B.TECH.

(BIOTECHNOLOGY)

(Effective from the admitted batch of 2015-16)

Scheme and Syllabi

DEPARTMENT OF CHEMICAL ENGINEERING
AU COLLEGE OF ENGINEERING (A)
ANDHRA UNIVERSITY
VISAKHAPATNAM

1/4 B.Tech. (Biotechnology) First Semester

ENG-1101 ENGLISH

Objectives:

Reading Skills

- Addressing explicit and implicit meanings of a text on current topics.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

Writing Skills

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, emails, reports and presentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

Interactive Skills

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

Life Skills and Core Skills

- Examining self-attributes and identifying areas that require improvement: self-diagnosis and self-motivation.
- Adapting to a given situation and developing a functional approach to finding solutions: adaptability and problem solving.
- Understanding the importance of helping others: community services and enthusiasm.

Outcome:

- The overall performance of the students will be enhanced after the course; they will be in a position to make presentations on topics of current interests - politics, famous personalities, science and technology, tourism, work and business environment, with increased public speaking skills.

- Students will be able to read, listen, speak and write effectively in both academic and non-academic environment.

- The students will be updated with certain real life situations, which they can handle when come to face to face.

Syllabus:

1.Vocabulary: Word Search, Discuss and Note – Word Quiz – A List of 100 Basic Words – One Word Substitutes – 100 Difficult Words, Synonyms, Antonyms, Idioms, Technical terms.

2.Grammar: Types of Sentences, Verbs, Adverbs, Pronouns, Adjectives, Gerunds & Infinitives, Articles, Quantifier, Punctuation, Prepositions, Conjunctions, Exclamation.

3.Reading: Famous People – What is Personality, Personality Based on Blood Groups – News Report, Magazine Article, Mobile Towers and Health – An Excerpt from a Short Story, An Excerpt from a Biography – Open Letter to Prime Minister, Business Dilemmas: An Email Exchange – A

Review of IPL: The Inside Story, Marck Zuckerberg: World's Youngest Billionaire – Solar Power: The Way Forward, From the Very Small to the Very Large.

4.Listening: Life in a Hostel – Eating Away those Blues!, Meeting Carl Jung – A Documentary on the Big Cat – A Consultant Interviewing Employees – A Conversation about a Business Idea – An Interview with a Woman Engineer.

5.Speaking: Your favorite Holiday Destination – Describe yourself – Why we need to save Our Tigers-a Dialogue – Your First Interview – Pair Work: Setting up a New Business – Great Engineering Achievements.

6.Scenario: Sharing a Flat – Living in the Twenty-First Century – Global warming – Reality TV – Recession – The Sky-High Project.

7.Writing: Writing Sentences – Using your dictionary – Paragraph Writing, Arguing a Case – Essay, Formal Letters, Emails, Reports, and Presentations.

8.Life Skills and Core Skills: Self Awareness and Self Motivation – Communication, Adaptability – Motivation, Problem Solving – Personal Presentation Skills, Stress Management – Professionalism, Ethics – Innovativeness and Creativity.

Prescribed Text Book: *Life through Language: A Holistic Approach to Language Learning.* Board of Editors, Pearson Publishers, India. 2013.

Life through Language: An Effective Learning Experience

Life through Language has a systematic structure that builds up communicative ability progressively through the chapters. It will enable the learner to manage confusion; frame question for themselves and others; develop new ideas; support ideas with evidence; express themselves with poise and clarity; and think critically. Acquisition of skill leads to confidence.

Chapter-1

People and Places:-Word search - Ask yourself-Self-assessment-I -Self-assessment-II - Sentence and its types- A guidebook entry- Life in a hostel-Your favorite holiday destination-Designing a holiday-Writing sentences-Self-awareness- Self-motivation.

Chapter-2

Personality and Lifestyle:- Word quiz – Verbs-Adverbs- A big fat wedding- Wine and dine- Going places-Negotiations-Proving yourself- Meeting Carl Jung- Describing yourself- Living in the 21st century- Using your dictionary- Communication-Adaptability.

Chapter-3

Media and Environment: - A list of 100 basic words – Nouns- Pronouns- Adjectives-News report- Magazine article- User's Manual for new iPod- A documentary on the big cat- Why we need to save our tigers: A dialogue- Global warming- Paragraph Writing-Arguing a case- Motivation- Problem solving.

Chapter-4

Entertainment and Employment:- One word substitutes- Parts of speech- Gerunds and infinitives- An excerpt from a short story an excerpt from a biography- A consultant interviewing employees- Your first interview- Reality TV- Writing an essay-Correcting sentences- Integrity Sense of humor.

Capter-5

Work and Business:- A list of 100 difficult words- Articles, Quantifiers- Punctuation - Open letter to the Prime Minister Business dilemmas: An email exchange- A review of *IPL: The Inside Story,* Mark Zuckerberg: World's Youngest Billionaire- A conversation about a business idea- Pair work: Setting up a new business- Recession- Formal letters-Emails- Reports- Professionalism-Ethics.

Reference Books:

1. Basic Vocabulary. Edgar Thorpe, Showick Thorpe. Pearson P. 2008.
2. Quick Solutions to Common Errors in English, Angela Bunt. MacMillan P. 2008.
3. Know Your English (Volume 1&2), by Dr. S. Upendra, Universities Press, India 2012
4. Business Communication Strategies. Mathukutty Monippally. Tata Mc Grahill P. 2009.

ENG-1102 **MATHEMATICS-I**

OBJECTIVES:

To impart the knowledge of partial differentiation involving two or more variables, Euler's theorem, change of variables, Jacobins, Geometrical interpretation. To apply the concept of partial differentiation in finding the errors and approximations, maxima and minima of two variables, to introduce the Lagrange's method of undetermined constants and Leibnitz's rule. To solve the ordinary differential equations of first order and first degree, Bernoulli's equation, exact differential equations, and equations reducible to exact equations. To get knowledge about the applications of differential equations of first order like orthogonal trajectories, simple electric circuits, law of natural growth and decay. To solve the linear differential equations of higher order, also to impart the knowledge in convergence, divergence and oscillation of an infinite series.

OUTCOMES: By the end of the course, the student will be able to

1. Use the different methods to solve the partial differentiation involving two or more variables and acquire skills to find solutions of maxima and minima of functions of two variables.
2. Use the different methods to find solutions to ODEs of first order and first degree, orthogonal trajectories, simple electric circuits and law of natural growth and decay. Also acquire the skills to solve the higher order differential equations.
3. Calculate the convergence, divergence or oscillation nature of an infinite series, and apply different test techniques like comparison test, limit test, D Alembert's test and other tests.

SYLLABUS:

Unit-I

Partial Differentiation

Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobians - Geometrical interpretation: Tangent plane and Normal to a surface.

Unit-II

Application of Partial Differentiation

Taylor's theorem for functions of two variables - Errors and approximations – Total differential - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rules.

Unit-III

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER and First degree

Formation of the ordinary differential equations(ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations.

Unit-IV

Applications of DIFFERENTIAL EQUATIONS OF FIRST ORDER

Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Unit-V

LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear equations.

Unit-VI

Infinite Series

Introduction to Series – Convergence, Divergence and Oscillation of a Series - Comparison Test – Limit form - Integral Test - D Alembert's Ratio Test - Raabe's Test - Logarithm Test - Cauchy's Root Test - Alternating Series: Lebnitz Rule - Series of positive, negative terms: Absolute and Conditional Convergence-Uniform Convergence: Weirstrass M-Test. (All Tests without proofs)

TEXT BOOK:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics by Erwin Kreyszig.
2. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
3. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
4. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.
5. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

ENG-1103 **MATHEMATICS-II**

OBJECTIVES: The students are introduced with matrix algebra, Laplace transforms and Special functions to enable them to use in their further studies.

In matrix algebra,

(i) Consistency and inconsistency of system of equations by the use of rank of a matrix.
(ii) Obtaining Eigen values and Eigen vectors of a square matrix and application of Cayley- Hamilton's theorem.
(iii) Quadratic and canonical forms.
(iv) Properties of complex matrices
(v) Solution of system of equations by direct methods are thoroughly discussed.

In Laplace transforms,

(i) Properties of Laplace transforms.
(ii) Properties of Inverse Laplace transforms.
(iii) Applications of Laplace transforms are presented.

Whereas in Special Functions,

(i) Series solution of differential equations.
(ii) Properties of Legendre polynomial.
(iii) Properties of Bessel function are introduced to the students.

OUTCOME:

The students comeout with a good knowledge of Matrix Algebra, Laplace Transforms and Special Functions and ready to use these mathematical techniques when required. And also, the students are able to discuss and apply all the contents mentioned in the objectives in their further study.

SYLLABUS:

Unit-I

Matrices I

Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct Methods: Gauss elimination method, LU Factorization method - Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton theorem.

Unit-II

Matrices II

Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form - Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Unit-III

LAPLACE TRANSFORMS

Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Laplace Transforms of Unit Step Function, Unit Impulse Function and Periodic Functions.

Unit-IV

LAPLACE TRANSFORMS

Inverse Laplace Transform - Convolution Theorem - Applications of Laplace Transforms to Ordinary Differential Equations, Simultaneous Linear Differential Equations with Constant Coefficients.

Unit-V

SPECIAL FUNCTIONS

Bessel's Equation - Bessel's Functions - Recurrence Formulae for Bessel's Function - Generating Function - Equations reducible to Bessel's equation - Orthogonality of Bessel's Functions.

Legendre's Differential Equation - General Solution of Legendre Equation - Legendre Polynomials - Rodrigue's Formula - Generating Function, Recurrence Formulae, Orthogonality of Legendre Polynomials.

TEXT BOOK:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43r^d edition, Khanna publishers.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics by Erwin Kreyszig.
2. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
3. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
4. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

ENG-1104 CHEMISTRY

Objectives: The student will be able to:

1. appreciate the nature and scope of chemistry in engineering.
2. apply the knowledge of water, solid state of mater, polymers, corrosion, building material, fuels and lubricants as foundation for engineering discipline
3. apply key concepts from water chemistry, solid state chemistry for future society and industry needs
4. apply solid state chemistry in all major disciplines of engineering
5. apply the role of polymers, plastics and building materials and their properties for industrial and day to day use
6. apply the effects of corrosion on industrial scale and the measures for its control
7. apply fuels and lubricants and their properties for industrial and day to day use

Outcome:

The course introduces studentsto water chemistry, solid state chemistry, polymers, plastics, corrosion, building materials, fuels and lubricants for engineering applications, future materials and devices

Syllabus:

Chapter 1: Water Chemistry [8 Hrs.]

Sources of Water – Impurities and their influence on living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange – Municipal Water Treatment – Break Point Chlorination – Desalination of Sea Water –Reverse Osmosis Method, Electrodialysis

Chapter 2: Solid State Chemistry: [8 Hrs.]

Solids: Classification of Solids – Types of Crystals – Fundamental Laws of Crystal Structure – X-Rays and Bragg's Law – Imperfections in Crystals – Band Theory of Solids – Chemistry of Semiconductors – Intrinsic, Extrinsic, Compound and Defects – Organic Semiconductors - Super Conductivity - Purification of Solids by Zone refining – Single Crystal Growth – Epitaxial Growth – Liquid Crystals

Chapter 3: Polymers and Plastics [10 Hrs.]

Polymers: Definition – Types of Polymerisation (Addition & Condensation) – Mechanisms of Polymerisation - Radical and Ionic – Thermodynamics of Polymerisation Process

Plastics: Thermosetting and Thermoplastics - Effect of Polymer Structure on Properties of Plastics –Compounding of Plastics – Fabrication of Plastics – Preparation and Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Bakelite, Reinforced Plastics – Conducting Polymers

Chapter 4: Corrosion [10 Hrs.]

Corrosion: Origin and Theory – Types of corrosion: Chemical and Electrochemical; Pitting, Intergranular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion

Corrosion Controlling Methods: Protective Coatings: Metallic coatings Electroplating and Electroless Plating – Chemical Conversion Coatings – Phosphate, Chromate, Anodized, Organic coatings – Paints and Special paints.

Chapter 5: Building Materials [10 Hrs.]

Portland Cement: Manufacture of Cement– Dry and Wet Processes – Chemical Composition of Cement – Setting and Hardening of Cement – Cement Concrete – R.C.C – Decay of Concrete and Protective Measures – Special Cements

Refractories: Classification – Properties – Engineering Applications

Ceramics: Classification – Properties – Engineering Applications

Chapter 6: Fuels and Lubricants [10 Hrs.]

Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications

Liquid Fuels: Petroleum Refining – Motor fuels – Petrol and Diesel oil – Knocking – Octane number – Cetane number

Gaseous Fuels: Biogas, LPG and CNG – Characteristics – Applications

Rocket Fuels – Propellants – Classification – Characteristics

Lubricants – Classification – Mechanism – Properties of Lubricating Oils – Selection of lubricants for Engineering Applications

Reference Books:

Engineering Chemistry – PC Jain and M Jain – DhanpathRai and Sons, New Delhi

A Text Book of Engineering Chemistry – S. S. Dara – S. Chand and Co. New Delhi

Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut

ENG-1106 COMPUTER PROGRAMMING AND NUMERICAL METHODS

Objectives :
To make the student familiar with programming in C and enable the student to implement the numerical methods described in this course using C as Programming language.

Section A
Computer Programming in C :
Basics : Variables, constants, expressions, operators and their precedence and associativity, basic input and output statements, control structures, simple programs in C using all the operators and control structure.
Functions : Concept of a function, parameters and how they are passed, automatic variables, recursion, scope and extent of variables, writing programs using recursive and non-recursive functions.
Arrays and Strings : Single and multidimensional arrays, character array as a string, functions on strings, writing C programs using arrays and for string manipulation.
Structures : Declaring and using structures, operations on structures, arrays of structures, user defined data types, pointers to using files.
Files : Introduction, file structure, file handing functions, file types, files, error handing, C programming examples for using files.

Section B
Computer oriented numerical methods :
Basic concepts : Preliminary concepts of algorithms, flow charts and their execution traces, a simplified model of a computer,
Representation for characters and numbers : Representation for integer and real numbers, effect of finite representation on arithmetic operations for ex. overflow, underflow, associativity and normalization, some elementary methods for overcoming these limitations,
Numerical methods : Notation of round-off and truncation errors, numerical methods of finding roots of an algebraic equation of one variable, successive bisection method, false position method, Newton Raphson method and Secant method.
Solutions of simultaneous algebraic equations ; Gauss elimination method and Gauss Seidal methods,
Interpolation : Lagrange's interpolation and difference table methods,
Numerical integration : Simpson's rule, Gaussian quadrature furmula,
Numerical solution of differential equation : Euler's method, Taylor's series method and Runge-Kutta method.

SYLLABUS:

1. **Introduction to C :** Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations, Formatted Input, Formatted Output.

2. **Descision Making, Branching, Looping, Arrays & Strings :** Decision making with if statement, Simple if statement, The if… else statement, Nesting of if ….esle statement, the else…. If ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops, One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

3. **Functions :** Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions : No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Return a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, The scope, visibility and lifetime of variables.

4. **Pointers :** Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications.

5. **Structure and Unions :** Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields-Program applications.

6. **File handing :** Defining and opening a file, closing a file, Input/Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments – Program Applications.

7. **Numerical Methods : Solutions of Algebraic and Transcendental Equations :** Bisection Method, Newton Raphson Method. **Interpolation :** Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. **Numerical Integration :** Trapezoidalrule, Simpson's 1/3 rule. **Solutions of Ordinary First Order Differential Equations** : Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Books :

1. Programming in ANSI C, E Balagurusamy, 6th Edition, McGraw Hill Education (India) Private Limited.
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall.

Reference Books :

1. Let Us C, Yashwant Kanetkar, BPB Publications, 5th Edition.
2. Computer Science, A structured programming approach using C", B.A. Forouzan and R.F. Gilberg, "3rd Edition, Thomson, 2007.
3. The C-Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.
4. Scientific Programming : C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

ENG-1108 HISTORY OF SCIENCE AND TECHNOLOGY

Objectives:

- To know the contributions of scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the economy.
- To identify the technological transfer versus economic progress of the countries.

Outcome: By the end of this course the students should be able to understand the contribution of Scientific and Technological developments for the benefit of society at large.

Syllabus:

UNIT-I

Historical Perspective of Science and Technology:

Nature and Definitions; Roots of Science – In Ancient Period and Modern Period (During the British Period); Science and Society; Role of Scientist in the Society. **(6 periods)**

UNIT-II

Policies and Plans after Independence:

Science and Technology Policy Resolutions; New Technology Fund; Technology Development (TIFAC); Programs aimed at Technological Self Reliance; Activities of Council of Scientific and Industrial Research. **(6 periods)**

UNIT-III

Science and Technological Developments in Critical Areas:

Space – The Indian Space Program: India's Geostationary Satellite Services – INSAT System And INSAT Services; **Defense Research and Technology** – Research Coordination, Research efforts and Development of technologies and Spin-off technologies for civilian use; **Nuclear Energy** –Effects of a nuclear explosion and India's safety measures**. (6 Periods)**

UNIT-IV

Impact of Science and Technology in Major Areas:

Ocean Development: Objectives of Ocean Development, Biological and Mineral resources, Marine Research and Capacity Building; **Biotechnology:** Meaning, Biotechnology techniques-Bioreactors, Cell fusion, Cell or Tissue Culture, DNA Fingerprinting, Cloning, Artificial Insemination and Embryo Transfer Technology and Stem Cell Technology; Application of Biotechnology – Medicine, Biocatalysts, Food Biotechnology, Fuel and Fodder and Development of Biosensors. **(6 periods)**

UNIT-V

Technology Transfer and Development:

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques; **Appropriate Technology** - Criteria and Selection of an Appropriate Technology; Barriers of Technological Change. . **(6 periods)**

Text Books:

1. Kalpana Rajaram, **Science and Technology in India,** Published and Distributed by Spectrum Books (P) Ltd., New Delhi-58.

2. Srinivasan, M., **Management of Science and Technology (Problems & Prospects),** East – West Press (P) Ltd., New Delhi.

1/4 B.Tech. (Biotechnology) Second Semester

ENG-1201 MATHEMATICS-III

OBJECTIVES : The main objective of Engineering Mathematics is to make the students familiar with mathematical thinking and realization of the background of their problems. Multiple Integral is a natural extension of a definite integral to a function of more than one real variable. A major reason to study solid geometry is the application to computer graphics, sphere and cylinder are one of the most basic curvilinear geometric shapes. Fourier Series is a way to represent a periodic signal into the sum of a set of simple oscillating functions namely sines and cosines. Fourier Series has many applications in Electrical Engineering, vibration analysis, acoustics, signal and image processing, etc.

OUTCOMES : On successful completion of the course , the student will be able to evaluate double and triple integrals which are useful in evaluating area, volume, mass, centroid and moments of inertia of plane and solid regions. He knows how to convert a double integral in Cartesian co-ordinates into an integral in polar co-ordinates. He also knows to find the volume in between the intersection of solids. He can evaluate the surface area of solid figures. The student can expand a given function as Fourier series and half range series. The student will be familiar with the properties and relations of lines, surfaces and solids in space.

Syllabus:

Unit-I
Solid Geometry

Equations of Straight Line - Conditions for a line to lie in a Plane - Coplanar lines - Shortest distance between two lines - Intersection of three Planes - Equations of Sphere - Tangent Plane to a Sphere –Cone - Cylinder.

Unit-II
Multiple Integrals-1

Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Unit-III
Multiple Integrals-2

Beta Function - Gamma Function - Relation between Beta and Gamma Functions - Error Function or Probability Integral - Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of mass - Center of gravity - Moment of inertia - product of inertia – principal axes.

Unit-IV
Fourier series

Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula.

TEXT BOOK:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd edition, Khanna publishers.

REFERENCE BOOKS:

1. Advanced Engineering Mathematics by Erwin Kreyszig.
2. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal; Lakshmi Publications.
3. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
4. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.
5. Engineering Mathematics series by Chandrica Prasad.

ENG-1202 **PHYSICS**

Outcome:

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

- Solve engineering problems using the concepts of wave and particle nature of radiant energy
- Understand the use of lasers as light sources for low and high energy applications
- Apply the concepts of light in optical fibers, light wave communication systems.
- Construct a quantum mechanical model to explain the behaviour of a system at microscopic level Mapping of course outcomes
- student will be able to understand many modern devices and technologies based on lasers and optical fibers.
- Student can also appreciate various material properties which are used in engineering applications and devices.
- The student will be able to understand fundamentals of electrodynamics and semiconductor physics which is base of many modern devices and technologies.
- Student will also get an exposure to modern physics topics like nanotechnology and advanced materials.

Syllabus:

Unit-I

THERMODYNAMICS

Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

(8 Hours)

Unit –II

ELECTROMAGNETISM

Concept of electric flux, Gauss's law - some applications, Electric potential and field strength, potential due to a point charge and dipole, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Inductance, L-R Circuit, Induced magnetic fields, Displacement current, Maxwell's equations (Both differential and Integral forms), Magnetic materials: Classification of magnetic materials and properties.

(16 Hours)

Unit III

OPTICS

Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films, Wedge shaped film, Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Single slit (Qualitative and quantitative treatment)

Polarisation : Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization and detection.

(12 Hours)

Unit - IV

LASERS

Introduction, spontaneous and stimulated emissions, population inversions, pumping, Ruby laser, Gas laser (He-Ne Laser), Semiconductor laser, Applications of lasers.

FIBRE OPTICS

Optical Fibre and Total Internal Reflection, Acceptance Angle and cone of a fibre, Numerical aperture, Fibre optics in communications, Optical parts in Fibre, Application of optical fibers.

ULTRASONICS

Introduction, Production of Ultrasonics by Magnetostriction and Piezoelectric effects, Ultrasonics and diffraction pattern, Applications of Ultrasonics.

(14 Hours)

Unit - V

MODERN PHYSICS

De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators .

SUPERCONDUCTIVITY

Super conductivity, Meisner Effect, Types of Superconductors and Applications of Superconductors.

NANOPHASE MATERIALS – Introduction and properties, Synthesis - Chemical vapour deposition method – sol-gel methods, Applications of nano materials.

(10 Hours)

Books Recommended

1. Engineering Physics by R.K. Gaur and S.L. Gupta
2. Physics by David Halliday and Robert Resnick – Part I and Part II

Reference Books:

1) Engineering Physics by M.N. Avadhanulu & P.G. Kshirasagar; S. Chand & Company Ltd.
2) Modern Engineering Physics by A.S. Vadudeva
3) University Physics by Young and Freedman
4) Nonconventional Energy by Ashok V. Desai

ENG-1204 ENGINEERING GRAPHICS

Introduction: Lines, Lettering and Dimensioning. Geometrical Constructions. Introduction to Scales.
Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes. Normal and tangent.
Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of straight line inclined to both the reference planes:
Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.
Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projection of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.
Projections of Section of Solids: Section Planes: Parallel and inclined section planes, Sections and True shape of section, Sections of Solids: Prism, Pyramid, Cylinder and Cone .
Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.
Isometric Views: Introduction to Isometric projection, Isometric scale and Isometric view. Isometric views of simple planes. Isometric view of Prisms, Pyramids, cylinder and cone. Isometric view of an object when projections are given.
Text Book:
Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.
Reference:
Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill.

ENG-1206 **ETHICS AND MORAL VALUES**

Objectives:

- To inculcate Ethics and Human Values into the young minds.
- To develop moral responsibility and mould them as best professionals.
- To create ethical vision and achieve harmony in life.

Outcome: By the end of the course student should be able to understand the importance of ethics and values in life and society.

Syllabus:

UNIT – I

Ethics and Human Values: Ethics and Values, Ethical Vision, Ethical Decisions, **Human Values** – Classification of Values, Universality of Values. **(6 Periods)**

UNIT - II

Engineering Ethics: Nature of Engineering Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Sample Codes – IEEE, ASCE, ASME and CSI. **(6 Periods)**

UNIT – III

Engineering as Social Experimentation: Engineering as social experimentation, Engineering Professionals – life skills, Engineers as Managers, Consultants and Leaders, Role of engineers in promoting ethical climate, balanced outlook on law. **(6 Periods)**

UNIT - IV

Safety Social Responsibility and Rights: Safety and Risk, moral responsibility of engineers for safety, case studies – Bhopal gas tragedy, Chernobyl disaster, Fukushima Nuclear disaster, Professional rights, Gender discrimination, Sexual harassment at work place. **(6 Periods)**

UNIT – V

Global Issues: Globalization and MNCs, Environmental Ethics, Computer Ethics, Cyber Crimes, Ethical living, concept of Harmony in life. **(6 Periods)**

Text Books:

1. Govindharajan, M., Natarajan, S. and Senthil Kumar, V.S., Engineering Ethics, Prentice Hall of India, (PHI) Delhi, 2004.
2. Subramainam, R., Professional Ethics, Oxford University Press, New Delhi, 2013.

References:

1. Charles D, Fleddermann, "Engineering Ethics", Pearson / PHI, New Jersey 2004 (Indian Reprint).

DS-1208 INORGANIC CHEMISTRY

Objectives: The student will be able to:

1. appreciate the nature and scope of inorganic chemistry.
2. apply key concepts from atomic structure and periodic table
3. apply valence shell, electron pair repulsion method, molecular orbital theory for homonuclear diatomic molecules
4. apply chemical bonding and molecular structure
5. understand titrimetric analysis, classification of reactions in titrimetric analysis, standard solutions and classification of errors

Outcome:

The course introduces studentsto the atomic structure and periodic table, chemical bonding and molecular structure, chemistry of transition elements and coordination compounds and fundamentals of analytical chemistry

Syllabus:

Chapter 1: Atomic structure and periodic table: Early models of atom - Rutherford's model, Bohr's model, Bohr-Sommerfeld model, quantum numbers and their significance, dual nature of matter, failure of classical mechanics, Louis de Broglie wavelength, the uncertainty principle-Schrodinger wave equation (derivation not required), the meaning of wave function, quantum mechanical model of the hydrogen atom-some general conclusions, radial dependence, radial probability distribution curves and angular dependence curves, electronic configuration of elements, the modern periodic table (a brief discussion on the arrangement of elements), classification of elements, periodic properties - ionization energy, electron affinity, electronic structure and color, electronic structure and magnetism,

Chapter 2: Chemical bonding and molecular structure: The covalent bond, the simplest molecule H^+ ion its exact description, dative bond and its influence on covalence, the concept of resonance and hybridization, multiple bonding characters of second period and higher period elements and the difference between the two, Pauling's electro-neutrality principle, valence shell, electron pair repulsion method, molecular orbital theory for homonuclear diatomic molecules only, electro-negativity (Milliken approach), Fajan's rules for the prediction of non-polar character,

Chapter 3: Chemistry of Transition Elements and Co-ordination Compounds: First transition series and their general physical and chemical properties- oxides, halides, sulphides, chemistry in aqueous solution of first transition metals, co-ordination compounds, nomenclature, Werner's theory, isomerism in coordination compounds, valence bond theory, crystal field theory, colors of transition metal complexes, stability of complexes,

Chapter 4: Analytical Chemistry: Titrimetric analysis, classification of reactions in titrimetric analysis, standard solutions, equivalents, normalities and oxidation numbers, preparation of standard solutions, primary and secondary standards, classification of errors-accuracy, precision-minimization of errors, significant figures and computation-mean and standard deviation, reliability results, confidence interval.

Text books:

1. 'University General Chemistry' by C.N.R. Rao, MacMillan India Ltd., Hyderabad
2. C'oncepts and Models of Inorganic Chemistry' by B.E Douglas, D.H McDaniel and J. Alexander. 3rd edition; John Wiley & Sons Inc., New York
3. 'Concise Inorganic Chemistry' by J.D.Lee, Fourth Edition, Chapman & Hall

2/4 B.TECH. (BIOTECHNOLOGY) FIRST SEMESTER

BT-2.1.1 - MICROBIOLOGY

Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.

Outcome:

- Students gain the knowledge and skills both theoretically and practically.
- Students are equipped with theoretical approach to study them and understand their importance in ecosystem

Syllabus:

History and Development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

Microbial Taxonomy: Bacteria, archea and their broad classification. molecular approaches to microbial taxanomy, physiology of extremophiles,

Morphology and Functions of Viruses, Yeast, Molds and Bacteria:

Viruses- Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

Yeast and Molds: Morphology, life cycle, economic importance of yeast and *Aspergillus,*

Bacteria : Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

Microbial growth: Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass) growth yield, continuous culture- chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

Microbial Nutrition and Control of Microorganisms: Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

Methods in Microbiology: Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, light (bright field only) and electron microscopy,

Applied Microbiology: Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

Text book:

1. 'Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

Reference books:

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill
2. "Brock biology of Microorganisms", Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall

BTM-2.1.2 PHYSICAL CHEMISTRY

Objectives: The student will be able to:

1. appreciate the nature and scope of Physical chemistry.
2. apply key concepts from Liquid state and properties of liquids
3. apply thermodynamics, thermochemistry and chemical equilibrium, electrochemistry, Phase rule for various systems in chemical engineering
4. apply chemical kinetics and catalysis for effective reaction processes

Outcome:

The course introduces studentsto the liquid state and various properties of liquids, thermodynamics and thermo chemistry. It brings in an understanding of chemical equilibrium, electrochemistry, phase rule and catalysis to the students of chemical engineering

Syllabus:

Chapter 1: Liquid State: Liquefaction of gases, critical constants, Classius-Clayperon equation, vapor pressure of liquids, salt hydrates, variation of vapor-pressure with temperature, elementary treatment of vapor pressure, composition diagrams of binary liquid mixtures, azeotropic and zeotropic mixtures, fractional distillation and steam distillation.

Physical properties of liquids: Surface tension, explanation, measurement, effect of temperature on surface tension, applications, viscosity - definition, measurement, applications, intermolecular forces in liquids, hydrogen bond,

Chapter 2: Thermodynamics and thermochemistry: First law, internal energy, work and heat changes, enthalpy, reversible changes, maximum work, heat capacities at constant pressure and volume, adiabatic changes, heat of reaction, heat of formation, heat of combustion, thermo-chemical laws, effect of temperature on heat of reaction, second law of thermodynamics, spontaneous processes, entropy and entropy change for an ideal gas, entropy change accompanying phase change, physical significance of entropy, Gibb's free energy and applications,

Chapter 3: Chemical equilibrium: Reversible reactions, law of mass action, homogeneous equilibria in gaseous and liquid systems, simple example of heterogeneous equilibria, effect of temperature on equilibrium, Van'tHoff equation,

Chapter 4: Electrochemistry: Laws of electrolysis and their applications, difference between galvanic and electrolytic cells, electrode reactions, polarized electrode, decomposition potential, over voltage and its applications, EMF galvanic cells, free energy changes in cells, reversible electrode potentials, single electrode potential and its determination, Nernst equation and its derivation, reference (hydrogen and calomel) electrode, EMF series and its applications, primary and secondary galvanic cells (acid and alkaline)-lead acid battery, fuel cells and applications,

Chapter 5: Phase rule: Definition and explanation of terms involved in phase rule, derivation of the phase rule, one component systems (Ag-Pb and KI-H_2O), eutectic point and its significance

Chapter 6: Chemical kinetics and catalysis: Order and molecularity of a reaction, specific reaction rate and its determination, first order and second order reactions, half life period, pseudo first order and second reactions, effect of temperature on reaction rate, energy of activation, elementary treatment of collision theory and activated complex theory,

Catalysis: Types, characteristics of a catalyst, enzyme catalysts, industrial applications of catalysts.

Text books:

1. 'Elements of Physical Chemistry' by Samuel Glasstone and David Lewis Macmillan & Company Ltd., London

2. 'Physical Chemistry' 3rd edition, by P.W.Atkins, Oxford University Press
3. 'Text Book of Physical Chemistry' by Bahl and Tuli

BTM-2.1.3 **ORGANIC CHEMISTRY**

Objectives:

The student will be able to:

1. appreciate the nature and scope of organic chemistry.
2. apply key concepts from general chemistry including electronegativity, bonding (ionic and covalent), hybridization of atomic orbitals, and molecular orbital theory to organic systems.
3. draw skeletal structures for organic compounds.
4. apply acid-base concepts to organic systems; predict ordering of acid or base strength.
5. name alkanes, alkenes, polyenes, alkynes, alkyl halides, aromatic compounds, carbonyl compounds, amines and their various derivatives using systematic (IUPAC) nomenclature.
6. draw reaction mechanisms for some key reactions.
7. recognize stereochemistry and be able to apply the Cahn-Ingold-Prelog system to designation of stereochemistry (E/Z or R/S).
8. learn many of the reactions of alkanes, alkenes, polyenes, alkynes, aromatic, carbonyl, and amine compounds, and close related species. Be able to predict reactions involving these functional groups.
9. be able to solve problems employing spectroscopic methods including mass spectrometry, infrared and NMR spectroscopy
10. understand the basic chemical and structural features of biomolecules, including lipids, carbohydrates, amino acids and proteins, and nucleic acids

Outcome:

This course enables the students to acquire knowledge, comprehension and application in numerical problems related to organic chemistry, nomenclature and reactions of alkanes, alkenes, alkynes, dienes, electrophilic aromatic substitution, alcohols, acids, aldehydes and ketones, amines, soaps and detergents.

Syllabus:

Chapter 1:Numerical problems: Determination of percentage composition of carbon, hydrogen and nitrogen, molecular weight determination by depression in freezing point and elevation of boiling point methods, molecular weight of acids by silver salt method; molecular weight of bases by chloroplatinate method, determination of molecular formula of a compound, problems relating to reactions of carboxylic acids, functional derivatives of acids, carbonyl compounds, alcohols, amines, phenols, diazonium salts applications, alkenes and their laboratory tests,

Chapter 2:Nomenclature of alkanes, alkenes, alkynes, dienes, cyclic aliphatic hydrocarbons, structure of benzene, nomenclature of benzene derivatives, arenas, industrial preparation of ethylene, acetylene; sp, sp^2 and sp^3 hybridization; preparation and chemical reactions; conformational analysis of ethane, propane and butane, Wurtz reaction, Diels-Alder reaction, aromaticityMorkovinkov rule, Clemmensen and Wulf-Kishner reduction.

Chapter 3:Electro-philic and nucleo-philic aromatic substitution: Orientation in desubstituted benzenes, mechanism of nitration, halogenation, sulphonation, Friedel-Craft's alkylation and acylation reactions, nomenclature of alkyl halides, preparation and chemical reactions, mechanisms of SN_1, SN_2, E_1, E_2 reactions, nomenclature of aryl halides, preparation and chemical reactions: low reactivity of vinyl and aryl halides, Sandmeyer reaction,

Chapter 4: Nomenclature of alcohols; industrial preparation of ethyl alcohol, preparation and chemical reactions, Lucas test, nomenclature of mono, dicarboxylic acids, industrial preparation of formic, acetic, benzoic, phthalic, salicylic acids, preparation and chemical reactions, mechanism of HVZ reaction and Claisen condensation, nomenclature of functional derivatives of acids, preparation and chemical reactions, mechanism of Hoffmann bromamide reaction, acid and base catalyzed hydrolysis of ester, nomenclature of ethers and epoxides, industrial preparation of ether and ethylene oxide, preparation and chemical reactions; Williamson's synthesis,

Chapter 5:Nomenclature of aldehydes and ketenes: Industrial preparation of formaldehyde, acetaldehyde, benzaldehyde, salicyaldehyde, acetone; preparation and chemical reactions; mechanisms of Cannizaro, Aldol, Reformatsky and Wittig reactions, reactions without mechanisms -Perkin, Cope, Knoevenagel and Pinacol-Pinacolone reactions, difference between aldehyde and ketone, nomenclature of phenols, industrial preparation of phenol, preparation and chemical reactions, mechanisms of Fries rearrangement, Kobe reaction, Reimer-Tiemann reaction, classification of carbohydrates, structure of glucose and fructose, reactions of glucose and fructose, Ruff degradation, Wohls degradation, filiani-Fisher synthesis, glucose into fructose, fructose into glucose, glucose to vitamin-C, mechanism of Osazone formation,

Chapter 6:Nomenclature of amines, industrial preparation of aAniline, preparation and chemical reactions - exhaustive methylation, mechanism of Hoffmann elimination, benzedene rearrangement without mechanism, Hinsberg test, differentiation test using nitrous acid, preparation of diazonium salts and synthetic applications, preparation of sulphanilamide, sulphaguanidine, sulphamerazine, sulphapyridene (sulpha drugs), mode of action of sulpha drugs,

Chapter 7:Preparation of soaps and detergents: Mode of action of soaps, differences between soaps and detergents; preparation of malonic, acetoacetic ester and their synthetic applications, preparation of Grignard reagents and their synthetic applications, preparation of polyethylene, polystyrene, teflon, PVC, polyvinyl cyanide, rubber-vulcanisation, styrene-butadiene rubber, polychloroprene, bakelite, nylon-6 and nylon 6-6, plexiglas, terylene, Ziegler-Natta polymerization, definition of thermoplastics and thermosetting plastics,

Chapter 8:Isomerism: Structural and optical isomerism, geometrical isomerism, E Z configuration, sequence rules, R & S configuration, racemic mixture and their separation, asymmetric synthesis - Fischer projection formula, definitions of axial and equatorial bonds, 1-3-diaxial interaction, enatiomers, diastereomers, mesomers, isomerism in cyclic compounds, chair, boat and twisted boat structures (1-methylcyclohexane, 1, 2-cyclohexane diol), sSynthetic applications of - Zn/Hg, Na-$NH_3$$LiAH_4$, $NaBH_4$, diborane and zinc dust, soda lime, OsO_4, hydroxylamine, acetic anhydride, benzoylchloride and PCl_5.

Reference books:

1. 'Text Book of Organic Chemistry' by Morrison & Boyd
2. 'Text Book of Organic Chemistry' by Bahl&Tuli
3. 'Text Book of Organic Chemistry' by M.K.Jain
4. 'Text Book of Organic Chemistry' by I.L.Finar (Vols.1&2 as **reference books**)

BTM – 2.1.4 FUNDAMENTALS OF BIOLOGY

Objective:

- To study about the cell structure and function.
- To study about the plant structure, functions of various cells in the plants, flower structure, pollination and fertilization.
- To study about the physiological processes in the plant and various methods of plant breeding techniques.
- To study about the general characters of animals- invertebrates, vertebrates.
- To study about the general physiological processes like digestion, respiration, and excretion etc of the animals.

Outcome:

- Students will obtain knowledge in the biological processes occurring in the cells.
- Students will obtain knowledge in the structure of plants, and understand the phenomena of Embryology so that they can acquire knowledge to produce new varieties of plants.
- Students will obtain knowledge in various physiological processes of the plants and they also acquire knowledge in plant breeding techniques.
- Students will obtain knowledge in the general characters of animals and understand the phenomena of reproduction and life cycle of plasmodium vival.
- Students will obtain knowledge in various physiological processes of the animals. Digestion, respiration Excretory system, Nervous system functions are understood to the student so that student can do research in their future studies.

Syllabus:

Cell Biology: Structure and function of prokaryotic and eukaryotic cell, cell organelles, cell membrane, chloroplast, mitochondria, golgi complex, endoplasmic reticulum, lysosomes, ribosomes and nucleus, chromosome structure, mitosis and meiosis,

Plant Biology: Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

Embryology: Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

Anatomy: Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, secondary growth of dicot stem,

Plant Physiology: Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,
Mineral nutrition: Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,
Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, photo system I and II, photolysis of water, photophosphorylation, CO_2 fixation – C_3, C_4 and CAM pathway, photorespiration, factors affecting photosynthesis – Blackman's law of limiting factors,
Nitrogen metabolism: Introduction, nitrogen cycle, biological nitrogen fixation,

Plant Growth Regulators: Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

Plant Breeding: Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

Animal Biology: General characters of invertebrates, morphology, life cycle and reproduction of *Plasmodium Vivax,* general characters of vertebrates.

Animal Physiology: Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions, digestion, absorption and assimilation of digested products, egestion,

Respiration: Respiration in humans – respiratory system, mechanism of respiration,
Circulatory system: Blood vascular system in humans, blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and course of blood circulation, lymphatic system-lymph, lymph vessels, lymph nodes and lymphatic ducts and pacemakers,

Excretion: Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

Nervous system: Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

Text books:

1. 'Biology Text Book for class XI and XII', NCERT.
2. 'AP Academy Text Book for Botany and Zoology, for intermediate

BT-2.1.5 **GENETICS**

Objectives:

- To introduce Mendel's law of inheritance.
- To introduce interaction of Genes and inheritance.
- To introduce Gene linkage, crossing over and mapping.
- To introduce sex determination & linkage.
- To introduce chromosomes & chromosomal variation.

Outcome:

- To know inheritance, different types of inheritance.
- To know gene interaction. To know about complementary, duplicate genes and interaction between different two gene pairs.
- To know linkage patterns, different cross gene types.
- To know sex determination mechanisms and inheritance of sex linked traits.
- To know different types of cytogenetic effects and numerical changes in chromosomes.

Syllabus:

Mendel's law of Inheritance: Mendel's experiments–Mendels materials, crossing technique, results of Mendel's experiments, phenomenon of dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation-monohybrid cross, mechanism of segregation, monohybrid ratio, principle of independent assortment, Mendels dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio,

Interaction of Genes: Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs,

Quantitative / Multiple factor inheritance: Multiple factors, quantitative and quantative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations,

Multiple alleles : (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in *Drosophila*, self sterility in *Nicotiana,* blood groups in humans, complementation test or cis-trans test,

Linkage, crossing over and mapping:

Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage, linkage groups, significance of linkage,

Crossing over – Types of crossing over - mitotic and meiotic crossing over, mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization,

Molecular mechanism of recombination- Holiday model, cytological basis of crossing over; significance of crossing over,

Construction of a genetic mapping: Two point and three point test crosses and gene mapping, interference and coincidence,

Sex Determination :Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism (X/A ratio in *Drosophila*), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and *Drosophila*),

Sex Linkage: Inheritance of sex linked (X-linked) traits-eye color in *Drosophila*, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings,

Cytoplasamic Inheritance : Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in *Paramecium,* cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o-clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlymadomonas,

Chromosomal variations: Origin, types and cytogenetic effects,

Structural changes in chromosomes: Duplications, translocations, inversions (paracentric and pericentric cross over suppressors),

Numerical changes in chromosomes: Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

Text books:

1. "Genetics", by P.K.Gupta, Rastogi Publications
2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

Reference book:

1. "Principles of Genetics", by E.J. Gardner, M.J.Simmons & D.Peter Snustard, John Wiley & Sons, INC.

BT-2.1.6 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Objectives:

- To provide the students with knowledge of fundamental laws in electrical Engineering
- The ability to formulate and solve the differential equations describing time behavior of circuits containing energy storage elements.
- The capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.
- To understand the working of various D.C Machines.
- To inculcate the understanding about the AC fundamentals.
- To provide an insight into the principles of working of transformers, dc machines, alternators and induction motors.
- An understanding of how complex devices such as semiconductor diodes and field-effect transistors are modeled and how the models are used in the design and analysis of useful circuits.
- Understand the characteristics of transistors in CE, CB, CC configuration and it's usage as an amplifier and oscillator.

Outcome:

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

- Understand concept source of electrical generation, transmission, distribution, protection, safety measures and power & energy measurement.
- Understand construction & working of electrical machines and evaluate their performance
- To impart knowledge on constructional details, principle of operation, Performance, starters and speed control of DC Machines
- To impart knowledge on Constructional details, principle of operation of Transformers.
- To impart Knowledge on Constructional details, principle of operation of AC Machines
- Student will learn how to develop and employ circuit models for elementary electronic components like semiconductor diodes and transistors;

Syllabus:

(<u>Five</u> questions to be set from **Section A** and **<u>Three</u>** questions from **Section B)**

<u>Section-A</u>

Fundamentals Laws and Theorems: KVL, KCL, ohm's law, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem,

D.C. and A.C. Circuits: Mesh analysis, nodal analysis, star-delta transformation, sinusoidal steady state analysis of 1-φ circuits, series and parallel circuits, 3-φ circuits, Star-Delta circuits,

D.C. Machines : Construction and working of D.C. generators, EMF equation, classification, characteristics, armature reaction, construction and working of D.C. motors, torque equation, characteristics, speed control methods and 3-point starter, efficiency calculation,

Single phase Transformers: Construction and working of single phase transformers, equivalent circuits, efficiency, regulation, O.C and S.C tests,

A.C. Machines: Construction and working of 3 – φ Induction motor, slip, torque equation, efficiency, calculation, construction and working of synchronous generator (alternator), EMF equation, regulation-synchronous impendence method, synchronous motor, torque equation, starting methods.

<u>Section-B</u>

Electronics: Chartersistics of semiconductor diodes, transistors, characteristics of CB, CE, CC transistor configurations, oscillators, cathode ray oscilloscope, construction, working, applications, mechanical transducers, electrical transducers, pressure gauges, LVDT.

Text books:

1. 'Elements of Electrical Engineering and Electronics' by V.K. Mehta, S.Chand & Co.
2. 'Fundamentals of Electrical Engineering and Electronics' by B.L.Thereja
3. 'Electronic Devices and Circuits' by Allen Mottorshad, Prentice Hall of India
4. 'Basic Electrical Engineering' by V.N. Mitthal, Tata Mc-Graw Hill

2/4 B.TECH. (BIOTECHNOLOGY) SECOND SEMESTER

BT -2.2.1 BIOCHEMISTRY

Objectives:

- To study about the principles and significance of biochemistry.
- To study about the structure and function of Carbohydrates, Proteins and Aminoacids and Lipids.
- To study about the Nucleic acids like DNA and RNA and also to study about the structure and function of enzymes.
- To study about haemoglobin and chlorophyll molecules and their functions.
- To study about the fat soluble and water soluble vitamins also to study about the structure and function of harmones.

Outcome:

- Student will obtain knowledge in the subject of Biochemistry- study of chemical reactions and processes in living systems
- Students will obtain knowledge in Carbohydrates, Proteins and Amino acids and Lipids. Students will obtain knowledge in quantitative and qualitative analysis of these biomolecules.
- Student will obtain knowledge in nucleic acids-DNA and RNA hereditary materials and also acquire knowledge in enzyme structure and functions.
- Students will obtain knowledge in the basic structure of porphyrins and the detailed structure of haemoglobin and chlorophyll molecules.
- Students will obtain knowledge in the structure and function of vitamins which are necessary for sound health and students will also obtain knowledge in the structure and function of endocrinal glands, which secrete harmones.

Syllabus:

Scope and importance of Biochemistry.

Carbohydrates: Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolysaccharides), metabolism of carbohydrates - glycolysis, TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

Proteins and amino acids: Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

Lipids: Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

Nucleic acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

Enzymes: Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non-competitive and uncompetitive inhibitions,

Porphyrins: Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

Vitamins and hormones: Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

Text books:

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand & Company Ltd, New Delhi
2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

BT- 2.2.2 **BIOANALYTICAL TECHNIQUES**

Objective: Bioanalysis is a sub-discipline of analytical chemistry covering the quantitative measurement of xenobiotics (drugs and their metabolites, and biological molecules in unnatural locations or concentrations) and biotics (macromolecules, proteins, DNA, large molecule drugs, metabolites) in biological systems. Many scientific endeavors are dependent upon accurate quantification of drugs and endogenous substances in biological samples; the focus of bioanalysis in the pharmaceutical industry is to provide a quantitative measure of the active drug and/or its metabolite(s) for the purpose of pharmacokinetics, toxicokinetics, bioequivalence and exposure–response (pharmacokinetics/pharmacodynamics studies). Bioanalysis also applies to drugs used for illicit purposes, forensic investigations, anti-doping testing in sports, and environmental concerns. Modern drugs are more potent, which has required more sensitive bioanalytical assays to accurately and reliably determine these drugs at lower concentrations. This has driven improvements in technology and analytical methods.

Outcome: At the end of course the students would have learnt about the need of bio analysis and the techniques involve in various instruments which are useful in modern era.

SYLLABUS:

Unit 1: Chromatography- Distribution coefficient, modes of chromatography. Paper, Thin layer, Ion-Exchange and Affinity chromatography. GLC- Principle, sample preparation, apparatus, detectors types and applications. HPLC- Principle, Components and applications.

Unit 2: Electrophoresis- General principles, support media and applications. SDS-PAGE, Isoelectric focusing, Agarose gel electrophoresis, capillary electrophoresis. Centrifugation- Principle of sedimentation, sedimentation coefficient, Preparative and Analytical centrifuges, Ultracentrifuge. Differential centrifugation, density gradient centrifugation. Applications- in determination of molecular mass, purity and conformation of macromolecules.

Unit 3: Radioisotope techniques- Detection and measurement of radioactivity. Gas ionization, Excitation of solids and solutions, Autoradiography, Application in biological sciences- Metabolic pathways, turn over time determination, isotope dilution analysis, radiodating, clinical diagnosis and sterilization and tracer techniques. Biosensors- Principle and applications of Electrochemical, Thermometric, Optical and Peizoelectric Biosensors.

Unit 4: UV Visisble Spctroscopy- Principle, Beer-Lamberts law, Instrumentation of Single and Double beam spectrophotometers. Bathochromic and hypsochromic shifts and applications. Turbidometry and Nephlometry- Principles and Applications. Infra red and Raman Spectroscopy- Principles and Applications. Spectrofluorimetry- Principle and Applications.

Unit 5: ESR Spectroscopy- Principle, Hyperfine splitting, Instrumentation and applications. NMR Spectroscopy- Principle, Theory of Proton Magnetic resonance and Instrumentation. NMR parameters- Chemical shifts, spin-spin splitting, Intensity and line width and applications- Magnetic resonance imagning. Mass spectroscopy- Principle, Instrumentation, Ionization techniques, Electron impact and chemical Ionization, Ion desorption and evaporation methods, Magnetic and electric sector analyzers, detectors (Faraday cup). X-ray crystallography- Principle, Braggs equation, determination of crystal structure-Rotating crystal method and Powder method, and applications.

Reference book:

Practical Biochemistry- Principles and techniques- by Keith Wilson and John Walker.

Text book:

Biophysical techniques, by K.Upadhyay, A. Upadhyaya and N.Nath. Himalaya publishihng house.

BT-2.2.3 CELL AND MOLECULAR BIOLOGY

Objectives :

1. The main objective is to prepare the students for career in fields that require advance knowledge of cell and molecular biology.
2. With the application of study in cell and molecular biology, the student can also provide services and economic opportunities to the communities.

Outcome:

1. The student can develop basic knowledge and skills in cell & molecular biology and become aware of the complexity and harmony of the cells.
2. The student will be able to conduct research in the frontier and multi disciplinary areas of modern biology.

Syllabus:

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression: Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

Regulation of gene expression in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

TEXT BOOKS:

1. "The world of the cell" Becker, Klein smith & Hordin, Pearson education

REFERENCE:

1. Molecular cell biology by Lodish et.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

BT-2.2.4 **PROCESS CALCULATIONS**

Objective: To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

Outcome: 1. Able to solve the problems based on stoichiometry, ideal gas and vapor pressure.
2. Able to write and solve material and energy balances for a process.

Syllabus:

Stoichiometry and composition relationships- the gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales,
Behavior of ideal gases- application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis,
Vapor pressures- Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes,
Humidity - Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature,
Material balances- Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge,
Heat capacities of gases and gaseous mixtures- effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity,

Standard heat of reaction - Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non-adiabatic reactions, theoretical and actual flame temperatures.

Text book:

1. 'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995
2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)
3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

BT-2.2.5 FLUID MECHANICS AND HEAT TRANSFER

The main objectives are to provide:

1. Knowledge on pressure distribution in static fluids.
2. Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.
3. Knowledge of incompressible fluid flow in pipes
4. Knowledge on pipes, fittings, transportation and metering devices.
5. Knowledge on conduction, convection and radiation
6. Knowledge on heat flow by conduction and heat flow in fluids.
7. Knowledge on heat exchange equipment.

Outcome:

1. Able to estimate the pressure drop.
2. Enhance the flow by reducing boundary layer separation.
3. Estimating the pumping capacity and friction losses of flowing fluids.
4. Able to select pumps based on their performance.
5. Able to select proper measuring device and estimate the quantity of flow.
6. Able to solve heat transfer problems.
7. Able to design heat transfer equipment.

Syllabus:

Dimensional Analysis: Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis, Buckingham π theorem, Geometric similarity, kinematic similarity, and dynamic similarity.
Fluid statics and applications: Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.
Fluid Flow phenomena: Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.
Basic Equations of Fluid Flow: Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

Incompressible flow in pipes and channels : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Turbulent flow in pipes and channels, Velocity distribution for turbulent flow, effect of roughness, friction factor chart, drag reduction, friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.
Transportation of Fluids: Pipes, fittings, valves, positive displacement pumps (reciprocating, rotary and peristaltic pumps), centrifugal pumps
Metering of fluids: Full bore meters – Venturi meter, Orifice meter, Rotameters, Pitot Tube, Open orifice and V-notch.

HEAT TRANSFER

Nature of heat flow - Conduction, convection and radiation
Heat transfer by Conduction: Basic law of conduction, thermal conductivity, steady state conduction, compound resistances in series, heat flow through a cylinder and a sphere, unsteady state conduction – one dimensional heat flow with constant surface temperature.
Principles of heat flow in fluids: countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, LMTD, individual heat transfer coefficients, fouling factor.
Heat exchange equipment: condenser, heat exchanger, evaporator, boilers and calendears
Heat transfer to fluids without phase change: boundary layer, prandtl number, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, Natural convection.

Text Books:

1. "Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Books:

1. "Introduction to Chemical Engineering" by W L Badger and J T Banchero, Tata Mc Graw Hill

BT-2.2.6 **ENVIRONMENTAL STUDIES**

Objective: The main objective of this course is to understand the importance of the environment, various sources of pollution, impact of pollution on environment, social issues related to the atmosphere.

Outcome: At the end of course the students would have learnt about the ecosystems, different sources of land, energy, water, forest. Different types of environmental issues with their causes are also discussed. Social issues affecting the environment along with different case studies will be explored.

SYLLABUS:

MODULE-1 INTRODUCTION

Definition, scope and importance; measuring and defining environmental development: indicators.

MODULE-2 ECOSYSTEMS

Introduction, types, characteristic features, structure and functions of ecosystems-Forest, grassland, desert and aquatic(lakes, rivers and estuaries)

MODULE-3 ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizers-pesticides problems

Forest resources- Use and over exploitation, mining and dams- their effects on forest and tribal people

Water resources- Use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams- benefits and costs, conflicts over water

Energy resources- Energy needs, renewable and non renewable energy sources, use of alternate energy sources, impact of energy use on environment.

MODULE-4 BIODIVERSITY AND ITS CONSERVATION

Value of biodiversity- Consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India- India as a mega diversity habitat, threats of biodiversity- in-situ and ex-situ conservation

MODULE-5 ENVIRONMENTAL POLLUTION- LOCAL AND GLOBAL ISSUES

Causes, effects and control measures of- air, indoor air, water, soil, marine, noise pollutions, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain, ozone depletion.

MODULE-6 ENVIRONMENTAL PROBLEMS IN INDIA

Drinking water, sanitation and public health, effects of activities on the quality of environment- urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams- resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management.

MODULE-7 ECONOMY AND ENVIRONMENT

The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable life styles, environmental impact assessment

MODULE-8 SOCIAL ISSUES AND THE ENVIRONMENT

Population growth and environment, environmental education, environmental movements, environmental vs development

MODULE-9 INSTITUTIONS AND GOVERNANCE

Regulation by government; monitoring and enforcement of environmental regulation; environmental acts, water(prevention and control of pollution) act, air(prevention and control of pollution) act, environmental protection act, wild life protection act, forest conservation act, coastal zone regulations; institutions and policies relating to India; environmental governance.

MODULE-10 INTERNATIONAL CONVENTIONS

Stockholm conference 1972, earth summit 1992, world commission for environmental development(WCED).

MODULE-11 CASE STUDIES

Chipko movement, narmada bachao andolan, silent valley project, Mathura refinery and taj mahal, industrilisation of pattancheru, nuclear reactor at nagarjuna sagar, their dam, ralegaon siddhi(anna hazare), kolleru lake- aqua culture, flourosis in AP

MODULE-12 FIELD WORK

Visit to local area to document and mapping environmental assests- river/forest/grassland/hill/mountain; study of local environment- common plants, insects, birds; study of simple ecosystems- pond, river, hill, slopes, etc; visit to industries, water treatment plants, effluent treatment plants.

3/4 B.TECH(BIOTECHNOLOGY)-FIRST SEMESTER

BTM -3.1.1 MASS TRANSFER

Objectives:

- To explain the students with the basic principles of mass transfer operations and other separation processes with examples.
- To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer of components from one phase to other phases.
- To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.
- To focus on absorption and distillation operations and the process design aspects of the same operations.
- To provide the knowledge on humidification and dehumidification operations and their applications in real situations

Outcome:

- An ability to define the basic principles of mass transfer operations and other separation processes
- An ability to identify the basic techniques for measurement of diffusivity, mass transfer coefficient, evaporation rate,
- An ability to understand the importance of mass transfer phenomena in the design of process equipment in distillation operation
- An ability to understand the VLE concepts and application to different distillations
- An ability to identify the major parts of various mass transfer equipment
- An ability to understand the design of sizing of packed columns in absorption and plate columns in distillation
- An ability to understand the importance of humidification and dehumidification processes and their industrial applications

Syllabus:

Introduction: Mass transfer Operations.

Molecular diffusion in fluids: Binary solutions, Fick's law, equation of continuity, Steady state equimolal counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

Mass transfer coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Interphase mass transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on-isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method, Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations.

Text book:

1. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference books:

1."Unit Operations in Chemical Engineering" by McCabe,W.L.,Smith,J.C.and Harriot,P., 5th Edition, McGraw-Hill Book Co.,

2. "Chemical Engineering Hand Book" by J.H. Perry.

BT-3.1.2 **BIOSTATISTICS**

Objectives :

To make them understand about the Introduction of bioinformatics, Moments like skewness and kurtosis, correlation, Probability distribution and sampling theory, Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling and Numerical solutions of PDEs.

Outcome:

- Able to know about collection and classification of data, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion.
- Acquiring knowledge on the empirical relation between measures of dispersion, standard deviation of combined samples.
- Acquiring knowledge about coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

Syllabus:

Introduction, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples

Moments, skewness and kurtosis, correlation, scatter diagram, coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation

Probability distribution and sampling theory: Random variable both discrete and continuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution, **Sampling Theory:** sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f-distribution, Fisher's z-distribution, Chi-square distribution

Numerical solutions of PDEs – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method)

TEXT BOOKS:

Higher engineering mathematics by B.S.Grewal

REFERENCES:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi
2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.
3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

BTM -3.1.3 DOWN STREAM PROCESSING

Objectives:
The course will help to:

1. Learn the fundaments of downstream processing
2. Understand the principle, working and application of major unit operations in Bioprocessing of industrially important products.
3. Understand strategies for development of novel Bioprocessing protocol by applying the concise principles of downstream processing.

Outcome: On completion of this course student will have improved ability:-

1. To better understand the applied concepts of downstream processing.
2. To execute precise and efficient bioseparation process, which in cost effective and yield high degree of pure substance.
3. To develop novel bio separation process which is gives high resolution, economical bioproducts.

Syllabus :

SEPARATION OF INSOLUBLE PRODUCTS: Filtration, centrifugation (batch, continuous, basket), Coagulation and flocculation, gravity sedimentation, settling, decanting.

CELL DISRUPTION: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods.

SEPARATION OF SOLUBLE PRODUCTS: Extraction, precipitation, adsorption, dialysis, reverse osmosis, ultra filtration, Cross- flow ultra filtration and micro filtration, electrophoresis, gel exclusion chromatography, ion exchange chromatography, electro dialysis.

PRODUCTS PURIFICATION & POLISHING: Crystallization, drying and pervaporation.

ADSORPTION: Theory of adsorption, industrial adsorbents, adsorption equilibria, freundlich equation, single and multi stage operations, unsteady state adsorption, equipment for single stage and continuous contact, ion- exchange.

TEXT BOOKS:

1) “Bioprocess Engineering” by Michael L.Shuler Fikret Kargi, Prentice Hall of India
2) “Bioseperations – downstream processing for Biotechnology”, by paul A belter and E.L.cussler.

REFERENCE BOOKS:

1) "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw-Hill (1986).
2) "Bioseperations–principles & techniques” by B.Siva sankar.
3) "Priniciples of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).

BT-3.1.4 **ENZYME ENGINEERING**

Objectives:

- Improvement in the activity and usefulness of an existing enzyme or creation of a new enzyme activity by making suitable changes in its amino acid sequence is called enzyme engineering. When this approach is used to modify the properties of any protein, whether enzyme or non-enzyme, it is termed as protein engineering.
- Since enzymes are proteins, enzyme engineering is a part of the larger activity of protein engineering. Enzyme engineering utilizes recombinant DNA technology to introduce the desired changes in the amino acid sequences of enzymes.
- Recombinant DNA technology is also used to transfer genes encoding useful enzymes from dangerous, unapproved, slow growing or low producing microorganisms into safe, fast growing and high producing microorganisms. In addition, the level of production of an enzyme may be increased by introducing more copies of the gene into the concerned organism.
- The recombinant strain produced the enzyme in considerably higher quantities than did the original/parent strain, which reduced production costs and enhanced enzyme purity. For the present, such applications of recombinant DNA technology are likely to be much more fruitful as well as numerous than that for modifying amino acid sequences of enzymes. But it should be kept in mind that these are not examples of enzyme or protein engineering, which must rest on modification of the amino acid sequence of the concerned enzyme or protein.

The chief objective of enzyme engineering is to produce an enzyme that is more useful for industrial and/or other applications.

The various properties of an enzyme that may be modified to achieve this objective are as follows:

1. Improved kinetic properties
2. Elimination of allosteric regulation
3. Enhanced substrate and reaction specificity
4. Increased thermostability
5. Alteration in optimal pH
6. Suitability for use in organic solvents
7. Increased/decreased optimal temperature
8. Modification of substrate specificity
9. Increased stability to oxidizing agents
10. Improved stability to heavy metals
11. Resistance to proteolytic degradation
12. Fusion of two or more enzymes to create bi- and poly-functional enzymes.

Outcome:

After passing the course, the student should be able to:

- describe design of enzymatic reactions based on kinetic principles, also updated vision of the potentials and limitations of biocatalysis, especially with respect to recent applications in processes of organic synthesis.

- describe the classification of enzymes, their sources, production and purification methods for an enzyme, also the application of enzymes in various sectors
- describe basic principles of enzyme structure and function to reactor design for homogeneous systems with soluble enzymes and heterogeneous systems with immobilized enzymes.
- explain the key structural and energetic factors which give rise to increased enzyme stability important for industrial application.
- research a contemporary application of enzyme technology or metabolic engineering and present the results in a well-structured oral presentation.
- describe methods for selection and optimization of industrial enzymes using genetic and biochemical techniques.
- summarize current processes involved in industrial enzyme production, from protein production to purification and formulation.

Syllabus:

Introduction: Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts,

Enzyme Production: Enzyme sources, synthesis, recovery, purification, and formulation of enzymes,

Homogeneous Enzyme Kinetics: Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of kinetic inhibition, reactions with more than one substrate, effect of environmental variables- pH, temperature, and ionic strength,

Heterogeneous Enzyme Kinetics: Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion,

Enzyme Reactors: Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, effect of thermal inactivation and mass transfer limitation on design and performance of enzyme reactors,

Application of Enzymes: Application in biosensors, Food processing applications, Medical and pharmaceutical applications.

Text books:

1. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer
2. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990. (Website for the book, www:lsbu.ac.uk/biology/enztech/)

Reference books:

1. "Biocatalysts and Enzyme Technology" by K. Buchholz,V. Kasche and U.T. Bornscheur, Wiley,2005
2. "Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008
3. "Biochemical Engineering Fundamentals' by Bailey,J.E., and Ollis,D.F., Mcgraw-Hill,1986.
4. "Bioprocess Engineering", 2nd edition, by Shuler and Kargi, Prentice-Hall

BT -3.1.5 **THERMODYNAMICS**

Objective: To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and to predict phase equilibria and chemical reaction equilibrium.

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

- Understand the laws of thermodynamics
- Understand the degrees of freedom and phase & chemical reaction equilibria
- Calculate thermodynamic parameters involved in biochemical reactions
- Differentiate between ideal and non-ideal solutions

Syllabus:

The first law and other basic concepts : Joule's experiments, internal energy, the first law of thermodynamics, thermodynamics 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.

Heat effects: Sensible heat effects, internal energy of ideal gases, microscopic view, latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion.

The second law of Thermodynamics: Statement of the second law, heat engines, thermodynamic temperature scales, ideal gas scale, entropy, entropy changes of an ideal gas, mathematical statement of second law, the third law of thermodynamics, entropy from the microscopic view point.

Thermodynamic properties of fluids : Property relations for homogeneous phases, residual properties, Solution thermodynamics : partial properties, concepts of chemical potential and fugacity, ideal and non-ideal solutions, Gibbs-Duhem equation, excess properties of mixture, activity coefficients, activity coefficients correlations.

Criteria for phase equilibria: Vapour-liquid equilibrium calculations for binary mixtures, Liquid-liquid equilibria and solid liquid equilibria, Chemical reaction equilibria.

Biochemical thermodynamics : Energetics of metabolic pathways, Energy coupling (ATP & NADH), Energetic analysis of cell growth and product formation. Thermodynamics of microbial growth, oxygen consumption and heat evolution in aerobic cultures, energy balance equation for cell culture, reaction thermodynamics.

Text books:

1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 6th Ed. McGraw-Hill, 2000.
2. Kinetics and Energetics in Biotechnology, J.A. Roels, Elsevier, 1983.

Reference Book :

1. Chemical Engineering Thermodynamics, Y.V.C. Rao, University Press.

BT- 3.1.6A FOOD TECHNOLOGY (ELECTIVE - I)

Objective: To identify Pathogenic and spoilage microorganisms in foods, the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods, laboratory techniques to identify microorganisms in foods, beneficial microorganisms in food systems ,understand the principles involving food preservation via fermentation processes, influence of the food system on the growth and survival of microorganisms, understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., pH, temperature) on growth and response of microorganisms in various environments, Understand the principles involving food preservation via fermentation processes.

Outcome: At the end of the course the students must be able to identify the conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

SYLLABUS:

Food processing and preservation: Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation.

Fermented food products: Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking,

Food spoilage and Food Microbiology: Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production,

Food processing operations: Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods,

Text books:

"Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
"Food processing and preservation", by B. Sivasankar

Reference books:

I. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart 2. "Basic Food Microbiology", by George J Banward, CBS publishers
"Modern Food Microbiology", by James M Jay, CBS publishers.

3/4 B.TECH. (BIOTECHNOLOGY) SECOND SEMESTER

BT–3.2.1 CHEMICAL REACTION ENGINEERING

Objectives:
To learn principles of rate law and stoichometry. Isothermal reactor- Batch, plug flow reactor nd mixed flow reactor.

Outcome: The student learns the design of homogeneous reactors

Syllabus:

Introduction and overview of the subject, kinetics of homogeneous reactions, non elementary reactions, Arrhenius relation, Collision theory and Transition-state theory, various methods of analyses of batch reactor data obtained for various types of reactions including variable volume and variable pressure data .

Isothermal batch reactor design, **Homogeneous flow reactors**: Design equation for plug flow reactor (PFR) and continuous stirred tank reactor (CSTR), data analysis in flow reactors, space time, space velocity, recycle reactor, cascade of CSTRs and combination for PFR and CSTR.

Text book:

1. Chemical Reaction Engineering' by Octave Levenspiel, 3rd Edition, John Wiley & Sons, 1999

Reference books:
1. Elements of Chemical Reaction Engineering by H. S. Fogler, 3rd Edition, Printice Hall International, 2000
2. Chemical Engineering Kinetics by J. M. Smith, 3rd Edition, McGraw Hill, 1981

BT -3.2.2 **IMMUNOLOGY**

Objective:

To study about the process of immunity and organs and cells of lymphoid system.

- To study about the properties of antigens and structure and function of antibodies and various reactions of antigen and antibody.
- To study about complement system, major histocompatibility and various immune responses.
- To study about the hypersensitive reactions and their role in graft rejection and to study transplantation and various auto immune diseases.
- To study the hybridoma technology and to study the various vaccines and vaccination process.

Outcome:

- Student will obtain knowledge in immunology, the structure and function of lymphoid organs and cells.
- Student will obtain knowledge in the process of antigenecity, and in the production of antibodies and student will also acquire knowledge in the precipitation, agglutination, and other antigen-antibody reactions so that student will become a good immunologist.
- Student will obtain knowledge in the complement system which is in the blood and immune response –humoral and cell mediated and student will also obtain knowledge in MHC(Majorhistocompatibility).
- Students will obtain knowledge in the hypersensitive reactions, organ transplantations and also obtain knowledge in various auto immune diseases.
- Students will obtain knowledge in the fusion of cells to produce hybrid cells(Hybridoma technology) so that they can obtain knowledge to produce monoclonal antibodies. Student will also obtain knowledge in the preparation of vaccines and understand clearly the method of vaccination

Syllabus:

Immunity, Lymphoid organs and cells: Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

Antigens, Antibodies and Ag-Ab reactions: Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

Complement, MHC and Immune response: Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

Hypersentivity, Transplantation, Autoimmune disease: Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

Hybridoma and Vaccination: Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

Text book:

1. 'Immunology' by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby
2.'A Text book of Microbiology' by R.Ananthanarayan and C.K.J.Pandey.

BT-3.2.3 ENGINEERING ECONOMICS & BIOPROCESS DESIGN

Objectives:

- To introduce bioprocess design with its basic function of a bioreactor.
- To study the construction of bioreactor.
- To introduce the basic fundamentals such as aeration and agitation used in fermentation industrial.
- Designing of fermentation vessels and problems related to scale up of microbial processes.
- Engineering economics deals with value of money equivalence and depreciation.

Outcome:

- Fundamentals concepts of bioprocessing
- Bioprocess design and operation.
- Ability to design of fermentation vessels.
- To understand the value of money equivalence and depreciation.

Syllabus:

Engineering Economics:

Value of money equivalence: Value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, annuities: relation between ordinary annuity and the periodic payments, continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalised costs, bonds and debentures: value of a bond and yield rate,

Depreciation: Types and various methods of calculating depreciations, depreciation accounting, cost accounting- basic relationship in accounting, balance sheet and income statements.

Bioprocess Design:

Basic function of a Bioreactor for plant and microbial or animal cell culture, factors involved in bioreactor design and principal operating characteristics of bioreactors.

Body construction: construction material, temperature control,

Aeration and agitation: Agitators (impellers), stirrer glads and bearings, baffles, aeration system (spargers), valves and steam traps used in fermentation industries,

Scale up: Basic concepts, problems related to the scale up of the microbial processes, designing of other fermentation vessels,

Text books:

1. 'Plant Design and Economics for Chemical Engineers' fourth edition, by Max S Peters and Klans D Timmerhans, Mc Graw Hill Book Company
2. 'Fermentation and Biochemical Engineering Handbook' 2nd Edition by Henry C. Vogel and Celeste L. Todaro, Noyes Publications, 1997.

Reference books:

1. 'Biochemical Engineering Fundamentals', 2nd edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986
2. 'Bioprocess Engineering' 2nd edition, M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi
3. 'Principles of Fermentation Technology' by Stanbury, Pergamon
4. 'Text Book of Biochemical Engineering', by D.G. Rao, Tata McGraw Hill

BT-3.2.4 **BIOPROCESS ENGINEERING**

Objectives:

1. To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.
2. To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.
3. To know the configuration of various bioreactors for cell growth and their operations.
4. To understand the instrumentation and control of bioreactors their scale up aspects etc.

Outcomes:

1. The student is able to know the importance of bioprocess aspects and the role of bioprocess engineer.
2. The student can analyze the kinetics and mechanism of enzyme action.
3. The student will be able to design a bioreactor.
4. The student will know about the instrumentation used in bioreactors and their operation.

Syllabus:

Introduction to biotechnology and bioprocess engineering, role of bioprocess engineer, regulatory constraints in bioprocesses, FDA, GMP, GLP and SOPs.

Enzyme kinetics: Mechanism of enzyme action, Michaelis-Menten equation and determination of kinetic parameters, effect of pH and temperature.

Stoichiometry of microbial growth and product formation: Elemental balances, degree of reduction, yield co-efficients, maintenance co-efficients.

Cell kinetics and fermentor design: Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of kinetic parameters, Fed batch operation, chemostat with cell recycle, multistage chemostat systems.

Non-conventional bioreactors, Scale up of bioreactors, bioreactor instrumentation and control, bioreactors for animal culture.

Principles and mechanism of media and air sterilization: Batch and continuous sterilization of media, air sterilization, air filter design.

Text books:

1. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi.
2. Biochemical Engineering fundamentals, 2nd Edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986.

Reference Books:

1.Textbook of biochemical engineering, D.G. Rao, Tata McGraw Hill, New Delhi,2004.
2. Biochemical Engineering, J. M. Lee, Prantice Hall 1992.

BT-3.2.5 **PROCESS CONTROL**

Objectives :

The main purpose of teaching Process Dynamics & Control for first year postgraduate students is to take the student from basic mathematics to a variety of design applications in a clear, concise manner. This course is focused on the use of the digital computer in complex problem solving and in process control instrumentation. For chemical engineering problem solving students need more advanced mathematical preparation like partial differential equations, linear algebra and Fourier series all are introduced in this course.

Outcome:

- Able to know the sampled data control systems consists of sampling and advanced mathematical model Z- transforms.
- Able to describe the process in which the flow of the signals is interrupted periodically like in chromatograph.
- Able to calculate the open loop response of a sampled data system and can develop a pulse transfer function that is the counterpart of the transfer function for continuous systems.
- Able to know the sophisticated instruments used for the analysis of water and air pollutants, The student should have knowledge to design the equipment used for the abatement of these pollutants.
- In a position to modernize the solid waste management and the student must be in a position to get awareness on accidents that are occurring in industries during handling, storage, and manufacturing of chemicals, remedial measures to arrest the accidents immediately.

Syllabus:

Chapter-1: Review of time domain, Laplace domain and frequency domain dynamics of process and control system

Chapter-2: Sampled data control system – sampling and Z–Transforms , open loop and closed loop response, Stability.

Chapter-3: State space methods – representation of physical systems – transfer function matrix – Multivariable systems – Analysis and control.

Chapter-4: Non linear control –examples of non linear systems – Methods of phase plane analysis.

Chapter-5: Control of heat exchangers, distillation columns and Chemical Reactors.

Textbooks:

1. Process system Analysis and control, 2nd edition, Donald R Coughanower and Koppel.
2. Automatic process Control by Peter Harriot.
3. Process Modeling, Simulation and control for Chemical Engineers by W.L. Luyben.

BT-3.2.6 A **PHARMACEUTICAL BIOTECHNOLOGY (Elective –II)**

Objective: The main objective of this course is to contribute to improve human health by exploiting the potential biopharmaceutical research by

* Promoting research and development in the field of pharmaceutical biotechnology.

* Promoting interactions between academia, biotechnology and pharma companies within the field of pharmaceutical biotechnology to support creativity, innovations and facilitate the commercialization of scientific finding.

Outcome: At the end of course the students would have learnt about the * Promoting appropriate education and training for students in the field of pharmaceutical biotechnology

.

SYLLABUS:

Introduction- Development of Drug and Pharmaceutical Industry, Therapeutic agents – their uses and economics, Regulatory aspects.

Drug metabolism and Pharmacokinetics- Metabolism, Physico-chemical principles, radioactivity, Pharmaco kinetics action of drugs on human bodies.

Important Unit Processes and their applications: Bulk drug manufacturing, Types of reactions in bulk drug manufacturing and processes, Special requirements for Bulk Drug manufacture.

Manufacturing Principles: Wet granulation, Dry granulation or slugging, Direct compression, Tablet presses. Coating of tablets, capsules. Sustained action dosage. Forms- Parental solutions, oral liquids, injections, ointments. Various topical drugs and pharmaceuticals, Packaging- Packaging techniques, Quality management and GMP.

Pharmaceutical products and their control- Therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals- Hormones.

REFERENCE BOOK:

Remington’s Pharmaceutical Sciences, Mark publishing and Co.

TEXT BOOKS:

Leon and Lachman et al- Theory and Practice of Industrial pharmacy.

Cooper and Gunn’s – Dispencing Pharmacy.

4/4 B.TECH. (BIOTECHNOLOGY) FIRST SEMESTER

BT-4.1.1 - ENVIRONMENTAL BIOTECHNOLOGY

Objectives:

- To make the student learn about origin and evolution of microbes.
- To make the student understand structure and functioning of different microbial groups.
- To make them to acquaint the cultivation of microbes in artificial medium.

Outcome:

- Students gain the knowledge and skills both theoretically and practically.
- Students are equipped with theoretical approach to study them and understand their importance in ecosystem

Syllabus:

BT-4.1.2 - GENETIC ENGINEERING

Objectives:

- The objective of this course is to discipline to students knowledge of main engines of implementation and transmission of a genetic material at molecular and cellular levels, and also methods of change of a genetic material and constructioning of transgene organisms with the given properties.
- Genetic engineering: refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics.
- A gene is a basic constituent unit of any organism. It is a locatable region of a genome which contains the whole hereditary information of the organism. A gene corresponds to a unit of inheritance. It is a segment of the **DNA** which determines the special features or functions of the organism.
- Genetic engineering meddles with the organism's natural reproductive process, whether sexual or asexual. It gives it a new direction which is different from its natural disposition and development. The process involves the isolation and manipulation of the genes by introducing the new DNA into the cells. DNA is a blue print of the individual characteristics of an organism. The information stored in the DNA controls the management of biochemical process of each organism. The life, development and unique characteristics of the organism depend upon on its own DNA.

Content:

- Definition, history and multidisciplinary nature of biotechnology.
- Introduction to some important components - genetic engineering.
- Gene cloning - concept and basic steps,
- Application of bacteria and viruses in genetic engineering, molecular biology of E. coli and bacteriophages in the context of their use in genetic engineering.
- DNA Fingerprinting –RFLP RAPD techniques
- Restriction endonucleases, ligases and other enzymes useful in gene cloning,
- PCR technology for gene/DNA detection,
- cDNA, usages of plasmid and phages as vectors,
- Model vectors for eukaryotes - viruses, use of agrobacterium for genetic engineering in plants,
- Gene libraries, use of marker genes. Current trends in genetic engineering.
- Agriculture related applications: plant character amenable to change by biotechnology - seed quality, photosynthesis, nitrogen fixation, herbicide resistance.
- Medicine related applications: commercial synthesis of hormones, vaccines etc., gene therapy, and disease diagnosis.
- Environmental related application.

OUTCOMES

After passing the course, the student should be able to know about:

The aims of the study, development and practice of **genetic engineering** are noble and beneficial for mankind. Genetic engineering may help make crops resistant to herbicides used to kill the unwanted plants and weeds which obstruct their full growth. Though some herbicides are selective and kill only the specifically targeted unwanted plants, there are others which are non selective and besides killing the useless and obstructive weeds, kill any plants they come in contact thus killing the plants which are sought to be protected.

The domain of genetic engineering can extend from plants to cover both the animal and human life. It can, for example, hybridize the production of the animals and promote the growth of healthy species of milk producing animals, stronger and healthier horses, cows and bullocks which can better withstand the wear and tear of life.

BT-4.1.3 BIOINFORMATICS

Objective: Objectives of this course essentially focuses on the development of skills of students for a successful career in industry or research. The course emphasizes enough effort on theory. The course emphasizes on the delivery of the state of the art technologies in Genomics, Proteomics and Drug discovery. It is essential for the students to read research papers and deliver seminars that would help them to know the recent advances in the subject and also develop the communication skills.

Outcome: At the end of the course the students would have learnt about the major bioinformatics resources available so far, sequencing alignments and its data bases, taxonomy and phylogenetics neural networks leading to the role idea of the Dna in computer applications.

SYLLABUS:

UNIT – I Major Bioinformatics Resources:

Knowledge of the following databases with respect to: organization of data, retrieval of data using text-based search tools, sources of data method for deposition of data to databases.

Introduction, Primary & Secondary databse, Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD Genome Databases at NCBI, EBI, ExPASy, TIGR, SANGER Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI

Sequence and Structure Databases: PDB, MMDB Metabolic pathways databases such as KEGG, EMP.

UNIT – II Sequence Alignment and Database Searching:

Introduction- Collection, annotation and alignment of sequences. Basic concepts of sequence similarity, identity and homology. Scoring matrices – PAM and BLOSUM, gap penalties, Database similarity searching, FASTA, BLAST.

Pairwise sequence alignments: basic concepts of sequence alignment, Dynamic programming-Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments

Multiple sequence alignments (MSA): the need for MSA, basic concepts of MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW. Use of HMM method, concept of dendograms and its interpretation.

UNIT – IV Taxonomy and phylogenetic analysis:

Basic concepts in taxonomy and phylogeny; molecular evolution; nature of data used, Definition and description of phylogenetic trees and various types of trees, tree building and tree evaluation methods, Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Maximum likelihood algorithm.

UNIT – V: Secondary structure prediction methods- ChouFASMAN/GOR, Nearest neighbor, Neural network

UNIT – VI Genome Mapping and Applications:

Human genome project, application of genome mapping, DNA microarrays.

TEXT BOOKS:

1.Introduction to Bioinformatics. T.K. Attwood and P.J.Parry – Smith. Pearson Bioinformatics.

2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

REFERENCES:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

2. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

3. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman H. Rashidi and Lukas K.Buehler CAC Press 2000.

4. Algorithms on Strings Trees and Sequences Dan Gusfiled. Cambridge University Press

BT -4.1.4 INDUSTRIAL BIOTECH PRODUCTS

Objectives:

- To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.
- To study about the preparation of alcohol using yeast cells and sugars by fermentation process.
- To study about the production of Acetic acid, Citric acid and lactic acid using fermentation technology.
- To study about the production of fungal foods- mushroom and other foods like cheese. And also studies the production of bakers yeast, amino acids and vitamins(Microbial origin)
- To study about the antibiotics production, industrial enzymes-amylase, protease, lipase, and the production of biopolymers- Xanthan gum.

Outcome:

- Students will obtain knowledge in the preparation of microbial slants, maintenance of stock cultures and other microbial techniques and they will also acquire knowledge in fermentation technology.
- Students will obtain knowledge in the production of alcohols using fermentation technology.
- Students will obtain knowledge in production of acetic acid, citric acid, lactic acid using micro organisms and biological substrates by fermentation technology.
- Students will obtain knowledge in the production of foods using microorganisms and Students will obtain knowledge in the production of mushrooms, cheese and vitamins, etc.
- Students will acquire knowledge in the production of antibiotics and enzymes used in large scale and also in the production of vaccines and biopolymers eg- Xanthan gum, Dextran.

Syllabus:

Microbial Processes: Introduction, types of fermentations, components of industrial microbial process, source of industrial cultures, maintenance and improvement of culture for better production,

Alcohol fermentation: Production of industrial alcohol, biosysthetic mechanism, recovery of latest developments, wine manufacture, glycerol fermentation, production of acetone and butanol,

Organic acid production- Biochemistry of acetic acid production, vinegar manufacture, production of citric acid and lactic acid,

Microbial foods: Mushrooms, cheese, Baker's yeast

Amino acids – L-Glutamic acid, Lysine

Vitamins – Vitamin B_{12}

Antibiotics – Penicilin and streptomycin.

Industrial enzymes: production of amylase, protease and lipase

Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines.

Text books:

1. "Industrial Microbiology" by Cruger & cruger
2. "Industrial Microbiology" by Cassida
3. "Industrial Microbiology" by A.H.Patel

Reference books:

1 'Industrial Microbiology' by Prescott & Dunn

2 "Biotechnology" by U. Satyanarayana.

BT- 4.1.5 PLANT CELLL AND TISSUE CULTURE

Objectives:

- To know the basics of plant tissue culturing.
- To know the production of callus from carrot.
- To measure the efficacy of root and shoot.
- To develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell and tissue culture systems.
- To know how cell and tissue culture contributes to global sustainability.
- To develop the practical skills and confidence of students to successfully culture plant cells and tissues.

Outcome:

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

- Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components
- Explain the various steps taken to establish and optimize media for particular purposes in particular species, without the aid of texts.
- Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
- Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.
- Explain the various cell lines used in tissue culture and their origins and uses.

Syllabus:

UNIT I: Fundamentals of plant tissue culture: laboratory organization, sterilization methods, culture medium and growth regulators.

Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

UNIT II: Cell culture: single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

UNIT III: Somatic embryogenesis and synthetic seeds: principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation

UNIT IV: Somoclonal variations – its genetic basis and application in crop improvement-cell line selection for resistance to herbicides, stress and diseases. **Haploid production and its advantages-** androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture.

UNIT V: Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization

Production of disease free plants- meristem tip culture- virus indexing.

UNIT VI: Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

UNIT VII: Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations.

Automation and Economics of tissue culture.

TEXT BOOKS

1. Plant tissue culture – Kalyan Kumar De – New Central Book Agency

REFERENCE

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.

2. Plant tissue culture- theory and practice. Bhojwani, SS & Razdan

   MK.Elsevier

3. Plant tissue and Cell culture. Street, HE.Blackwell

BT-4.1.6A AGRICULTURAL BIOTECHNOLOGY (ELECTIVE- III)

Objective: Agriculture has been theorized to have become the dominant way of producing food since the Neolithic Revolution. Throughout the history of agriculture, farmers have inadvertently altered the genetics of their crops through introducing them to new environments and breeding them with other plants — one of the first forms of biotechnology. Agricultural Biotechnology is being used to address problems in all areas of agricultural production and processing. This includes plant breeding to raise and stabilize yields; to improve resistance to pests, diseases and abiotic stresses such as drought and cold; and to enhance the nutritional content of foods. Biotechnology is being used to develop low-cost disease-free planting materials for crops such as cassava, banana and potato and is creating new tools for the diagnosis and treatment of plant and animal diseases and for the measurement and conservation of genetic resources. Animal feeds and feeding practices are being changed by biotechnology to improve animal nutrition and to reduce environmental waste. Biotechnology is used in disease diagnostics and for the production of vaccines against animal diseases.

Outcome: Student gains fair knowledge clearly by coming to a conclusion that biotechnology is more than genetic engineering. Indeed, some of the least controversial aspects of agricultural biotechnology are potentially the most powerful and the most beneficial for the poor. In general we can say agricultural biotechnology as understanding, characterizing and managing genetic resources.

Syllabus:

Introduction - Definition, classical vs modern approach, demand for biological resources, achievements,

Nitrogen Fixation- Basic concepts, nif genes and their regulation, potential scope in crop improvement,

Genetic engineering - aims of genetic engineering, techniques of gene manipulation, **Transformation Techniques** -Physical methods, *agrobacterium,* mediated transformation. **Transgenics -** Basic concept and essential steps of the process, some examples of transgenic plants, use of suitable promoters, gene silencing and measures to overcome it, commercial aspects of the technology. **Molecular Markers -** concept, SNPs, RAPD, RFLP, role in crop improvement and genome mapping,

Molecular and biochemical basis, signalling pathways in the production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, pest resistance, drought and other abiotic stress resistance,

Plant as Biofactories - Concept, production of chemicals, pigments, perfume, flavors, insecticides, anticancer agents and other important compounds, molecular farming, use of plants for production of neutraceuticals, edible vaccines and other desired products,

SCP - micro organisms, nutritional value, production of algal biornass, bio fertilizers and bio pesticides, mass cultivation of *Rhizobium, AzatLibacter, Azospirillum, Mycorrhiza,* bluegreen algae and *Azolla.*

Text books:

1. "Agricultural Biotechnology" by Arie Altman, Marcel Dekker, Inc. (2001)
2. "Agricultural Biotechnology", by S.S.Purohit, Agro Bios (India)

Reference book:

1. "Molecular Biotechnology Principles and Applications of Recombinant DNA", by Bernard R. Glick and Jack J. Pasternak,. ASM Press

4/4 B.Tech. (Biotechnology) Second Semester

CHE 4.2.1 - INDUSTRIAL TRAINING REPORT

Note: 50% of the 4/4 1st semester students will do course work in the first semester and the remaining 50% of the students will go for industrial training. The students who have gone for industrial training during first semester will do 1st semester course work in second semester and the students who have done course work in 1st semester will go for industrial training during second semester.