and Retelling Stories - Collage

Exercise – V
CALL Lab:
Instruction: Identifying the literal and implied meaning
Practice: Listening for Evaluation - Write the Summary – Listening Comprehension Exercises
(It is essential to identify a suitable passage with exercises for practice.)
ICS Lab:
Instruction: Understanding Non-Verbal Communication
Practice: Silent Speech - Dumb Charades Activity
❖ **Post-Assessment Test on 'Express Your View'**

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:
The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.
System Requirement (Hardware component):
Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:
i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:
The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V. or LCD, a digital stereo – audio & video system and camcorder etc.

✍ **Note: English Language Teachers are requested to prepare Materials / Handouts for each Activity for the Use of those Materials in CALL & ICS Labs.**

Suggested Software:
- Cambridge Advanced Learners' English Dictionary with CD.
- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).

REFERENCE BOOKS:

1. Shobha, KN & Rayen, J. Lourdes. (2019). *Communicative English – A workbook.* Cambridge University Press
2. Board of Editors. (2016). *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient BlackSwan Pvt. Ltd.
3. Mishra, Veerendra et al. (2020). *English Language Skills: A Practical Approach.* Cambridge University Press
4. (2022). *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd.
5. Ur, Penny and Wright, Andrew. 2022. *Five Minute Activities – A Resource Book for Language Teachers.* Cambridge University Press.

BT201BS: MATHEMATICS – II FOR BIOTECHNOLOGY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To learn how to use matrices to solve linear systems, understand eigenvalues and eigenvectors, use mean value theorems to optimize functions of several variables, and solve different types of differential equations.

Course Outcomes: After completing the course, the students will be able to:

CO1 Apply matrix techniques to solve system of linear equations. (SDG 4,9)

CO2 Find the Eigenvalues and Eigenvectors. (SDG 4,9)

CO3 Apply Mean value theorems for given functions and also find maxima and minima for functions of two and three variables. (SDG 4,9)

CO4 Solve First Order Ordinary differential equations by analytical methods. (SDG 4,9)

CO5 Solve Higher Order Ordinary differential equations by analytical methods. (SDG 4,9)

UNIT - I: MATRICES AND SYSTEM OF LINEAR EQUATIONS: Matrices: Types of Matrices, Symmetric, Skew-symmetric, Orthogonal, Hermitian, Skew-Hermitian, Unitary, Properties (without proof). Rank of a matrix by Echelon form. **System of linear equations:** Solving system of homogeneous and non-homogeneous equations by Gauss-Elimination method.

UNIT - II: EIGENVALUES AND EIGENVECTORS: Eigenvalues and Eigenvectors and their properties (without proof), Diagonalization of a matrix, Cayley- Hamilton Theorem (without proof), finding inverse and powers of a matrix by Cayley-Hamilton Theorem.

UNIT - III: MEAN VALUE THEOREMS AND FUNCTIONS OF SEVERAL VARIABLES: Mean value theorems: Rolle's Theorem, Lagrange's Mean value theorem (without proof) with their Geometric Interpretation and applications, Cauchy's Mean value theorem. **Functions of Several Variables:** Partial differentiation, Jacobian, Functional dependence, Maxima and Minima of functions of two and three variables using method of Lagrange Multiplier.

UNIT - IV: FIRST ORDER ORDINARY DIFFERENTIAL EQUATION AND APPLICATIONS: Introduction to first order ODE, Exact, Reducible to exact equations, linear and Bernoulli's equations. Applications: Newton's law of cooling, Law of natural growth and decay.

UNIT - V: HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS: Second and higher order linear differential equations with constant coefficients, non-homogeneous terms of the type e^{ax}, sin $(ax + b)$, cos a $(ax + b)$, Method of variation of parameters.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint.

REFERENCE BOOKS:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
4. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Fifth Edition, Narosa Publishing House, 2016.
5. Pharmaceutical Mathematics with application to Pharmacy by D. H. Panchaksharappa Gowda.

CH202BS: APPLIED CHEMISTRY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To develop adaptability to new advances in Engineering Chemistry and acquire the essential skills to become a competent engineering professional.
2. To understand the industrial significance of water treatment, fundamental principles of battery chemistry, and the impact of corrosion along with its control methods for structural protection.
3. To impart foundational knowledge of various energy sources and their practical applications in engineering.
4. To equip students with an understanding of smart materials, biosensors, and analytical techniques applicable in engineering, industrial, environmental, and biomedical fields.

Course Outcomes:

1. Students will be able to understand the fundamental properties of water and its applications in both domestic and industrial purposes.
2. Students will gain basic knowledge of electrochemical processes and their relevance to corrosion and its control methods.
3. Students will comprehend the significance and practical applications of batteries and various energy sources, enhancing their potential as future engineers and entrepreneurs.
4. Students will learn the basic concepts and properties of polymers, lubricants and other engineering materials.
5. Students will be able to apply the principles of UV-Visible, IR spectroscopy and Raman spectroscopy in analyzing pollutants in dye industries and biomedical applications.

UNIT-I: Water and its treatment: [8]

Introduction, types of hardness and units– Estimation of hardness of water by complexometric method - Numerical problems. Potable water and its specifications (WHO) - Steps involved in the treatment of potable water – Disinfection of potable water by chlorination and break-point chlorination. Defluoridation - Nalgonda technique.

Boiler troubles: Scales, Sludges and Caustic embrittlement. Internal treatment of boiler feed water - Calgon conditioning, Phosphate conditioning, Colloidal conditioning. External treatment methods - Softening of water by ion- exchange processes. Desalination of brackish water - Reverse osmosis.

Unit-II: Electrochemistry and Corrosion: [8]

Introduction - Electrode potential, standard electrode potential, types of electrodes, Nernst equation (no derivation), Galvanic cell, cell representation, EMF of cell- Numerical problems. Reference electrodes - Primary reference electrode – Standard Hydrogen Electrode (SHE), Secondary reference electrode - Calomel electrode. Determination of pH of an unknown solution using SHE and Calomel electrode.

Corrosion: Introduction - Definition**,** causes and effects of corrosion - Theories of corrosion, chemical and electrochemical corrosion - Mechanism of electrochemical corrosion, Types of corrosion: galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion - Nature of the metal, Nature of the corroding environment. Corrosion control methods - Cathodic protection Methods - Sacrificial anode and impressed current methods.

UNIT–III: Energy Sources: [8]

Batteries: Introduction – Classification of batteries - Primary, secondary and reserve batteries with examples. Construction, working and applications of Zn-air and Lithium ion battery. Fuel Cells – Differences between a battery and a fuel cell, construction and applications of Direct Methanol Fuel Cell (DMFC).

Fuels: Introduction and characteristics, Calorific value of fuel - HCV, LCV- Dulongs formula -Numerical problems.

Fossil fuels: Introduction, classification, Petroleum - Refining of Crude oil, Cracking - Moving bed catalytic cracking. LPG and CNG - composition and uses.

Synthetic Fuels: Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen.

UNIT - IV: Polymers: [8]

Definition, classification of polymers: Based on origin and tacticity with examples - Types of polymerization - Addition (free radical addition mechanism) and condensation polymerization.

Plastics, Elastomers and Fibers: Definition and applications (PVC, Buna-S, Nylon-6,6). Themoplastics and thermo setting plastics, Fiber reinforced plastics (FRP).

Conducting polymers: Definition and classification with examples - Mechanism of conduction in trans-polyacetylene and applications of conducting polymers.

Biodegradable polymers: Polylactic acid(PLA) and its applications.

UNIT-V - Applications of Materials: [8]

Cement: Portland cement, its composition, setting and hardening.

Phase rule: Definition – Phase, component, degrees of freedom. Phase rule equation. Phase diagrams - One component system - water. Two component system - Lead silver system.

Lubricants: Definition and characteristics of a good lubricant – thin film mechanism of lubrication, properties of lubricants - viscosity, cloud and pour point, flash and fire point.

Interpretative spectroscopic applications of UV-Visible spectroscopy for Analysis of pollutants in dye industry, IR spectroscopy in night vision-security, Pollution Under Control- CO sensor (Passive Infrared detection).

SUGGESTED TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010.
2. Engineering Chemistry by Rama Devi, Dr.P.Aparna and Rath, Cengage learning, 2025.

REFERENCE TEXT BOOKS:

1. Engineering Chemistry: by Thirumala Chary Laxminarayana & Shashikala, Pearson Publications (2020)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011.
3. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi 2015.
4. Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007.
5. Challenges and Opportunities in Green Hydrogen by **Editors:** Paramvir Singh, Avinash Kumar Agarwal, Anupma Thakur, R.K Sinha.
6. Raman Spectroscopy in Human Health and Biomedicine, https://www.worldscientific.com/doi/epdf/10.1142/13094
7. E-Content- https://doi.org/10.1142/13094 | October 2023
8. E-books: https://archive.org/details/EngineeringChemistryByShashiChawla/page/n11/mode/2up

CS203ES: PYTHON PROGRAMMING

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Basic knowledge of computer fundamentals, C programming.

Course Objectives:

Introduce the fundamentals of Python programming for problem-solving.

1. Develop skills to write structured, modular, and efficient Python code.
2. Enable students to use Python's built-in data structures and libraries effectively.
3. Provide knowledge on file handling, exception handling, and object-oriented programming in Python.
4. Equip students with the ability to apply Python for real-world applications including data processing and automation.

Course Outcomes:

1. Write Python programs using variables, operators, expressions, and control structures.
2. Implement Python programs using built-in data structures like lists, tuples, sets, and dictionaries.
3. Apply modular and object-oriented programming principles in Python.
4. Handle files, exceptions, and apply Python libraries for problem-solving.
5. Develop small-scale applications in Python for automation and data manipulation.

CO–PO Mapping

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

UNIT-1 – Introduction to Python and Basics of Programming

Introduction to Python: Features, Applications, Installation, IDEs, Python Syntax, Indentation, Comments, Variables, Data Types, Type Casting, Operators: Arithmetic, Relational, Logical, Assignment, Membership, Identity, Bitwise, Input/Output functions (input(), print()), Control Structures: if, if-else, if-elif-else, Nested Conditions, Looping: for, while, Nested Loops, break, continue, pass.

UNIT-2 – Data Structures in Python

Strings: Creation, Indexing, Slicing, Methods, String Formatting, Lists: Creation, Indexing, Slicing, List Comprehension, Methods, Tuples: Properties, Indexing, Methods, Sets: Creation, Operations, Methods, Dictionaries: Creation, Access, Methods, Dictionary Comprehension, Iterating over data structures.

UNIT-3 – Functions and Modules

Functions: Defining, Calling, Parameters, Return Values, Types of Arguments: Positional, Keyword, Default, Variable Length, Scope of Variables: Local and Global, Lambda Functions, Map, Filter, Reduce, Recursion in Python, Modules: Importing, Creating User-defined Modules, Standard Modules (math, random, datetime), Packages in Python.

UNIT-4 – File Handling and Exception Handling

File Handling: Opening, Reading, Writing, Appending, File Modes, File Methods, Working with CSV and JSON Files, Exception Handling: try, except, else, finally, Built-in Exceptions, Raising Exceptions, Introduction to Regular Expressions (re module).

UNIT-5 – Object-Oriented Programming and Applications

OOP Basics: Classes, Objects, Attributes, Methods, Constructor (__init__), self keyword, Inheritance: Single,

Multiple, Multilevel, Hierarchical, Method Overriding, Method Overloading (conceptual), Encapsulation and Polymorphism, Application Development: Data Processing Script, Basic Calculator, File Organizer, Simple Data Analysis with pandas.

TEXT BOOKS:

1. Python Programming: Using Problem Solving Approach by Reema Thareja.
2. Python Crash Course by Eric Matthes, Learning Python by Mark Lutz.

REFERENCE BOOKS:

1. Introduction to Python Programming by Gowrishankar S., Veena A.
2. Python Cookbook by David Beazley and Brian K. Jones.
3. Fluent Python by Luciano Ramalho, Automate the Boring Stuff with Python by Al Sweigart.

EE204ES: ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the concepts of electrical circuits and its components
2. To understand magnetic circuits, DC circuits and AC single phase and three phase circuits
3. To study and understand the different types of DC, AC machines and Transformers.
4. To import the knowledge of various electrical installations.
5. To introduce the concept of power, power factor and its improvement.
6. To introduce the concepts of diodes and transistors, and
7. To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

1. To analyze and solve electrical circuits using network laws and theorems.
2. To understand and analyze basic Electric and Magnetic circuits
3. To study the working principles of Electrical Machines
4. To introduce components of Low Voltage Electrical Installations
5. To identify and characterize diodes and various types of transistors.

UNIT - I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL and KCL, analysis of simple circuits with dc excitation.

A.C. 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, Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II:

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT - III:

Electrical Machines: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three phase Induction motor, Torques equations and Speed control of Three phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:

P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt, Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

Rectifiers and Filters: P-N junction as a rectifier, Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V:

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering, M S Sukija and TK Nagasarkar, Oxford University, 1st Edition, 2012

2. Basic Electrical and electronics Engineering, D P Kothari and I J Nagarath, McGraw Hill Education, 2nd Edition, 2020

REFERENCE BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI,9th Edition, 2006.
2. Millman's Electronic Devices and Circuits,J. Millman, C. C. Halkias and Satyabrata Jit, TMH, 2nd Edition, 1998.
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971.
4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press, 2nd edition, 2004.
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005.
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011.
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th edition, 2003.
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010.
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989.

BT205ES: CELL BIOLOGY

B.Tech. I Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: The cell biology course provides a basic understanding of the structure and function of cellular organelles and components, and the functional interaction of the cell with its microenvironment.

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

CO1 Explain the structure and functions of basic cells. (SDG 3,4)
CO2 Describe the structure and functions of plasma membrane. (SDG 3,4)
CO3 Relate the Cellular motility and Cytoskeleton. (SDG 3,9)
CO4 Understand cell cycle and causes of deviation and complications. (SDG 3,4)
CO5 Analyse how the cell signalling helps in cell metabolism. (SDG 3,9)

UNIT-I: CELL STRUCTURE AND FUNCTION: Structure of Prokaryotic and Eukaryotic cells: Cellular organelles and their organization, Structure and functions of Nucleus, Endoplasmic Reticulum, Golgi complex, Lysosomes, Peroxisomes, Chloroplast & Mitochondria, Extra Cellular Matrix, Cell-Cell and Cell-ECM interactions, Introduction to Cell Junctions.

UNIT – II: CELL WALL, CELL MEMBRANE AND TRANSPORT MECHANISM: Structure and function of cell wall in microbes, Plasma membrane structure and function, Active and passive transport of ions, Na+/K+ pump, Symport, Antiport, P-type and V-Type Pumps, Phagocytosis, Pinocytosis and Exocytosis.

UNIT-III: CYTOSKELETON & CELL MOTILITY: Microtubules, intermediate filaments, microfilaments and their dynamics. Cilia, flagella, mechanisms of motility of cells, Prokaryotes and Eukaryotes, disorders/diseases associated with disturbance in cytoskeleton structures.

UNIT-IV: CELL CYCLE / CELL DIVISION: Cell cycle: Various phases of cell cycle, Interphase, Mitosis, Meiosis and Cytokinesis. Cell cycle Control & Checkpoints. Role of cyclins and CDKs in regulation of cell cycle, Disorders associated in cell cycle: Cancer, Characteristics of Cancer cells, Benign & Malignant tumor.

UNIT-V: CELL SIGNALING: Intracellular signalling, types of signal receptors - Cytosolic, Nuclear & Membrane bound receptors, Signal Transduction by hormones - Steroid / Peptide hormones, Concept of Secondary messengers, cAMP, cGMP, Protein Kinases, G Proteins, Receptors & Non - receptors associated tyrosine Kinases.

TEXT BOOKS:

1. The Cell by Cooper.
2. Cell and Molecular biology – De Robertis and De Robertis Waverly Pvt. Ltd.

REFERENCE BOOKS:

1. Cell & Molecular Biology by Gerald Karp (2nd Ed.) Wiley publishers.
2. The World of the cell by Becker, Reece, Poenie (3rd edition) Benjamin Publishers.
3. Molecular Biology of the cell by Bruce Alberts.
4. The Biochemistry of Cell Signalling-Ernst J. M. Helmreich. Oxford Press.

ME206ES: ENGINEERING DRAWING AND COMPUTER AIDED DRAFTING

B.Tech. I Year II Sem.

L	T	P	C
2	0	2	3

Course Objectives:

1. To introduce the fundamentals of engineering drawing and projection systems.
2. To develop skills in constructing orthographic, isometric, and sectional views.
3. To train students in interpreting and creating technical drawings using CAD tools.
4. To familiarize students with dimensioning standards and drafting conventions.
5. To bridge manual drafting techniques with computer-aided drafting practices.

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

1. Understand and apply the principles of orthographic and isometric projections.
2. Create sectional views and dimensioned drawings using BIS standards.
3. Use CAD software to generate 2D engineering drawings.
4. Visualize and construct solid models from 2D views.
5. Interpret and produce engineering drawings of mechanical components and assemblies.
6. Demonstrate drafting skills for practical and industrial applications.

UNIT – I: Introduction to Engineering Graphics (Conventional)
Principles of Engineering Graphics and their Significance, Geometrical Constructions, Scales, Plain and Diagonal, Conic Sections including the Rectangular Hyperbola, General method only. Cycloid, Epicycloid and Hypocycloid.

UNIT - II: Orthographic Projections (Conventional and Computer Aided)
Principles of Orthographic Projections, Conventions, Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes. Computer aided orthographic projections, points, lines and planes. Introduction to Computer aided drafting, views, commands and conics.

UNIT – III: Projections of Regular Solids (Conventional and Computer Aided)
Auxiliary Views, Sections or Sectional views of Right Regular Solids, Prism, Cylinder, Pyramid, Cone, Auxiliary views, Computer aided projections of solids, sectional views

UNIT – IV: Development of Surfaces (Conventional)
Prism, Cylinder, Pyramid and Cone.

UNIT – V: Isometric Projections (Conventional and Computer Aided)
Principles of Isometric Projection, Isometric Scale, Isometric Views, Conventions, Isometric Views of Lines, Plane Figures, Simple and Compound Solids, Isometric Projection of objects having non, isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice- versa, Conventions. Conversion of orthographic projection into isometric view.

Note:

1. The End Semester Examination will be in conventional mode.
2. CIE – I will be in conventional mode.
3. CIE – II will be using Computer.

TEXT BOOKS:

1. Engineering Drawing, N. D. Bhatt, Charotar, 54th Edition, 2023.
2. Engineering Drawing and graphics Using AutoCAD, T. Jeyapoovan and Vikas, S. Chand and company Ltd., 3rdEdition,2010.

REFERENCE BOOKS:

1. Engineering Drawing, Basant Agrawal and C.M. Agrawal, McGraw Hill, 3rd Edition, 2019.
2. Engineering Graphics and Design, WILEY, John Wiley and Sons Inc, 3rdEdition, 2020.
3. Engineering Drawing, M. B. Shah and B.C. Rane, Pearson, 2nd Edition, 2009.
4. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford, 1st Edition, 2015.
5. Computer Aided Engineering Drawing, K. Balaveera Reddy, CBS Publishers, 2nd Edition, 2015.

CH207BS: CHEMISTRY LAB FOR ENGINEERS

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Course Description: The course includes experiments based on fundamental principles of chemistry essential for engineering students, aiming to develop practical skills and reinforce theoretical concepts.

Course Objectives

1. Students will understand and perform experiments based on core chemical principles relevant to engineering applications.
2. Students will learn to estimate the hardness of water to assess its suitability for drinking purposes.
3. Students will acquire the ability to perform acid-base titrations using instrumental methods such as conductometry, potentiometry, and pH metry.
4. Students will gain hands-on experience in synthesizing polymers like Bakelite and Nylon – 6, 6 in the laboratory.

Course Outcomes:

1. Students will develop practical skills through hands-on chemistry experiments relevant to engineering.
2. Students will learn to determine important parameters such as water hardness and the corrosion rate of mild steel under various conditions.
3. Students will be able to apply techniques like conductometry, potentiometry, and pH metry to determine concentrations or equivalence points in acid-base reactions.
4. Students will gain experience in synthesizing polymers such as Bakelite and Nylon-6,6.

List of Experiments:

I. Volumetric Analysis: Estimation of Hardness of water by EDTA Complexometry method.

II. Conductometry:

1. Estimation of the concentration of strong acid by Conductometry.
2. Estimation of the concentration of strong and weak acid in an acid mixture by Conductometry.

III. Potentiometry:

1. Estimation of concentration of Fe^{+2}ion by Potentiometry using $KMnO_4$.
2. Estimation of concentration of strong acid with strong base by Potentiometry using quinhydrone

IV. pH Metry: Determination of an acid concentration using pH meter.

V. Preparations:

1. Preparation of Bakelite.
2. Preparation Nylon – 6, 6.

VI. Corrosion: Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.

VII. Lubricants:

1. Estimation of acid value of given lubricant oil.
2. Estimation of viscosity of lubricant oil using Ostwald's Viscometer.

VIII. Virtual lab experiments

1. Construction of Fuel cell and it's working.
2. Smart materials for Biomedical applications
3. Batteries for electrical vehicles.
4. Functioning of solar cell and its applications.

REFERENCE BOOKS:

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's text book of practical organic chemistry 5th edition
3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007).

CS208ES: PYTHON PROGRAMMING LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives:

- To install and run the Python interpreter
- To learn control structures.
- To Understand Lists, Dictionaries in python
- To Handle Strings and Files in Python

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

- Develop the application specific codes using python.
- Understand Strings, Lists, Tuples and Dictionaries in Python
- Verify programs using modular approach, file I/O, Python standard library
- Implement Digital Systems using Python

Note: The lab experiments will be like the following experiment examples.

List of Experiments:

1.
   I. Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.
   II. Start the Python interpreter and type help() to start the online help utility.
1. Start a Python interpreter and use it as a Calculator.
2. Write a program to calculate compound interest when principal, rate and number of periods are given.
3. Read the name, address, email and phone number of a person through the keyboard and print the details.
4. Print the below triangle using for loop.

   5
   4 4
   3 3 3
   2 2 2 2
   1 1 1 1 1
5. Write a program to check whether the given input is digit or lowercase character or uppercase character or a special character(use 'if-else-if' ladder)
6. Python program to print all prime numbers in a given interval (use break)
7. Write a program to convert a list and tuple into arrays.
8. Write a program to find common values between two arrays.
9. Write a function called palindrome that takes a string argument and returnsTrue if it is a palindrome and False otherwise. Remember that you can use the built-in function len to check the length of a string.
10. Write a function called is_sorted that takes a list as a parameter and returns True if the list is sorted in ascending order and False otherwise.
11. Write a function called has_duplicates that takes a list and returns True if there is any element that appears more than once. It should not modify the original list.
12. Write a function called remove_duplicates that takes a list and returns a new list with only the unique elements from the original. Hint: they don't have to be in the same order.
13. The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add "I", "a", and the empty string.
14. Write a python code to read dictionary values from the user. Construct a function to invert its content. i.e., keys should be values and values should be keys.
15. Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'
16. Remove the given word in all the places in a string?
17. Write a function that takes a sentence as an input parameter and replaces the first letter of every word with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?
18. Writes a recursive function that generates all binary strings of n-bit length
19. Write a python program that defines a matrix and prints

20. Write a python program to perform multiplication of two square matrices
21. How do you make a module? Give an example of construction of a module using different geometrical shapes and operations on them as its functions.
22. Use the structure of exception handling all general-purpose exceptions.
23. Write a function called draw_rectangle that takes a Canvas and a Rectangle as arguments and draws a representation of the Rectangle on the Canvas.
24. Add an attribute named color to your Rectangle objects and modify draw_rectangle so that it uses the color attribute as the fill color.
25. Write a function called draw_point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas.
26. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw_circle that draws circles on the canvas.
27. Write a python code to read a phone number and email-id from the user and validate it for correctness.
28. Write a Python code to merge two given file contents into a third file.
29. Write a Python code to open a given file and construct a function to check for given words present in it and display on found.
30. Write a Python code to Read text from a text file, find the word with most number of occurrences
31. Write a function that reads a file *file1*and displays the number of words, number of vowels, blank spaces, lower case letters and uppercase letters.
32. Import numpy, Plotpy and Scipy and explore their functionalities.
33. Install NumPypackage with pip and explore it.
34. Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR
35. Write a GUI program to create a window wizard having two text labels, two text fields and two buttons as Submit and Reset.

TEXT BOOKS:

1. Supercharged Python: Take your code to the next level, Overland
2. Learning Python, Mark Lutz, O'reilly

REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Python Programming A Modular Approach with Graphics, Database, Mobile, and Web Applications, Sheetal Taneja, Naveen Kumar, Pearson
3. Introduction to Python Programming, Gowrishakar S, Veena A, CRC Press
4. Programming with Python, A User's Book, Michael Dawson, Cengage Learning, India Edition
5. Python for Data Science, Dr. Mohd Abdul Hameed, Wiley publications
6. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech press
7. Introduction to Python, Gowrishankar S, Veena A., CRC Press

EE209ES: ELEMENTS OF ELECTRICAL AND ELECTRONIC ENGINEERING LAB

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. To introduce the concepts of electrical circuits and its components.
2. To understand magnetic circuits, DC circuits and AC single phase and three phase circuits.
3. To study and understand the different types of DC, AC machines and Transformers.
4. To import the knowledge of various electrical installations.
5. To introduce the concept of power, power factor and its improvement.
6. To introduce the concepts of diodes and transistors.
7. To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:

1. To analyze and solve electrical circuits using network laws and theorems.
2. To understand and analyze basic Electric and Magnetic circuits.
3. To study the working principles of Electrical Machines.
4. To introduce components of Low Voltage Electrical Installations.
5. To identify and characterize diodes and various types of transistors.

List of Experiments:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a SinglePhase Transformer
   (ii) Verification of Relationship between Voltages and Currents (StarDelta, DeltaDelta, Delta Star, StarStar) in a Three Phase Transformer
3. Measurement of Active and Reactive P ower in a balanced Threephase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Threephase Induction Motor
6. NoLoad Characteristics of a Threephase Alternator

PART B: ELECTRONICS

1. Study and operation of
   (i) Multimeters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. P-N Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator
4. Input and Output characteristics of Transistor in CB, CE configuration
5. Full Wave Rectifier with and without filters
6. Input and Output characteristics of FET in CS configuration

TEXT BOOKS:

1. Basic Electrical and electronics Engineering, M.S. Sukija and T.K. Nagasarkar, Oxford University press, 1st Edition, 2012.
2. Basic Electrical and electronics Engineering, D.P. Kothari and I.J. Nagarath, McGraw Hill Education, 2nd Edition,2020.

REFERENCE BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI, 9th Edition, 2006.
2. Millman's Electronic Devices and Circuits, J. Millman,C. C. Halkias and Satyabrata Jit, TMH, 2nd Edition, 1998.
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971.

4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press 2nd Edition, 2004.
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005.
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011.
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th Edition 2003.
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010.
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989.

BT301BS: MATHEMATICS III FOR BIOTECHNOLOGY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: To Understand probability theory and distributions for one or multiple random variables; apply least squares techniques for curve fitting, correlation, and regression; and perform hypothesis testing on statistical data.

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

CO1 Apply the concepts of probability and distributions to case studies. (SDG 4,9)
CO2 Analyze and interpret statical data using appropriate probability distributions. (SDG 4,9)
CO3 Formulate and Solve problems involving random variables and apply statistical methods for analyzing experimental data. (SDG 4,9)
CO4 Apply suitable test to accept or reject a given hypothesis. (SDG 4,9)
CO5 Correlate the concepts of one unit to the concepts in other units. (SDG 4)

UNIT-I: PROBABILITY AND EXPECTATION: Basic Probability, Probability Spaces, Conditional Probability, Independent Events and Bayes' Theorem. **Random Variables:** Discrete and Continuous Random Variables, Expectation of Random Variables, Variance of Random Variables.

UNIT-II: DISCRETE PROBABILITY DISTRIBUTIONS: Binomial, Poisson, Poisson Approximation to the Binomial Distribution**.**

UNIT-III: CONTINUOUS PROBABILITY DISTRIBUTION: Continuous Random Variable and their Properties, Distribution Functions, Normal Distribution.

UNIT-IV: APPLIED STATISTICS: Applied Statistics Curve Fitting by the Method of Least Squares – Fitting of Straight Lines, Second Degree Parabolas and More General Curves, Correlation and Regression – Rank Correlation.

UNIT-V: TEST OF HYPOTHESIS TEST OF SIGNIFICANCE: Large Sample Test for Single Proportion, Difference of Proportions, Single Mean, Difference of Means, Test for Single Mean, Difference of Means for Small Samples.

TEXT BOOKS:

1. Probability and Statistics for Engineers and Scientists, Updated 9th Edition, by Pearson: Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying YE.
2. Fundamentals of Mathematical Statistics by S.C. Gupta and V. K. Kapoor, Khanna Publications.
3. Operations Research by S.D Sharma, Kedarnath and Ramnath Publishers, Meerut, Delhi.

REFERENCE BOOKS:

1. Fundamentals of Probability and Statistics for Engineers by T. T. Soong, John Willy & Sons, Ltd.
2. Probability and Statistics for Engineers and Scientists by Sheldon, Academic press.

BT302PC: BIOCHEMISTRY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: The main objective of the course is to study the various biomolecules, structures, properties and their metabolic pathways.

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

CO1 Understand the basics of Biochemistry and Bioenergetics. (SDG 3,4,9,12)
CO2 Evaluate the knowledge of Physical, Chemical, Biological properties and metabolism of Carbohydrates. (SDG 2,3,4)
CO3 Analyse the knowledge of Characteristics of Lipids and Hormones. (SDG 2,3,4,9)
CO4 Evaluating the Physical, Chemical and Biological properties relating to Amino acids and proteins. (SDG 2,3,9,12)
CO5 Analyse the Various metabolic pathways related to Nucleic acids and Vitamins. (SDG 2,3,4,9)

UNIT-I: CHEMISTRY OF LIFE: Covalent bonds and non-Covalent interactions, Water as a biological solvent and its role in biological processes. Concept of buffer, pH, Henderson-Hasselbalch equation, strength of buffer, range of buffer, important biological buffers.

UNIT-II: CARBOHYDRATES: Chemical Classification and Biological functions, Chemical Structure of Glyceraldehyde, Dihydroxy acetone phosphate, Erythrose, Ribose, Fructose, Glucose, Glycogen, Hyaluronic acid, Muramic and Sialic Acids, Physico-chemical Properties, Osazones, Benedict's test, action of acid and alkali, Metabolism-Glycolysis, TCA cycle, Electron transport chain and Oxidative Phosphorylation, Glycogen Synthesis**.**

UNIT-III: LIPIDS: Chemical classification and biological functions, chemical structure of Saturated and Unsaturated fatty acids, Triacyl Glycerol, Lecithin, Sphingomyelin, Gangliosides, Isoprene, Cholesterol, Physico chemical properties, Solubility, Saponification number, Iodine number, Lipoproteins; Metabolism- β-oxidation of fatty acids (C16) and Biosynthesis of Fatty acid (C16).

UNIT- IV: **PROTEINS & AMINO ACIDS**: Chemical classification and biological functions of amino acids, Properties-Solubility, Ninhydrin reaction, Sorenson's Formal titration, Edman and Sanger reaction, Structural and chemical classification of Proteins, Biuret reaction, Isoelectric Point, Metabolism-Transamination & Deamination, Urea cycle, Degradation and biosynthesis of amino acids - Glutamate and Tyrosine.

UNIT- V: NUCLEIC ACIDS AND VITAMINS: Structure of purines, pyrimidines, nucleosides and nucleotides. Metabolism of purine and pyrimidine nucleotides (Denovo and Salvage pathway), Biological functions of fat-soluble vitamins-Vitamin A,D,E,K and Water -soluble vitamins-Vitamin B and C.

TEXT BOOKS:

1. Biochemistry and Molecular Biology, Third Edition by William H. Elliott and Daphne C. Elliott, Oxford University press.
2. Biochemistry L. Stryer Third Edition.

REFERENCE BOOKS:

1. Biochemistry White, Handler and R.B. Smith 7th Ed.
2. Principles of Biochemistry A. Leininger.
3. Fundamentals of Biochemistry by J.L. Jain, Sanjay Jain AND Nitin Jain, S. Chand and Company Ltd.

BT303PC: MICROBIOLOGY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: The main objectives of this course are to understand the microbial structure and functions, classification, microbial growth, and its nutrients, apply aseptic and laboratory techniques in microbiological techniques.

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

CO1 Understand major breakthroughs that advanced microbiology into a technological science. (SDG 3,6,9)
CO2 Identify different microorganisms, their features, and their classification. (SDG 3,6,13)
CO3 Explain microbial growth, growth curves, and culture media. (SDG 2,3,9)
CO4 Choose suitable sterilization methods to control microbes in various settings. (SDG 3,6,9,12)
CO5 Describe viruses, their types, cultivation, and uses in medicine. (SDG 3,4,9)

UNIT- I: INTRODUCTION TO MICROBIOLOGY: Pioneers and their discoveries in Microbiology: Antony von Leuwenhoek, Louis Pasteur, Edward Jenner etc., Theory of spontaneous generation, Germ theory of diseases, Major contributions and events in the field of Microbiology, Scope and relevance of microbiology.

UNIT- II: MAJOR GROUPS OF MICROORGANISMS: General characteristics of Archaea, Eubacteria, Algae and Fungi. **Classification systems-**Phylogenetic, Phenetic, Taxonomic ranks, Major characteristics used in Taxonomy-Morphological, Physiological, Ecological, Biochemical, Immunological, Genetical and Molecular characteristics.

UNIT- III: MICROBIAL GROWTH AND NUTRITION: Microbial Growth: Growth Curve, Monoauxic, Diauxic and Synchronized Growth Curves. Factors affecting microbial growth. **Principles of Microbial Nutrition**: Nutritional requirements, Major & Minor elements, Trace metals and Growth factors, **Nutrient media:** Selective, differential, enriched, enrichment and special purpose media. Nutritional types based on energy source, carbon source and electron donor.

UNIT- IV: CONTROL AND PRESERVATION OF MICROBES: Control of microorganisms- Physical (moist and dry heat, radiation and filtration), Chemical (disinfectants, antiseptics, antibiotics and other chemotherapeutic agent), **Preservation of Microorganisms:** Short term and Long-Term Preservation Techniques.

UNIT- V: INTRODUCTION TO VIRUSES: Viruses: Nomenclature, General characteristics and Structure of viruses. **Classification of viruses**- Early methods, Casein and King, Baltimore classification. Isolation, cultivation, Purification and Enumeration of viruses, Life Cycle of Viruses, Application of viruses in Biomedicine.

TEXT BOOKS:

1. Microbiology, Pelczar M.J. Chan ECE and Krieg NR. Tata McGraw Hill.
2. Microbiology by Prescott.
3. An Introduction to Virology by Biswas and Biswas.

REFERENCE BOOKS:

1. Biology of Microorganisms. BROCK, Prentice Hall, International Inc.
2. General Microbiology. Hons. G. Schlege. Cambridge university press.
3. General Microbiology. Roger Y Stanier, Macmillan.

BT304PC: FLUID MECHANICS & HEAT TRANSFER

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course objective: To provide students with a fundamental understanding of fluid flow, heat transfer, evaporation, and condensation, and to enable them to apply these concepts to design and analyse equipment used in chemical and biological processes.

Course outcomes: At the end of this unit student will be able to :

CO1 Understand the basic principles of fluid flow, types of flow, and application of Bernoulli's theorem. (SDG 6,9)
CO2 Analyse frictional effects in fluid flow and apply dimensional analysis to fluid systems. (SDG 7,9)
CO3 Select and explain appropriate fluid flow measurement devices, pumps, compressors, and related equipment. (SDG 9,12)
CO4 Explain conduction, convection, and radiation heat transfer mechanisms, and analyse heat exchanger operations. (SDG 7,13)
CO5 Describe evaporation and condensation processes, perform related calculations, and analyse equipment used in these operations. (SDG 9,12)

UNIT-I: FLOW OF FLUIDS: Introduction, Definitions, Classification of fluids, Newtons laws of viscosity, Hydro static equilibrium, Manometers, Concept of volumetric and mass flow rate, various types of velocity, types of flow, Equation of continuity, Reynaldo's experiment, classification of fluid flow, Bernoulli theorem, Pump work in Bernoulli equation.

UNIT-II: CONCEPT OF FRICTION IN FLUID FLOW: Shear stress distribution in cylindrical tube, fanning friction factor for laminar and turbulent flow, Effect of roughness, velocity distribution for laminar flow in circular pipe, friction laws studies, pressure drop studies in turbulent flow, porous media and in fluidization. Dimensional analysis including Buckingham π Theorem and Rayleigh's method. **Flow of compressible fluids:** Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT-III: MEASUREMENT OF FLUID FLOW: **Introduction, various types of flow meters:** Venutri meter, orifice meter, Pitot tube, rotameter, measurement of flow in open channels. **Pipe fittings and valves**: Pipe, tubing and comparison, various types of fittings and applications. Transportation of liquids, classification pumps, centrifugal pumps, positive displacement pumps. Principle of compressor, blower and fans.

UNIT-IV: BASIC CONCEPTS IN HEAT TRANSFER: Introduction and Mechanisms of heat transfer: Conduction heat transfer (through slab, cylinder & Sphere), Conduction through solids in series, forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and biological materials, Heat transfer correlations and calculations, Types of heat exchange equipment, classification of shell & tube heat exchanger.

UNIT-V: BASIC CONCEPTS IN EVAPORATION AND CONDENSATION: Introduction, Types of evaporation equipment and operation methods, Overall heat transfer coefficients in evaporators, material and enthalpy balance for single effect evaporators, different types of evaporators, multiple effect evaporators, evaporation of biological materials. Types of condensation, numerical problems and condensation equipment.

TEXT BOOKS:

1. W L McCabe and JC Smith, "Unit operations in Chemical Engineering", 6th edition, McGraw Hill Intl. Ed.
2. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall India Pvt. Ltd.
3. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi.
4. D. Q. Kern, Process Heat Transfer, MGH.

REFERENCE BOOKS:

1. Chemical Engineering Fluid Mechanics by Ron Darby, CRC Press, 2nd Edn.
2. Holman, J. P.S. Bhattacharya, Heat Transfer, 10th Ed., Tata McGraw- Hill.
3. Chemical Engineering, Volume - I, J. Coulson and R.F. Richardson, Pergamon Press.
4. Unit operations, Vol-1 –Chattopadhyay, Khanna publishers.
5. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.
6. Heat Transfer by B. K. Dutta.

BT305PC: GENETICS & MOLECULAR BIOLOGY

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objective: This course aim is to understand the concepts on inheritance biology and molecular biology.

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

CO1 Analyse the mechanism of inheritance. (SDG 3,4)
CO2 Understand the sex determination and the linkage. (SDG 3,5)
CO3 Understand the prokaryotic and eukaryotic genome structure. (SDG 4,9)
CO4 Compare the prokaryotic and eukaryotic DNA replication process and gene expression. (SDG 3,9)
CO5 Understand the regulation of Transcription, Translation process. (SDG 3,9)

UNIT- I. **MENDELIAN GENETICS:** Principles, Segregation, Independent Assortment, Dominance Relations and Multiple Alleles, Epistasis, penetrance and expressivity, Extra Chromosomal Inheritance.

UNIT-II SEX DETERMINATION, LINKAGE, AND CHROMOSOMAL VARIATIONS: Sex Determination and Sex Linkage, Linkage of Genes on the X Chromosome, Crossing Over, Chromosomal mapping, Chromosome Variation in Number, Change in Chromosome structure, Mutations and its associated disorders.

UNIT- III: GENOME ORGANIZATION AND NUCLEIC ACIDS: Organization of the genome in prokaryotic and eukaryotic cells. Eukaryotic Organelle genomes. DNA and RNA: structure, types and function. Transposons and retrotransposons.

UNIT-IV: GENETIC MATERIAL, GENE EXPRESSION, AND DNA REPAIR: Evidences for nucleic acid as genetic material. DNA Replication in prokaryotes and Eukaryotes. Transcription in prokaryotes and eukaryotes. Regulation of gene expression in prokaryotes (Lac operon and tryptophan operon). Regulation of gene expression in Eukaryotes. DNA damage and repair mechanisms.

UNIT-V: RNA PROCESSING, TRANSLATION, AND GENETIC CODE: Post transcriptional modifications for mRNA and other RNA, Wobble hypothesis and Genetic code, Translation mechanism in prokaryotes and Eukaryotes. Post translational processing of proteins.

TEXT BOOKS:

1. An Introduction to Genetic Analysis by David Suzuki, Anthony I.F Griffiths.
2. Bruce Alberts, Molecular Biology of the Cell, 5th Edition, Garland Science.
3. David Freifelder, Molecular Biology, 2nd Edition, Narosa Publishing House.
4. T. A. Brown, Genomes 2, 2nd Edition, Garland Science.
5. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of the Gene, 6th Edition, CSHL Press.
6. Strick Berger M.W., Genetics, 3rd Edition, Prentice Hall India.

BT306BS: MATHEMATICS III FOR BIOTECHNOLOGY LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objective: This course is aimed to equip students with the ability to organize and graphically present biostatistical data, understand probability and regression modeling (including normal distributions and correlation), conduct both parametric and non-parametric hypothesis tests such as chi-square, and design randomized biological experiments covering bioequivalence, bioassay, and dose–response analysis**.**

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

CO1 Understand the mathematical basis and foundations of probability and statistics. (SDG 4)
CO2 Apply Statistical method to solve biological problems. (SDG 3,4)
CO3 Learn to use R for data analysis, Visualization. (SDG 4,9)
CO4 Use basic and modern statistical software to analyze the biological and clinical data. (SDG 3,9)
CO5 Perform common biostatistical tests using R. (SDG 4,9)

LIST OF EXPERIMENTS:

1. Introduction to bio statistics and organization of data: Graphical and Pictorial presentation of data, Measures of central tendency.
2. Probability and Regression: Definition and Probability distributions, normal distributions. Linear Regression and Correlation.
3. Parametric and Non-Parametric Tests: Testing hypothesis, Non-Parametric procedures, Chi-Square test.
4. Experimental Design: Randomization, Completely randomized, bioavailability and bioequivalence, Bioassay, dose effect, LD_{50}, $ED_{50,}$ Probability Calculations.

TEXT BOOKS:

1. Biostatistics: A Foundation for Analysis in the health Sciences, 9th Ed, Daniel Wayhe W., John Wiley & Sons
2. Fundamentals of Biostatistics, 7th Ed, RoshevBevnavd, Brocks/Cole
3. Intuitive Biostatics, 2nd Edition, Motulsky H, Oxfort University Press

BT307PC: BIOCHEMISTRY AND MICROBIOLOGY LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objective: To gain practical knowledge of essential biochemical and microbiological techniques through the analysis of biomolecules and microorganisms. This includes buffer preparation, staining, microbial culture, biochemical estimations, and antibiotic sensitivity testing.

Course Outcomes: At the end of the course the students will acquire the skills to:

- CO1 Prepare buffer solutions and accurately measure pH (SDG 3,4,6)
- CO2 Perform qualitative and quantitative assays for biomolecules: carbohydrates, amino acids, proteins, cholesterol, acid and saponification values of oils. etc., (SDG 2,3,12)
- CO3 Perform the essential microbiological techniques, including sterilization, media preparation, microbial isolation and enumeration, and staining methods (Gram, endospore, negative, and motility tests). (SDG 3,6,9)
- CO4 Analyse microbial growth dynamics, construct growth curves, and evaluate antibiotic sensitivity using disc diffusion. (SDG 2,3,4)
- CO5 Operate core laboratory instruments, such as pH meters and microscopes, employ aseptic technique, and accurately interpret and present biochemical and microbiological results. (SDG 4,9)

LIST OF EXPERIMENTS:

1. Preparation of Buffers and Measurement of pH.
2. Qualitative and Quantitative analysis of Carbohydrates.
3. Qualitative and Quantitative analysis of Amino Acids.
4. Qualitative and Quantitative analysis of Proteins.
5. Quantitative estimation of Cholesterol.
6. Determination of Acid value and Saponification value of oils.
7. Staining: Simple, Negative, Gram staining and Endospore Staining.
8. Hanging drop Technique for demonstrating motility of bacteria.
9. Preparation of Media (Simple, Differential, Selective and Enriched).
10. Isolation, enumeration and purification of microbes from a given sample.
11. Determination of Bacterial Growth Curve.
12. Antibiotic Sensitivity Test by Disc Diffusion Method.

BT308PC: FLUID MECHANICS & HEAT TRANSFER LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objective: To provide hands-on experience in measuring fluid flow, analysing flow behaviour, and studying heat transfer mechanisms for engineering applications.

Course Outcomes: At the end of the course the students will acquire the skills to:

CO1 Determine flow rates and coefficients using various flow measuring devices (orifice meter, venturi meter, rotameter, notches). (SDG 9)

CO2 Analyse frictional losses and flow characteristics in pipelines and fittings. (SDG 6,9)

CO3 Evaluate heat transfer parameters such as thermal conductivity, heat transfer coefficients, and emissivity. (SDG 7,9)

CO4 Verify fundamental fluid mechanics and heat transfer principles experimentally (e.g., Bernoulli's theorem, Reynolds number). (SDG 4,9)

CO5 Interpret experimental data to assess performance of fluid and heat transfer equipment. (SDG 9)

LIST OF EXPERIMENTS:

1. Determination of discharge coefficient for orifice meter and venturi meter.
2. Determination of discharge coefficient for rotameter.
3. Determination of weir meter constant K for v-notch and rectangular notch.
4. Determination of friction losses in pipe fittings.
5. Determination of Reynold's Number based on the types of flow.
6. Verification of Bernoulli's Theorem.
7. Determination of flow of fluid through process medium.
8. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions.
9. Determination of heat transfer coefficient in Natural convection.
10. Determination of heat transfer coefficient in forced convection.
11. Determination of emissivity of non-black surface.
12. Determination of Overall heat transfer coefficient for parallel flow/counter flow in a double pipe heat exchanger.

BT309PC: MOLECULAR BIOLOGY LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objective: This course aim is to understand the different molecular biology techniques and the practical knowledge on molecular biology experiments.

Course Outcomes: After completion of the course the student will acquire the skill to:

- CO1 Isolate and purify high-quality genomic DNA from both bacteria and plants using CTAB, and assess purity and integrity via UV spectrophotometry. (SDG 3, 15)
- CO2 Visualize and analyse nucleic acids on agarose gels, determining DNA concentration, absorption maxima, and melting temperature (Tm). (SDG 9, 4)
- CO3 Quantify nucleic acids using DPA for DNA and orcinol assays for RNA, and perform gel extraction to recover specific DNA fragments. (SDG 9, 3)
- CO4 Induce mutations through physical or chemical mutagens, screen and isolate mutants using replica plating, and validate genetic alterations. (SDG 2, 3, 15)
- CO5 Demonstrate competence in molecular biology workflows, from nucleic acid handling and mutation screening to accurate documentation and interpretation of results. (SDG 4, 9)

LIST OF EXPERIMENTS:

1. Isolation of Genomic DNA from Blood.
2. Plant genomic DNA isolation by CTAB method.
3. Quality check for Isolated Nucleic Acids: Spectrophotometric (UV Method).
4. Visualization: Agarose Gel Electrophoresis (Detection and separation of DNA).
5. Absorption maxima of Nucleic acids.
6. DNA melting temperature (Tm) determination.
7. Estimation of DNA by DPA method.
8. Estimation of RNA by orcinol method.
9. Induction of mutations by physical/chemical mutagens, screening and isolation of Mutants, Replica plating technique.
10. DNA Gel extraction.

BT310SD: R PROGRAMMING

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives: To equip students with fundamental knowledge of R programming, including data structures, control statements, and functions for data analysis. To develop skills in data visualization and analytical techniques using R for solving real-world problems.

Course Outcomes: Upon successful completion, students will be able to

- **CO1** Work with R interactive environment and list arrays, vectors.
- **CO2** Develop and evaluate loop constructs, available in R.
- **CO3** Make use of different data structures and functions.
- **CO4** Summarize different kinds of visualization techniques for plotting graphs.
- **CO5** Analyze the datasets using R-Programming.

Tasks:

1. (a). Write a R-Program to create an array of two 3X3 matrices from given vectors.
   (b). Find Sum, mean and product of given vector values.
2. (a). Write a R-Program for implementation of built-in functions.
   (b). Write a R-Program to find a factorial of given numbers using recursive functions.
3. Write a R-Program to create a list of random numbers in normal distribution and count the occurrence of each value.
4. Write a R-Program to create a data from give four vectors of students' data. (Name, R. No. Sub, marks).
5. Write a R-Program to implement data preprocessing technique.
6. Write a R-program to read .csv file and perform the following
   (a). Plot the data using ggplot.
   (b). Test a hypothesis on data.
7. Use R-Studio to implement logistic Regression model.
8. Use visualization technique and plot the resultant data of logistic regression.
9. Write a R-Program for string manipulation functions.
10. Write a R-Program for DNA and Protein sequence analysis and display results using pie chart.

BT401PC: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: The objective of the course is to create general understanding of Microscopy, Spectroscopy, Electrophoresis, CD&ORD Spectroscopy, X ray crystallography, Sequencing methods and different chromatographic methods.

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

- CO1 Understand microscopic techniques. (SDG 3,4)
- CO2 Acquire knowledge of spectroscopy, Beer- Lamberts Law, X ray diffraction and Optical Rotator Dispersion. (SDG 9,4)
- CO3 Understand different separation techniques viz., electrophoresis, sedimentation and centrifugation. (SDG 3,9)
- CO4 Understand the different chromatography and Flow Cytometry Techniques. (SDG 3,9)
- CO5 Understand different techniques involved in sequencing of proteins and nucleic acids. (SDG 3,2,9)

UNIT- I: INTRODUCTION TO MICROSCOPY: Different types of microscopies: Bright field, Dark field, Fluorescent, Phase contrast, Confocal microscopy, Electron microscopy (SEM & TEM), Raman microscopy and Atomic Force Microscopy.

UNIT- II: INTRODUCTION TO SPECTROSCOPY: Principle, Instrument flow chart and applications: UV – VIS Spectrophotometer and Beer lamberts law, Atomic absorption & Atomic Emission Spectroscopy, X-ray Crystallography, Optical Rotatory Dispersion, CD, FTIR and NMR.

UNIT- III: SEPARATION TECHNIQUES I: Sedimentation, Centrifugation and Filtration, Electrophoresis of proteins and nucleic acids. Two-dimensional gel electrophoresis. Pulse field gel electrophoresis. Capillary electrophoresis, Immunoelectrophoresis.

UNIT- IV: SEPARATION TECHNIQUES II: Chromatography: Adsorption, Affinity, Ion exchange, Gel permeation, Thin Layer Chromatography, Gas Chromatography, RPC, HPLC, FPLC. Flow Cytometry.

UNIT-V: SEQUENCING OF PROTEINS AND NUCLEIC ACIDS: N-terminal sequencing for determination of protein sequence (Edman degradation), MALDI-TOF analysis. Nucleic acid sequencing methods (Sangers Dideoxy and Maxim Gilbert methods), **Next generation sequencing methods:** Pyro sequencing, Ion torrent and Illumina sequencing.

TEXT BOOKS:

1. Principles & Techniques of Biochemistry & Molecular biology by Keith Wilson & John Warker.
2. Biophysical Chemistry Principles & Techniques by Upadhya & Upadhya 4th edition, Himalaya Publishing House.
3. Instrumental methods of chemical analysis – Gurudeep R. Chatwal Sham K Anand, Himalaya Publishing house.

BT402PC: GENETIC ENGINEERING

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To provide students with a comprehensive understanding of the tools, techniques, and applications of genetic engineering, including gene cloning, gene expression, gene editing, and their use in research, medicine, and biotechnology.

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

CO1 Understand the enzymes involved in recombinant DNA technology and also know the PCR and its application (SDG 3, 4, 9).
CO2 Evaluation of different types of vectors, cloning, transformation and selection. (SDG 9, 4).
CO3 Understand the different expression systems, hybridization techniques and also Genomic and c DNA library constriction and its application. (SDG 2, 3, 9).
CO4 Discuss advanced methods for gene editing and generation of transgenic organisms. (SDG 2, 3, 13).
CO5 Apply knowledge of genetic engineering in therapeutic and industrial applications. (SDG 3, 9)

UNIT-I: GENETIC ENGINEERING TOOLS AND TECHNIQUES: Important milestones of genetic engineering. Molecular Tools in Genetic Engineering – Restriction enzymes and DNA Modifying enzymes. Restriction mapping of DNA fragments, Polymerase chain reaction and its applications, Real time PCR, Digital droplet PCR, Gene cloning strategies, Gene Machine.

UNIT-II: CLONING VECTORS AND RECOMBINANT SELECTION: Cloning vectors: Plasmids, bacteriophages, cosmids, phagemids, BACs and YACs, *Agrobacterium* Ti and Ri plasmids, Viral vectors, Transformation and selection of recombinants.

UNIT-III: GENE LIBRARIES, EXPRESSION, AND DETECTION TECHNIQUES: Genomic and cDNA library construction and application, Strategies of gene delivery, Gene expression in bacteria, yeast, insect cells, mammalian cells and in plants, Detection of gene (Southern), m RNA (Northern), protein (Western), Micro array.

UNIT-IV: TRANSGENICS AND GENE EDITING TECHNIQUES: Transgenics and Gene knock out, Gene knock down (RNA i, Antisense technology and ribozyme technology), Gene editing Techniques (TALEN, Zinc fingers and CRISPER Cas9).

UNIT-V: **ADVANCED APPLICATIONS IN GENETIC ENGINEERING:** Recombinant Vaccines, Gene Therapy, Site-directed Mutagenesis and Protein Engineering. Co Immunoprecipitation, Yeast two hybrid, Yeast Three hybrid, Phage display.

TEXTBOOKS:

1. Principles of gene manipulation & genomics by B. Primrose.
2. Gene cloning & DNA analysis: An Introduction by T.A Brown.
3. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
4. DNA Cloning: A Practical Approach, M. Glover and B.D. Hames, IRL Press, Oxford.

REFERENCE BOOKS:

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J. Cseke, CRC Press, Florida.
2. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego.
3. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego.

4. DNA Science. A First Course in Recombinant Technology, D,A.Mickloss and G.A. Froyer. Cold Spring Harbor Laboratory Press, New York.
5. Molecular Biotechnology (2nd Edn.), S.B. Primrose. Blackwell Scientific Publishers, Oxford,
6. Milestones in Biotechnology. Classic papers on Genetic Engineering, J.A. Davies and W.S. Reznikoff, Butterworth-Heinemann, Boston.
7. Route Maps in Gene Technology, M.R. Walker and R. Rapley, Blackwell Science Ltd., Oxford.

BT403PC: CHEMICAL AND BIOCHEMICAL THERMODYNAMICS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To provide students with a comprehensive understanding of the fundamental laws of thermodynamics, properties of pure substances, solution thermodynamics, and chemical reaction equilibria, enabling them to apply these principles to real-world Bio process engineering.

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

CO1 Understand basic thermodynamic concepts, types of systems, and the Zeroth Law of Thermodynamics to explain temperature measurement and thermal equilibrium. (SDG 4,9)

CO2 Apply the First Law of Thermodynamics to closed and open systems, and analyse various thermodynamic processes using PVT relationships and equations of state. (SDG 7,12)

CO3 Interpret and explain the Second Law of Thermodynamics, entropy, and related thermodynamic properties for ideal gases. (SDG 7,13)

CO4 Analyse solution thermodynamics, including partial molar properties, fugacity, activity coefficients, and excess properties in binary systems. (SDG 9,12)

CO5 Evaluate phase and chemical reaction equilibria in binary systems using thermodynamic criteria, and estimate equilibrium conversions and yields. (SDG 9,13)

UNIT-I: BASIC CONCEPTS & ZERO LAW OF THERMODYNAMICS: The scope of thermodynamics, Basic concepts: temperature, volume, pressure, work, energy, heat, Joules Experiment. Types of systems, pure substances, thermodynamic equilibrium, state, property, Process, cycle reversibility. **Zero law of thermodynamics**: concept of equality of temperature, principles of thermometry, constant volume gas thermometer, scales of temperature, ideal gas scale, electrical resistance thermometer, thermos couple.

UNIT- II: THE FIRST LAW OF THERMODYNAMICS: The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant- V and constant- P processes, heat capacity, isobaric, isochoric, isothermal, adiabatic and polytrophic processes.

Volumetric properties of pure fluids: The PVT behavior of pure substances, Virial equations, the ideal gas, the applications of the Virial equations, second Virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

UNIT- III: THE SECOND LAW OF THERMODYNAMICS: The Second Law of Thermodynamics: Limitations to first law, qualitative statement of Kelvin Plank and Clausius versions of second law, entropy - definition, entropy and heat calculations for ideal gases. Maxwell relations (problems not included), Residual properties - definition (V^R , H^R , S^R , G^R - basic property relations for ideal gases, problems not included).

UNIT- IV: SOLUTION THERMODYNAMICS: Solution Thermodynamics: Partial molar properties: definition and simple applications involving 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-V: CHEMICAL REACTION EQUILIBRIA & REACTION COORDINATES: Phase Equilibria: Vapor-liquid equilibrium calculations for binary systems - P-x-y, T-x-y diagrams, using simple Raoult's law to 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. P. Ravikumar “A text book of Engineering thermodynamics”. The HITECH publishers.
2. Robert A. Alberty, "Biochemical Thermodynamics: Applications of Mathematical", John Wiley and Sons.
3. Stanley I. Sandler, "Chemical and Engineering Thermodynamics", rd3 Edition, Wiley.
4. K.V. Narayanan, "A Textbook of Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd.

BT404PC: ENZYME ENGINEERING AND TECHNOLOGY

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To introduce students to the fundamental principles of enzyme structure, function, and kinetics, including single and multi-substrate reactions, enzyme inhibition, active site analysis, and enzyme immobilization, enabling them to apply these concepts in biochemical and industrial applications.

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

CO1 Understand the nature, function, classification, and catalytic mechanisms of enzymes, including the role of co-enzymes and co-factors. (SDG 4,3)

CO2 Apply enzyme kinetics theories such as Michaelis-Menten and Briggs-Haldane models to analyse single-substrate enzyme reactions and different types of enzyme inhibition. (SDG 9,12)

CO3 Evaluate pre-steady-state kinetics, multi-substrate enzyme kinetics, and mechanisms of allosteric regulation. (SDG 3,9)

CO4 Analyse factors affecting enzyme activity, including pH and temperature, and identify catalytic and binding sites using various experimental techniques. (SDG 3,9)

CO5 Explain methods of enzyme immobilization and model the kinetics of immobilized enzymes. (SDG 9,6,12)

UNIT-I: INTRODUCTION TO ENZYMES: Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis., Role of co-enzymes and co-factors.

UNIT-II: ENZYMES SINGLE SUBSTRATE AND INHIBITION KINETICS: Kinetics of single substrate reactions: Michaelis - Menton equation, Briggs Haldane equation, Evaluation of MM kinetic parameters by various methods. Turnover number. Principles of catalysis: Arrhenius theory, Collison theory and transition state theory. Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition.

UNIT-III: PRE-STEADY–STATE AND MULTI SUBSTRATE ENZYME KINETICS: Determination of rate constants by using Rapid mixing methods, stopped flow methods and Relaxation techniques, Determination of the number of active sites of enzyme. Enzyme kinetics at limiting conditions: Dilute substrates, solid substrates and enzyme activity at interfaces. Kinetics of Multi substrate reactions. Allosteric enzymes: binding of ligand and proteins, the Monod- Changeux-Wyman model.

UNIT-IV: FACTORS AFFECTING ENZYME ACTIVITY & ACTIVE SITE STUDIES: Active Site Studies: The identification of binding sites and catalytic sites, Trapping the enzyme substrate complex, the use of Substrate analogues, Enzyme modification by chemical procedures affecting amino acids side chains, the enzyme modification by treatment with proteases and site-directed mutagenesis. Temperature and pH effects, thermal deactivation of enzymes. pH dependence: Ionization of Acids and Bases.

UNIT-V: ENZYME IMMOBILIZATION & KINETICS OF IMMOBILIZATION: Immobilization of Biocatalysts an Introduction, method of immobilization. **Kinetics of immobilization enzyme:** Electrostatic effect, Effect of external; charged and uncharged support, Effect of Intra-particle diffusion with uncharged supports, Simultaneous external and internal mass transfer resistances. Intraparticle diffusion and immobilized enzyme stability. Dam Kohler number and effectiveness factor.

TEXT BOOKS:

1. Blanch HW and Clark DS: Biochemical Engineering Marcel Decker.
2. Enzymes, Biochemistry, Biotechnology Clinical Chemistry: Trevor Palmer.

REFERENCE BOOKS:

1. Bailey JE, Ollis, DF: Biochemical Engineering Fundamentals, Prace and Stevens,

2. Handbook of Enzyme Biotechnology, 3rd Edition, Ellis Horwood Publication.
3. Moser, A: Bioprocess technology, kinetics and reactors: Springer Verlag.
4. Biochemical Engineering Principles and functions by Syed Trnveer Ahmed Inamdar, PHI Learning Private limited.

BT405PC: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: Introduce the basics in artificial intelligence, applications of AI, search strategies for AI programs, Knowledge representation and machine learning techniques.

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

CO1 Understand artificial intelligence problems and appraise its applications. (SDG 4,9)
CO2 Implement different search strategies for state space search. (SDG 9,11)
CO3 Develop statistical learning model. (SDG 3,9)
CO4 Apply supervised learning techniques for training a machine for classification. (SDG 8,9)
CO5 Explore neural networks and reinforcement learning. (SDG 9,13)

UNIT- I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE: Definitions of Artificial Intelligence, Artificial Intelligence Problems, Benefits of Artificial Intelligence, Timelines of Artificial Intelligence, Production Systems, Branches of Artificial Intelligence, Applications of Artificial Intelligence.

UNIT- II: HEURISTIC SEARCH TECHNIQUES AND KNOWLEDGE REPRESENTATION: Heuristic Search Techniques: Generate and Test, Hill Climbing, Search techniques – DFS, BFS, Greedy method, Best first search, A*. Knowledge Representation: Knowledge management, types of knowledge, knowledge representation, approaches to knowledge representation, issue in knowledge representation.

UNIT- III: INTRODUCTION TO MACHINE LEARNING: Machine Learning, Types of Machine Learning, Intelligent agents. Statistical Learning: Hidden Markov models, Linear classifiers, quadratic classifiers, decision trees, Bayesian networks.

UNIT- IV: SUPERVISED AND UNSUPERVISED LEARNING TECHNIQUES: Supervised Learning: SVM, Inductive logic programming, case-based reasoning, nearest neighbourhood. Unsupervised Learning: Types of Unsupervised learning, K-Means, K- Mediods Algorithm.

UNIT- V: NEURAL NETWORKS: Basics, Learning process, types of networks, ANN Perceptron, RBF networks. Reinforcement Learning: Markov decision problem, Q-learning, Temporal difference learning, Learning automata.

TEXT BOOKS:

1. Vinod Chandra S.S. and Anand Hareendran S., Artificial Intelligence and Machine Learning, PHI, 2014

REFERENCE BOOKS:

1. E. Rich and K.Knight, “Artificial Intelligence”, TMH.
2. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, SecondEdition, Pearson Education.
3. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education.
4. Tom M Mitchell, “Machine Learning”, TMH.

MS406HS: INNOVATION AND ENTREPRENEURSHIP

B.Tech. II Year II Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To familiarize on the basic concepts of innovation, entrepreneurship and its importance.
2. To Identify and analyze the process of problem-opportunity identification, market segmentation, and idea generation techniques.
3. To initiate prototype development and understand minimum viable product.
4. To develop initial Business and financial planning and Go-to-Market strategies
5. To impart knowledge on establishing startups, venture pitching and IPR

Course Outcomes:

1. Understand the entrepreneurship and the entrepreneurial process and its significance in economic development.
2. Assess the problem from an industry perspective and generate solutions using the design thinking principles.
3. Assess market competition, estimate market size, and develop a prototype.
4. Analyze Business and financial planning models and Go-to-Market strategies.
5. Able to build a start-up, register IP and identify funding opportunities.

Unit I: Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation.

Entrepreneurship: Introduction, types of entrepreneurship attributes, mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

Unit II: Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems**,** market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model.

Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER, Design thinking principles, Mapping of solution to problem.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

Unit III: Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity.

Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale and analyzing financial performance. Go-To-Market (GTM) approach – Selecting the Right Channel, creating digital presence, and building customer acquisition strategy.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Unit V: Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start-up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features.

Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting, International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

Suggested Readings:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
6. NISP -Brochure inside pages - startup_policy_2019.pdf

BT407PC: ANALYTICAL TECHNIQUES & ENZYME ENGINEERING AND TECHNOLOGY LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objective: This course intends to provide the practical knowledge of different analytical and enzyme engineering techniques**.**

Course Outcomes: By the end of this course student will acquire skills to:

CO1 Demonstrate proficiency in microscopy and basic laboratory techniques for studying cells and microorganisms. (SDG 3,4)

CO2 Perform electrophoresis and chromatography methods to analyse proteins and nucleic acids. (SDG 3,9)

CO3 Apply spectrophotometric principles to verify Beer-Lambert's law and determine molecular properties. (SDG 4,9)

CO4 Analyse enzyme kinetics and determine key kinetic parameters under varying environmental conditions. (SDG 4,12)

CO5 Demonstrate the microbial production of industrially important enzymes and evaluate their activity. (SDG 9,12)

LIST OF EXPERIMENTS:

1. Microscopy.
2. Electrophoresis of Proteins – SDS PAGE.
3. Electrophoresis of Nucleic acids.
4. Verification of Beer Lambert's Law & Determination of Molar Extinction Coefficient by UV – VIS spectrophotometer.
5. Ion-Exchange Chromatography.
6. Gel Permeation Chromatography.
7. HPLC.
8. IEF Demonstration.
9. Study of Michalis-Menton kinetics of invertase.
10. Effect of pH on enzyme kinetics.
11. Effect of temperature on enzyme kinetics.
12. Production of Amylase by *Aspergillus niger.*
13. Enzyme immobilization experiments (Diverse Techniques).
14. Determination of Enzyme activity for cellulase.

BT408PC: GENETIC ENGINEERING LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objective: To provide hands-on training in fundamental recombinant DNA technologies including nucleic acid isolation, genetic manipulation and to prepare students for applications in research and biotechnology.

Course Outcomes: By the end of this course student will acquire skills to:

- CO1 Isolate and analyse genomic, plasmid, and RNA molecules, and visualize DNA fragments via agarose gel electrophoresis. (SDG 4,9)
- CO2 Design and synthesize primers, perform PCR amplification, and conduct restriction digestion to manipulate DNA fragments. (SDG 3,9)
- CO3 Execute molecular cloning protocols, including ligation, preparation of competent cells, bacterial transformation, and recovery of recombinant DNA. (SDG 2,9)
- CO4 Screen and identify recombinants using methods like blue-white selection and confirm clone identity through analysis. (SDG 3,12)
- CO5 Develop proficiency in end-to-end molecular workflows, accurately documenting experimental procedures, troubleshooting techniques, and interpreting results. (SDG 4,8)

LIST OF EXPERIMENTS:

1. Isolation of DNA from Bacteria.
2. Isolation of RNA.
3. Isolation of Plasmid from bacteria.
4. Primer designing.
5. PCR-Amplification of DNA.
6. Restriction digestion of DNA.
7. RFLP.
8. Ligation.
9. Competent cells preparation.
10. Transformation.
11. Screening for recombinants (Blue-white).

TEXT BOOKS:

1. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
2. DNA Cloning: A Practical Approach, M. Glover and B.D. Hames, IRL Press, Oxford.

BT409PC: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objective: To develop practical skills in implementing fundamental and advanced artificial intelligence and machine learning algorithms, enabling students to apply them to real-world problems and datasets.

Course Outcomes: By the end of this course student will acquire skills to:

- CO1 Use different search strategies to solve AI problems. (SDG 9)
- CO2 Solve classic AI problems like the 8-puzzle. (SDG 4)
- CO3 Build and test classification models using methods like decision trees, random forests, and SVM. (SDG 3,9)
- CO4 Apply supervised and unsupervised learning to real datasets. (SDG 9,12)
- CO5 Use advanced methods like Hidden Markov models and reinforcement learning for prediction and learning tasks. (SDG 9,13)

LIST OF EXPERIMENTS:

1. Implement the following search strategies:
   (a)Depth First Search
   (b)Breadth First Search
   (c) Best First Search
   (d) A*
2. Write a program to implement 8 puzzle problem.
3. Apply Linear classifier on any dataset.
4. Construct a decision tree model on weather dataset by applying ID3 algorithm.
5. Create a random forest model for weather data and compare it with ID3.
6. Create a classifier using SVM for Iris flower dataset.
7. Perform cancer prediction using kNN supervised learning.
8. Perform stock market prediction using Hidden Markov model.
9. Implement reinforced learning on any application such as super Mario.
10. Implement K-means clustering on weather dataset.

BT410SD: INDUSTRIAL BIOTECHNOLOGY

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives: To provide students with practical knowledge of industrial fermentation, enzyme technology, and downstream processing techniques. To develop an understanding of industrial-scale bioprocessing, including process scale-up and recombinant protein production.

Course Outcomes: Upon successful completion, students will be able to

- **CO1 Perform microbial fermentation processes** and analyse product yield (e.g., ethanol, citric acid).
- **CO2 Apply techniques for enzyme production, immobilization, and assay** in an industrial context.
- **CO3 Demonstrate methods for purifying and analysing proteins,** such as affinity chromatography.
- **CO4 Assess microbial properties** like probiotic viability and antibiotic sensitivity.
- **CO5 Operate and simulate scale-up bioprocessing** in bench-top bioreactors and express recombinant proteins in *E. coli*.

List of Experiments for Industrial Biotechnology

1. Batch Fermentation for Ethanol Production Using Yeast
2. Solid-State Fermentation for Amylase Production
3. Enzyme Immobilization and Activity Assay
4. Protein Purification using Affinity Chromatography
5. Citric Acid Production using *Aspergillus niger*
6. Probiotic Viability and Acid Tolerance Testing
7. Antibiotic Sensitivity and Resistance Profiling
8. Scale-Up Simulation in Bench-Top Bioreactor
9. Recombinant Protein Expression in *E. coli.*

VA400HS: INDIAN KNOWLEDGE SYSTEM

B.Tech. II Year II Semester

Bharat is considered one of the oldest civilizations of the world. Some of the archaeological evidences proved the existence of Indus Valley Civilization in 7000 B.C. Bhartiya traditions, culture, cultural activities, rituals, sacraments, painting, art of dancing, art of singing etc. is being practised till the modern times without knowing scientific approaches behind that. Eternity of Indian knowledge system proved itself that not only many rituals but also many traditions, many streams of knowledge like astrology, mathematics, physics, chemistry, biology, language studies, yoga and meditation had been following from the starting till now with some changes, in the form of traditions.

This course is for undergraduate students to inculcate Indian values. It will promote advance study and inter disciplinary research on all aspects of the Indian knowledge system.

Course Objectives: This course aims:

1. To provide a tribune of the rich culture and traditions of Indian knowledge system to students of various disciplines.
2. To introduce historical account on the education and scientific literature available in ancient Indian traditions and its connections with ancient Indian Philosophy
3. To give insights about the applications of Bharatiya Jnana Parampara
4. To introduce Indian approach towards health and wellbeing
5. To elaborate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

Course Outcomes: Students will be able to:

1. Understand nature, scope and related fields of Indian knowledge system.
2. Demonstrate the scientific literature available in ancient Indian traditions
3. Understanding the application of Bharatiya Jnana Parampara
4. Understand Indian approach towards Wellbeing
5. Appreciate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

Unit 1: **Introduction to Indian Knowledge Systems**
Meaning**,** Nature, Scope and Salient Aspects of Bharatiya Jnana Parampara - Introduction to Vedas, Upanishads, Vidya, Kala, Jnana, Shastra - Practices and Continuity of Tradition

Unit 2: Overview of History of Indian Education and Scientific Literature
Gurukul System - Role of Sanskrit in Natural Language Processing - Scientific Literature - Vedic Literature - Available Scientific Treatises - Interlinkings

Unit 3: Introduction to Scientific Theories from Pure Sciences from Ancient Indian Knowledge Systems
Overview of theories from available ancient Indian Literature about Physics, Chemistry and Mathematics - Interlinkings and applications

Unit 4: Introduction to Ancient Indian Wellness Systems
Concept of Wellness – Yoga System - Ayurveda System - Ancient Indian Aesthetics

Unit 5: Development of Engineering, Science, Technology & Fine Arts in India
Various Industries - Silk, Cotton and Ship Building - Evolution of Indian Fine Arts – Cave and Temple Architecture, Vastu - Vidya, Sculpture, Forts and Stepwells, Observatories and Paintings - Music and Natyakala - Cultural Traditions & Folk Arts

❖ **Pedagogy for Teachers: Apart from Class Room Instruction, the following Methods are Suggested.**

1. Project based activities and learning.

2. Presentation and case studies.
3. Film screening and book reviews.
4. Visit to historical places, archives centre, research centre or library nearby.

***Note**: Activities mentioned above are only suggestive. Teacher-educators should encourage students to be innovative.*

Suggested Readings:

1. B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., (2022) '*Introduction to Indian Knowledge Systems: Concepts and Applications*' PHI learning PVT, New Delhi ISBN [9789391818203]
2. Dharmapal (1971) '*Indian Science and Technology in the Eighteenth Century*'. Other India Press, Goa.
3. Kapil Kapoor, Singh Avdhesh Kumar, (2005) '*Indian Knowledge Systems*' D.K. Printworld (P) Ltd. ISBN 10: 8124603367 / ISBN 13: 9788124603369
4. Chakradeo, Ujwala, Temples of Bharat, Aayu Publications, New Delhi, 2024.
5. D.N. Bose, S.N. Sen and B. V. Subbarayappa, *A Concise History of Science in India*, Indian National Science Academy, New Delhi, 2009.
6. Datta B. and A. N. Singh, *History of Hindu Mathematics: Parts I and II*, Asia Publishing House, Bombay, 1962.
7. Kapoor, K. (2021), *Indian Knowledge System: Nature, Philosophy, Character in Indian Knowledge System*, vol. 1, Pub. Indian Institute of Advanced Studies, Shimla
8. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Philosophical Systems, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.
9. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Knowledge: Framework and Classification, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.

Video Resources:

1. Introductory lectures by Prof. Gauri Mahulikar
2. Introductory lectures by Prof. Kapil Kapoor

Websites:

- https://iksin dia.org/index.php
- Official Website of IKS- Indian Knowledge System
- https://www.youtube.com/watch?v=uKcf-hSlcUE
- Address by Prof Kapil Kapoor | Indian Institute of Advanced Study (FDP 2021)
- https://www.youtube.com/watch?v=MDJTXNiH2_A
- Mukul Kanitkar on Bharatiya Knowledge System
- https://www.youtube.com/watch?v=uARMhv97pjk
- https://www.youtube.com/watch?v=oTwgf56GbsA
- Scientific History of India | Mukul Kanitkar Lecture in DTU
- https://youtu.be/gNJNmPJqXJc?si=WFBbuUT65mLZzpOW
- Ancient India's Scientific Achievements & Contribution in Mathematics, Astronomy, Science & Medicine