



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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School of Bio & Chemical Engineering

Department of Biotechnology

1.2.1 Number of new courses introduced of the total number of courses across all programs offered during the year 2023-2024

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SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY SMTB1102	BIOSTATISTICS		L	T	SCHOOL OF BIO AND CHEMICAL ENGINEERING		Credits	Total Marks
			3	1	P	EL	3	100

COURSE OBJECTIVES

- The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this course.

UNIT 1 INTRODUCTION TO STATISTICS

9 Hrs.

Introduction - collection and tabulation of data – Concept of primary and secondary data – quantitative and qualitative, attributes, variables, scales of measurement - Nominal, ordinal, interval and ratio – Data visualization - Bar diagram, Pie chart, histogram, frequency curve and frequency polygon – Ogives.

UNIT 2 DESCRIPTIVE STATISTICS

9 Hrs.

Measures of central tendency: Mean, Median, Mode – Measures of dispersion: Quartile Deviation and Standard deviation – Coefficients of variation, Skewness and Kurtosis (Pearson's and Bowley's).

UNIT 3 CORRELATION AND REGRESSION

9 Hrs.

Correlation: Karl Pearson's Correlation Coefficient, Spearman's Rank Correlation Coefficient, Tied ranks – Linear Regression Analysis – Fitting of straight line and parabola by the method of least squares.

UNIT 4 INTRODUCTION TO PROBABILITY

9 Hrs.

Definitions: Sample Space, Events – Addition Law of probability – Multiplication law of probability – Conditional probability – Baye's theorem (without proof) – problems on Baye's theorem.

UNIT 5 RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS

9 Hrs.

Definition of a random variable – Discrete and continuous random variables – Probability Mass function, Probability Density Function, Cumulative Distribution Function (Definition only) – Binomial Distribution – Poisson Distribution – Normal Distribution – application problems only.

COURSE OUTCOMES

On completion of the course, student will be able to

- C01 - List the data visualization tools used in descriptive statistics.
- C02 - Explain measures of central tendency and measures of dispersion
- C03 - Evaluate correlation, regression and generate straight line and parabola.
- C04 - Apply the concept of probability and Bayes theorem to solve the problems.
- C05 - Analyze discrete and continuous random variables.
- C06 - Predict the appropriate probability distribution for the real time data.

SBTB1102	MICROBIAL TECHNOLOGY	L	T	P	E L	Credit s	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To impart substantial knowledge on the world of microbes, their survival strategies, genetics and applications of microbial products.

UNIT 1 INTRODUCTION TO MICROBIOLOGY**9 Hrs.**

History of development of Microbiology; The spontaneous generation and Germ theory of disease; Domain and Kingdom concepts in classification of microorganisms; Criteria for classification; Structural and Genome organisation of prokaryotes and eukaryotes; Molecular methods – DGGE, TGGE, Amplified rDNA Restriction Analysis and TRFLP in assessing microbial diversity; 16S rDNA sequencing; Development of fields of Microbiology in 20th century.

UNIT 2 MICROBIAL GROWTH AND CONTROL**9 Hrs.**

Culture media and their types; Isolation and identification of microbes, culture techniques. Preservation of cultures. Microbial growth: Growth kinetics, Thermal death kinetics, Batch, fed-batch, continuous culture, synchronous growth, yield constants methods of growth estimation, stringent response, death of a bacterial cell; diauxic growth curve. Measurement of cell numbers; cell mass and metabolic activity. Physical and chemical methods for the microbial control- Sterilization.

UNIT 3 MICROBIAL INTERACTION**9 Hrs.**

Microbial interaction -Symbiosis, antagonism, commensalisms, predation, parasitism, amensalism, competition, bioluminescence, biodegradation, biofilms. Microbial communication system- Quorum sensing, Microbial fuel cells; Photosynthesis and chemosynthesis in bacteria Multidrug resistance- Mechanism and Example. Extremophiles (with classical example from each group) .

UNIT 4 MICROBIAL GENETICS**9 Hrs.**

Gene - a unit of mutation and recombination. Molecular nature of mutations; mutagens. Gene transfer mechanisms - transformation, transduction, conjugation and transfection. Plasmids, F- factors description and their uses in genetic analysis. Colicins and col factors. Plasmids - vectors for gene cloning. Replication of selected plasmids: compatibility. Transposons and their uses in genetic analysis. Bacteriophages, Lytic phages - T7 and T4. Lysogenic phages I and P1. M13 and fX174. Life cycle, and their uses in microbial genetics.

UNIT 5 INDUSTRIAL APPLICATIONS**9 Hrs.**

Basic principles in bioprocess technology; Media Formulation; Sterilization- Batch and continuous sterilization systems; Microbial processes-production, optimization, screening, strain improvement; factors affecting down stream processing and recovery. Primary and secondary metabolites; Biotechnologically important products – enzymes, alcohol, antibiotics and organic acids; Extracellular enzymes exopolymers; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH. Environmental application of microbes; Ore leaching; Toxic waste removal; soil remediation.

COURSE OUTCOMES

On completion of the course, student will be able to

C01 - Understand the origin of microbes and their structural diversities

C02 - Analyse the microbial growth and kinetics

C03 - Describe the physiology of microbial interactions.

C04 - Elaborate on microbial genetics

C05 - Identify the basic principles of industrial and environmental applications of microbes.

C06 - Demonstrate the microbial processes in industrially important products production.

S11BLH12	PROBLEM SOLVING TECHNIQUES USING C	L	T	P	EL	Credit	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVES

- Understand control structures, functions and Arrays in C.
- Construct modules for real time applications using Functions in C.
- Comprehend pointers and file handling mechanisms.

UNIT 1 BITS AND BYTES IN COMPUTING**9 Hrs.**

Computers: Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages – Evolution from COBOL, FORTRAN to C, Python – Need Algorithms: Role in problem solving – Analysis – Design – Flowcharts: Role in problem solving – Symbols– Design – Pseudocode: Role in problem solving – Design – Program: Role in problem solving – Design Practice Problems: 1. Describe a simple real world problem in your domain/department and describe it in the form of problem statement, input, output and provide its solution in terms of algorithm, flowchart, pseudo code and program.

UNIT 2 C: MATH BEHIND CODING**9 Hrs.**

C: Structure of program – Character set – Tokens – Keywords – Identifiers – Constants – Variables – Datatypes – Strings – Operators and its types – Functions – Header Files. Algorithmic Strategies: Iteration and Recursion – Efficiency – Role of Time and Space consumption while building an algorithm – Complexities Practice Problems:

1. Describe a simple real world problem in your domain/department and provide a computing and non-computing solution for the same. Calculate the time and space consumed in both solutions. Compare and contrast the pros and cons in both solutions.
2. Write an algorithm, flowchart, pseudo code followed by a simple C code to do find the Factorial and Fibonacci series using both iteration and recursion.

UNIT 3 C: MAGIC BEHIND INSTANT OUTPUTS**9 Hrs.**

Advanced Coding Concepts: Decision Making using Branching Statements and its types – Decision Making using Looping Statements and its types – Switch Statements – Break – Continue – Goto – Jump Statements Case Study: Fun with Code -- Printing Alphabets / Flags of Countries / Flying Alphabet Screensaver Practice Problems:

1. Describe a problem statement in your domain/department whose solution involves repetition of same steps and provide code as solution involving for, while and do while loops.
2. Describe a problem statement in your domain/department whose solution involves decision making and provide code as solution involving if-else, nested if-else and ladder if-else.
3. Develop a simple scientific calculator using Switch case statement.

UNIT 4 STORING GROUP OF HOMOGENOUS ELEMENTS: ARRAYS**9 Hrs.**

Diving into Arrays: Definition – Syntax – Types – Representation: Row & Column Order – Dynamic Arrays Idea behind Functions: Declaration – Definition – Types – Calling – Arguments – Prototypes – Call by Value – Call by Reference – Pointers.

Case Study: Fun with Code – Simple Game Development using Arrays and Functions.

Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of same type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. You're playing UNO cards, suddenly a person is getting rev card. Write a C program to reverse the round by storing the number of players in array.
3. Write a C program for Vehicle Regulation System where odd number ending vehicles can use the road on odd days and even number ending vehicles can use the road on even days using two separate arrays to store and display the odd and even numbers.

UNIT 5 STORING GROUP OF HETEROGENEOUS ELEMENTS: ARRAYS**9 Hrs.**

Outset of Structure and Union: Structure Definition & Declaration – Structures Fusion with: Arrays – Pointers – Functions – Union Initiation, Definition & Declaration

Working with Files: File Handling Functions – Read – Write – Other Operations – Different File Types Case Study: Report on using File Functions to create Score Board for any game, importing it to program Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of different type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. Write a C program to get the details of the student (roll no, name, date of birth, state, 10th percentage and 12th percentage) using Structure. Calculate the age of the student and display the eligibility status for his admission. Eligibility criteria: more than 60 percent in 10th and 12th, age >= 17, state == TN.
3. Write a menu driven C program for library management system with ten entries: (i). Add Book (ii). Add Author (iii). Add Category (iv). Book Cost (v). Display - Book by Author, Book by Category, Book under cost
4. Write a C program to create an employee Union with employee details (id, name, salary) Accept the details of 'n' employees, rearrange the data in ascending order of employee name, id and salary as three different functions and display it.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Interpret the difference between components of problem solving such as algorithm, flowchart, pseudo code and source code.
- CO2 - Build simple solution for any given problem statement using various components of problemsolving techniques and measure its efficiency in terms of time and space.
- CO3 - Infer and examine the roots and foundation of C programming's key concepts like datatypes, operators.
- CO4 - Devise and correlate the use of different core concepts such as arrays and functions in C language.
- CO5 - Formulate real time solutions through programs using structure and union in C language.
- CO6 - Design and develop various application-oriented program for solving real time societal problems.

S23BLH13	CELL BIOLOGY AND BIOCHEMISTRY	L	T	P	EL	Credits	Total mark
		3	0	2	0	4	100

COURSE OBJECTIVE

- To introduce the cell environment and the biomolecules which compose the main components of a cell.

UNIT 1 BASIC CELL BIOLOGY**9 Hrs.**

Prokaryotic and eukaryotic cells – cell organelles – nucleus, mitochondria, endoplasmic reticulum, golgi bodies, lysosomes and ribosomes. Plant and animal cell models – extra cellular matrix, cell – cell junction. **Laboratory: Visualize the cell and its organelles from onion cells.**

UNIT 2 TRANSPORT AND CELL SIGNALLING**9 Hrs.**

Active and passive transport – permeases, ion channels, ATP pumps, Na/K pump, uniport, symport and antiport system. Ligand gated / voltage gated channels, agonists and antagonists. Receptors and secondary messengers. Laboratory: Osmosis and dialysis experiments.

UNIT 3 BIOMOLECULES**9 Hrs.**

Structure of water, pH and biological buffers, Structure and properties of carbohydrates (Mono-, di-, oligo- and poly-saccharides). Glycosidic bond and Mutarotation. Lipids – fatty acids, glycerol, waxes, properties of lipids. Cholesterol and its derivatives. **Laboratory: Qualitative analysis of carbohydrates and lipids.**

UNIT 4 MACROMOLECULES**9 Hrs.**

Protein – Amino acids, peptides, primary, secondary, tertiary and quaternary structure of proteins. Nucleic acids – purines, pyrimidines, nucleoside, nucleotide, DNA – Structure, RNA – types of RNA. Laboratory: Qualitative analysis of amino acids. Estimation of protein and DNA.

UNIT 5 SMALL MOLECULES**9 Hrs.**

Vitamins – Fat soluble and water soluble vitamins – source, biological function and deficiency symptoms. Minerals – micro and macro minerals – source, biological function and deficiency symptoms. Laboratory: Estimation of ascorbic acid. Estimation of calcium / phosphorus.

COURSE OUTCOMES

On completion of the course, student will be able to

- C01 - Introduce the different cells and its components.
- C02 - Compare active and passive Transport
- C03 - Summarize the structure and properties of biomolecules.
- C04 - Construct the structure of proteins and nucleic acids.
- C05 - Categorize the various vitamins and minerals.
- C06 - Evaluate the importance of biomolecules.

SHSB1101	TECHNICAL ENGLISH	L	T	P	EL	Credits	Total Mark
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand specialized subject areas and skills included for their study.
- To comprehend and react in oral and written forms to the specialized texts
- To respond to listening, reading and writing tasks by using digital tools
- To enhance communication, collaboration and critical thinking skills
- To explore creativity through blended learning contexts

UNIT 1**9 Hrs.**

Listening	: Listening to choose the correct answer from the options given (MCQ)
Speaking	: Self Introduction, Talking about likes and dislikes
Reading	: Comprehending a passage- Skimming, scanning, detailed reading
Writing	: Letter of Job Application, Resume, Letter to the Editor (problems and solutions)
Vocabulary	: Kinds of Sentences, Affixes, Collocations, Sequence words, contextual guessing of words
Language Focus	: Parts of Speech, Tense and its types, Voice - Impersonal Passive
Language Lab work	: Focus Digital literacy: students join zoom platform/ using online tools

UNIT 2**9 Hrs.**

Listening	: Listening to advertisements about a product, say true or false
Speaking	: JAM on current topics, mini presentations
Reading	: Identifying topic sentences by reading content
Writing	: Writing compare/ contrast paragraphs, process description, E-Mail Writing
Vocabulary	: Verbal phrases, Prepositions and Prepositional phrases, Concord, Discourse Markers
Language Focus	: Clauses, Conjunctions, Sentence Types - Simple, Compound & Complex
Language Lab	: Digital literacy: Responding to quiz using Kahoot application

UNIT 3**9 Hrs.**

Listening	: Listening to summarize the information, debates/ discussions.
Speaking	: Group discussion on a given topic
Reading	: To find specific information and to prepare notes using the format
Writing	: Framing open ended questions- Survey Report- Arranging the sentences in the right order
Vocabulary	: Paired expressions, Adjectives/ adverbs, Technical definitions, Compound Nouns
Language Focus	: Punctuation, Editing, Same words used as different parts of speech
Language Lab	: Digital literacy: Power point tools -Slide share to make presentation on the survey report

UNIT 4**9 Hrs.**

Listening	: Listening to differentiate instructions and recommendations
Speaking	: Debate on current issues
Reading	: Reading to understand and classify the information
Writing	: Instructions, Recommendations, Preparation of User Manual
Vocabulary	: Classification of words, Abbreviations, Acronyms,
Language Focus	: Reported Speech, Causatives, Basic Sentence Patterns
Language Lab	: Digital literacy: Using online discussion forum

UNIT 5

9 Hrs.

Listening and summarizing: Listening to identify the structure of sentences, small talks, TED talks

Speaking : Giving impromptu talks, Speech Writing

Reading : Read argumentative essays and paragraphs

Writing : Essay writing, Checklist preparation, Note making

Vocabulary : Homophones/Homonyms, Idioms and Phrases

Language Focus : Negatives, Tag questions, Similes and Metaphors

Language Lab : Digital literacy: Creating own Blogs and interactive exercises and quizzes online

COURSE OUTCOMES

On completion of the course, student will be able to

C01 - Classify technical words to use them in sentences framing, compose problem solving paragraphs.

C02 - Categorize information based on the understanding of reading materials to prepare notes.

C03 - Prepare and document to report, identify elements of editing.

C04 - Interpret technical definitions related to the text and design a user manual using instructions.

C05 - Summarize reading materials and outline an essay on any topic given.

C06 - Demonstrate their language learning activities in the classroom/ online group environment.

SMTB1202	MATRICES, CALCULUS AND SAMPLING (COMMON TO BIO GROUPS)	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVE

- The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this course.

UNIT 1 MATRICES**9 Hrs.**

Characteristic equation of a square matrix – Eigenvalues and Eigen vectors of a real matrix – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem (without proof) verification – Finding Inverse and Power of a matrix using Cayley-Hamilton Theorem.

UNIT 2 DIFFERENTIAL CALCULUS**9 Hrs.**

Definitions – Derivative of standard functions (Results only) - Differentiation of function of function – Logarithmic differentiation – Derivatives of implicit function – Partial derivatives – Euler's theorem (Simple Problems only).

UNIT 3 INTEGRAL CALCULUS**9 Hrs.**

Integral of standard functions (Results only) – Integration by the method of substitution – Integration using partial fractions – Integration by parts – Generalization of integration by parts – Definite integral – Properties – Simple problems.

UNIT 4 THEORY OF SAMPLING**9 Hrs.**

Test of Hypothesis – Test of significance – Large samples – Z test - Single proportion – Difference of proportions – Single mean – Difference of means - Student's t test – Single mean – Difference of means – Test of variance – Fisher's F test – Chi square test – Goodness of fit – Independence of attributes.

UNIT 5 DESIGN OF EXPERIMENTS AND STATISTICAL QUALITY CONTROL CHARTS**9 Hrs**

Design of experiments: Completely Randomized Design, Randomized Block Design – statistical Quality Control: Mean, Range, p, np, c – charts.

COURSE OUTCOMES

On completion of the course, student will be able to

- C01 - Manipulate power, inverse, Eigen values and Eigenvectors of a matrix.
- C02 - Describe ordinary and partial derivatives of standard functions by various methods
- C03 - Evaluate the integrals of standard functions by various methods.
- C04 - Estimate the value of Chi square, F, t and Z values for small samples.
- C05 - Apply design of experiments using analysis of variance.
- C06 - Sketch the control charts and interpret the results based on the charts.

S11BLH11	PYTHON PROGRAMMING	L	T	P	EL	Credits	Total Mark
		2	0	2	0	3	100

UNIT 1 INTRODUCTION**9 Hrs.**

Introduction, History, Features of Python, Data types, Variables, Expressions, Conditional Statements, Operators, Looping, Control Statements .

Practice Programs

1. Develop a python program to find the best of two test average marks out of three test's marks accepted from the user and compute the overall pass percentage for their placements.
2. Write a class Money with attributes Rupees and Paise. Overload operators +, -, and >= so that they may be used on two objects. Also write functions so that a desired amount of money can be either added or subtracted from Money.

UNIT 2 FUNCTIONS AND STRINGS**9 Hrs.**

Function Calls, Conversion of functions, Arguments, Fruitful Functions, Boolean functions, Strings, Looping and Counting, String Operations.

Practice Programs

1. Defined as a function F as $F_n = F_{n-1} + F_{n-2}$. Write a Python program which accepts a value for N (where $N > 0$) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.
2. Analyze the string similarity between two given strings using Python program

Sample Output:

Original string:

Python Exercises

Python Exercises

Sample Output:

Original string:

Python Exercise

Python Exercise

UNIT 3 LIST, TUPLES AND DICTIONARIES**9Hrs.**

List, List Operations Built in List functions, Tuple, Tuple Operations, Dictionary, Operations in Dictionary, Built in Dictionary Methods.

Practice Programs

A hospital has received a set of lab reports. Totally five tests are conducted in the lab and the report is prepared in such a way that the 'nth' number correspond to value of test_n. Given the details of a test made for a patient, write an algorithm and the subsequent Python program to print if the test result is normal or not normal by referring the values in Table 1. Since the value is sensitive, provide a mechanism so that the values do not get altered.

NAME OF THE TEST	MINIMUM VALUE	MAXIMUM VALUE
Test 1	20	30
Test 2	30.5	40
Test 3	12	15
Test 4	120	150
Test 5	80	120



An University has published the results of the term end examination conducted in April. List of failures in physics, mathematics, chemistry and computer science is available. Write a program to find the number of failures in the examination. This includes the count of failures in one or more subjects.

Write a program to maintain a telephone directory of the employees of an organization. If the employee has more than one number store all the numbers. Write a program to print the mobile numbers given full or part of the name of the employee. Eg: Given name of the employee as 'John' the program must print phone numbers of 'John Paul' and 'Michel John'.

UNIT 4 FILES AND REGULAR EXPRESSIONS

Files, File Handling Operations, User Defined Exceptions, Regular Expression, Types using Match function, Postfix, Infix, prefix conversion.

Practice Programs

A proctor of our university wants a student to write a program that calculates the average of marks scored by her wards in CAT1. She has the details such as name, register number, mark1, mark2 and mark3 of her proctees. The constraint given by the faculty is that any of the details must not be altered by mistake. Help the student to develop a Python program.

Consider the following scenario for finding the number of students who secured centum in mathematics in their examination. A total of 6 lakhs students appeared for the examinations and their results are generated automatically and updates to the portal using file.

UNIT 5 CREATING GUI FORM, CLASSES AND OBJECTS

Creating a GUI Window, Widgets, Buttons, Canvas, Layout Management, Designing GUI Applications using Tkinter module, Overview of OOP, class Definitions, Built in Class Attributes, Real time Examples using Classes and objects.

Practice Programs

A farmer with a fox, a goose, and a sack of corn needs to cross a river. Now he is on the east side of the river and wants to go to west side. The farmer has a rowboat, but there is room for only the farmer and one of his three items. Unfortunately, both the fox and the goose are hungry. The fox cannot be left alone with the goose, or the fox will eat the goose. Likewise, the goose cannot be left alone with the sack of corn, or the goose will eat the corn. Given a sequence of moves find if all the three items fox, goose and corn are safe. The input sequence indicate the item carried by the farmer along with him in the boat. 'F'

- Fox, 'C' - Corn, 'G' - Goose, N-Nothing. As he is now on the eastern side the first move is to west and direction alternates for each step.

An university is setting up a new lab at their premises. Design an algorithm and write Python code to determine the approximate cost to be spent for setting up the lab. Cost for setting the lab is sum of cost of computers, cost of furnitures and labour cost. Use the following formulae for solving the problem.

S23BLH24	IMMUNOTECHNOLOGY	L	T	P	EL	Credits	Total mark
		4	0	0	0	3	100

COURSE OBJECTIVE

- The main aim of the course is to know the fundamentals of innate and acquired immunity and understand how immune system fights and combats the infection and diseases.

UNIT 1 INTRODUCTION TO IMMUNOLOGY AND IMMUNE SYSTEM**9 Hrs.**

History and Scope of Immunology, Hematopoiesis, Innate and Acquired Immunity; Cells of the immune system, Primary and Secondary lymphoid organs. Maturation, structure, activation and differentiation of T and B cells. Primary and secondary immune responses and its regulation.

UNIT 2 HUMORAL IMMUNITY**9 Hrs.**

Antigens: Characteristics and Types of Antigens, Factors affecting the immunogenicity, Haptens, Antigenic Determinants, Adjuvants, Immunoglobulins: Basic structures, classes and sub classes; Molecular Biology of Immunoglobulin synthesis. Antigenic determinants on Immunoglobulins. Monoclonal antibodies. Complement system - Alternate, Classical pathways.

UNIT 3 CELL MEDIATED IMMUNITY**9 Hrs.**

Phagocytosis, Inflammatory mediators, Structure, types and function of MHC, Exogenous and Endogenous pathways of antigen processing and presentation; Cytokines - Characteristics, function and regulation of the immune response. Antigen processing and presentation process.

UNIT 4 APPLIED IMMUNOLOGY**9 Hrs.**

Antigen Antibody Interactions, Precipitation reactions, Agglutination reactions - Immunofluorescence, Immunoelectroscopy, RIA, ELISA. Detection of bacterial endotoxins using immunological methods (LAL Test), Blotting Techniques, DNA hybridization methods

UNIT 5 IMMUNOLOGICAL DISORDERS**9 Hrs.**

Immunoematology, Hyper-sensitivity, Autoimmunity, Immunological Tolerance, Immunodeficiency diseases: Primary and secondary diseases, Transplantation immunology, Tumor immunology.

COURSE OUTCOMES

On completion of the course, student will be able to

C01 - Understand overall concept of immune system.

C02 - Outline the molecular and cellular mechanisms involved in the development and regulation of the immune response

C03 - Recognize effectors molecules fight against infectious diseases.

C04 - Demonstrate to produce monoclonal antibodies to diagnose and treat infectious diseases.

C05 - Implement immunotechniques to diagnose infectious diseases.

C06 - Describe the cause, challenges and treatment for Immune System Pathologies and Dysfunctions.



S81BLH11	BIOCHEMISTRY AND METABOLIC ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

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

- Develop a strong foundation in biochemistry, cellular metabolism, and metabolic engineering principles.
- Critically analyze and apply their knowledge to real-world problems in the field of biochemistry and metabolic engineering.

UNIT 1 INTRODUCTION TO BIOCHEMISTRY**9 Hrs.**

Overview of biochemistry and its importance in understanding cellular processes. Biomolecules: structure, function, and properties of carbohydrates, lipids, proteins, and nucleic acids. Enzymes: classification, kinetics, and regulation. Metabolism: an introduction to metabolic pathways, catabolism, and anabolism. Lab exercise: Estimation of protein (Lowry method), Estimation of DNA.

UNIT 2 CELLULAR METABOLISM**9 Hrs.**

Energy metabolism: ATP and its role as a universal energy currency. Glycolysis: pathway, regulation, and energy yield. Citric Acid Cycle (Krebs cycle): steps, regulation, and energy production. Oxidative phosphorylation: electron transport chain, ATP synthesis, and respiratory control. Photosynthesis: light reactions and carbon fixation. Lab exercise: Enzyme kinetics studies.

UNIT 3 METABOLIC PATHWAYS AND REGULATION**9 Hrs.**

Metabolic interconversions: gluconeogenesis, glycogen metabolism, and fatty acid metabolism. Amino acid metabolism: biosynthesis and degradation pathways. Nucleotide metabolism: synthesis and salvage pathways. Metabolic regulation: allosteric control, hormonal regulation, and signal transduction pathways. Lab exercise: Kinetic model development in COPASI

UNIT 4 METABOLIC ENGINEERING PRINCIPLES**9 Hrs.**

Introduction to metabolic engineering: goals, strategies, and applications. Rational strain design: optimization of metabolic pathways for improved production of desired compounds. Synthetic biology tools: genetic manipulation techniques and pathway engineering. Metabolic flux analysis: understanding and manipulating metabolic fluxes in engineered organisms. Case studies: examples of successful metabolic engineering projects. Lab exercise: Chemostat cultivation for carrying out metabolic flux.

UNIT 5 EMERGING TOPICS IN BIOCHEMISTRY AND METABOLIC ENGINEERING**9 Hrs.**

Systems biology: integration of computational modeling and experimental data for understanding complex biological systems. Metabolomics: techniques for studying small molecule metabolites and their role in cellular processes. Bioinformatics: computational approaches for analyzing and interpreting large-scale biological data. Bioprocessing and bioreactor design: scale-up strategies for industrial production of biofuels, pharmaceuticals, and other compounds. Ethical and societal considerations in biochemistry and metabolic engineering.

COURSE OUTCOMES

On completion of the course, the students should be able to

- C01** - Understand the fundamental principles of biochemistry, including the structure, function, and properties of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.
- C02** - Explain the key metabolic pathways involved in cellular metabolism, including glycolysis, the citric acid cycle, oxidative phosphorylation, and photosynthesis, and understand their regulation and energy production.
- C03** - Analyze and interpret the interconversions of metabolites in various metabolic pathways, including gluconeogenesis, glycogen metabolism, fatty acid metabolism, amino acid metabolism, and nucleotide metabolism.
- C04** - Apply the concepts of metabolic regulation to understand how enzymatic activity is controlled through allosteric control, hormonal regulation, and signal transduction pathways.
- C05** - Apply the principles of metabolic engineering to design and optimize metabolic pathways for the production of desired compounds, using rational strain design and synthetic biology tools.
- C06** - Discuss emerging topics in biochemistry and metabolic engineering, such as systems biology, metabolomics, bioinformatics, bioprocessing, and bioreactor design, and understand their applications and implications in the field.



S81BLH12	ENZYME AND PROTEIN ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

- To give an insight into the essential concepts of engineering proteins and enzymes and apply them for future research and solve problems in various fields.

UNIT 1 PROTEIN ARCHITECTURE AND CHARACTERIZATION**9 Hrs.**

Hierarchical representation of proteins, structural classification of proteins, protein folding and protein stability. Peptide sequencing - Sanger and Edman methods. Characterization of Protein structure: Crystallography and X-Ray Diffraction, Spectroscopy (UV-VIS, NMR and Fluorescence Spectroscopy). **Lab Exercise:** Separation and Identification of amino acids by circular paper chromatography, Molecular weight determination of proteins

UNIT 2 ENZYMES**9 Hrs.**

Enzyme nomenclature, classification of enzymes, Specificity, Turn over number, Enzyme units (IU and Katal), Active site, Fischer's Lock and key model, Koshland's Induced fit hypothesis, Activation energy, Factors affecting enzyme activity, Mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis, Role of co-enzymes and co-factors. **Lab Exercise:** Enzyme assay, Effect of pH on Enzyme activity, Effect of temperature on Enzyme activity

UNIT 3 ENZYME KINETICS**9 Hrs.**

Michaelis Menten equation, Lineweaver, Burk plot, Eadie Hofstee, Hanes Woolf Plots - K_m and V_{max} , Bi-substrate reactions, Enzyme Inhibition - Irreversible, Reversible-Competitive, Uncompetitive and Non-Competitive inhibition **Lab Exercise:** Determination of K_m using MM Plot, Determination of K_m using LB Plot

UNIT 4 ENZYME PURIFICATION AND APPLICATIONS**9 Hrs.**

Production and purification of crude enzyme extracts from plant, animal and microbial sources; Specific activity. Techniques for Immobilization of enzymes and Overview of applications of immobilized enzyme system. Abzymes and their applications. Enzyme electrodes, biosensors and their applications in industry, healthcare and environment, ELISA, EMIT **Lab Exercise:** Salting in, Salting out, Dialysis, Determination of specific activity of enzyme

UNIT 5 PROTEIN ENGINEERING AND COMPUTATIONAL STUDIES**9 Hrs.**

Overview of protein engineering strategies: Random and site-directed mutagenesis, Various PCR-based strategies. Antibody engineering, Industrial, Environmental and Biomedical applications. Protein databases. Sequence Analysis, Structure prediction. **Lab Exercise:** Retrieval of protein sequence from database, Pair-wise sequence alignment, Multiple sequence alignment

COURSE OUTCOMES

On completion of the course, student will be able to:

- C01** - Compare the levels of protein structure relating this information to the function of proteins
- C02** - Analyze the mechanism of action of various enzymes
- C03** - Elucidate the importance of K_m and V_{max} in enzyme kinetics and inhibition
- C04** - Interpret the vital role of enzymes in industry and medicine
- C05** - Apply appropriate computational databases and tools to predict the sequence and structure of proteins
- C06** - Appraise different protein design strategies used to design completely new proteins tailored to specific tasks



Employability



Entrepreneurship



Skill Development

SBTB5101	BIOPROCESS ENGINEERING	L	T	P	EL	Credits	Total marks
		3	0	0	0	3	100

COURSE OBJECTIVES:

- To understand the fundamental principles of bioprocess engineering to gain the knowledge in downstream processing.

UNIT 1 PRINCIPLE OF BIOPROCESS**9 Hrs.**

Rate law, zero and first-order kinetics, Ideal reactors- batch, mixed flow, and plug flow, Enzyme immobilization, diffusion effects – Thiele modulus, effectiveness factor, Dam Koehler number, Kinetics of Batch and continuous microbial growth.

UNIT 2 DESIN OF MEDIA AND STERILIZTION**9 Hrs.**

Design of media- Plackett burman and Response Surface model, Types of media: microbial culture medium, plant and animal cell culture medium. Media sterilization; kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilization, sterilization of air and filter design, Radiation and chemical sterilization.

UNIT 3 DESIGN OF BIOREACTORS**9 Hrs.**

Batch, fed-batch and continuous processes: Operation of batch, continuous and fed-batch processes and industrial applications, Comparison of batch, fed-batch and continuous processes, Multiple CSTR series.

UNIT 4 MASS TRANSFER**9 Hrs.**

Rheology of fermentation fluids: Newtonian and non-Newtonian fluids, Aeration and agitation, power requirement for gassed and un-gassed systems, time calculation for mixing. Mass transfer in bioreactors: Oxygen transport from the bubble to the cell. Measurement of k_La , Factors influencing mass transfer.

UNIT 5 DOWNSTREAM PROCESSING**9 Hrs.**

Downstream Process steps, salting out, Ultrafiltration principle and applications, dialysis and its applications, Chromatography: TLC, HPLC, Gel Permeation, Ion Exchange chromatography, Crystallization, Lyophilization and Drying.

COURSE OUTCOMES

On completion of course, student will able to

- C01** - Understand the principle of bioprocess technology.
- C02** - Design of fermentation media for desired product.
- C03** - Interpret filtration and heat sterilization.
- C04** - Evaluate microbial growth kinetics by Monod model.
- C05** - Determine the mass transfer coefficient by dynamic gassing out method.
- C06** - Compare the working principle of Ion and Gel Permeation chromatography.



Employability



Entrepreneurship



Skill Development

SBTB5102	RESEARCH METHODOLOGY AND IPR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on formulation of research problem, research methodology, and ethics involved in doing research and importance of IPR protection.

UNIT 1 RESEARCH METHODOLOGY**9 Hrs.**

Meaning of research problem, Sources of research problem. Criteria characteristics of a good research problem. Errors in selecting a research problem. Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism. Research ethics.

UNIT 2 RESULTS AND ANALYSIS**9 Hrs.**

Importance and scientific methodology in recording results. Importance of negative results. Different ways of recording, industrial requirement, artifacts versus true results. Types of analysis (analytical, objective, and subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT 3 TECHNICAL WRITING**9 Hrs.**

Effective technical writing, how to write a manuscript/responses to reviewers comments, preparation of research article/research report, writing a research proposal, presentation and assessment by a review committee.

Unit 4 INTELLECTUAL PROPERTY RIGHTS**9 Hrs.**

The concept of Intellectual property rights, Evolution and development of concept of IPR. Patents, Designs, Trade Mark, Copyright, Trade secrets, utility models, IPR and Bio diversity. Role of WIPO and WTO in IPR establishments. Functions of UNESCO in IPR maintenance. Protection of GMO's IP as a factor in R&D, IP's of relevance to biotechnology.

UNIT 5 PATENTS**9 Hrs.**

Origin of the patent regime. Early patents act & Indian pharmaceutical industry. Types of patents, Patent Requirements, objectives and benefits. Concept, features of patent, Inventive step, Specification, Patentable subject matter. Application preparation, filing and process, E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

COURSE OUTCOMES

On completion of the course, student will be able to

- C01** - Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- C02** - Understand research problem formulation & Analyze research related information and Follow research ethics
- C03** - Correlate the results of any research article with other published results. Write a review article in the field of engineering
- C04** - Appreciate the importance of IPR and protect their intellectual property.
- C05** - Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D,
- C06** - Create the new and better products, and in turn brings about, economic growth and social benefits.



SBTA1301	MOLECULAR BIOLOGY AND GENETICS	L	T	P	Credit	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- The course aims to give an understanding on the fundamentals of conventional genetics and the intricate molecular mechanisms of heredity and variations.
- To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.

UNIT 1 CLASSICAL GENETICS**9 Hrs.**

Fundamental principles of genetics- Mendel's principles and experiments, gene interaction, multiple alleles, complementation, linkage, sex linked, sex limited and sex influenced inheritance; Chromosomes basis of heredity- extra-chromosomal inheritance; Linkage and crossing over; Hardy-Weinberg equilibrium, Extensions of Hardy-Weinberg equilibrium.

UNIT 2 STRUCTURE AND PROPERTIES OF NUCLEIC ACIDS**9 Hrs.**

Introduction to nucleic acids: Evidence for DNA&RNA as a genetic material; Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3',5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff's rule; DNA replication- Overview of differences in prokaryotic and eukaryotic DNA replication, D-loop and rolling circle mode of replication, Telomere replication in eukaryotes; Okazaki fragments, Fidelity of DNA replication, Inhibitors of DNA replication, DNA repair- Mutagens, DNA mutations and various types of repair mechanisms.

UNIT 3 TRANSCRIPTION**9 Hrs.**

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

UNIT 4 TRANSLATION**9 Hrs.**

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

UNIT 5 REGULATION OF GENE EXPRESSION**9 Hrs.**

Organization of genes in prokaryotic and eukaryotic chromosomes- operon concept; Gene expression and regulation- Hierarchical levels of gene regulation, Prokaryotic gene regulation -lac and trp operon, Eukaryotic gene regulation- gene silencing.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Explain the foundations of Mendelian genetics and chromosomal theory and apply these, with appropriate terminology, to contemporary concepts in genetics.
- CO2 - Emphasize the molecular mechanism of DNA replication and repair in various organisms
- CO3 - Explain the properties of genetic materials and storage and processing of genetic information.
- CO4 - Analyze the processes of transcription and translation in both prokaryotes and eukaryotes at molecular level.
- CO5 - Understand the redundant and universal qualities of the genetic code and how it is used to determine the amino acid sequence of a polypeptide.
- CO6 - Compare the mechanisms of gene regulation in prokaryotes and eukaryotes.



SBTA1303	PROTEIN ENGINEERING AND BIOINFORMATICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the protein structure and its applications in bioinformatics

UNIT 1 PROTEIN STRUCTURE**9 Hrs.**

Hierarchical representation of proteins, structural classification of proteins, protein folding pathways and protein stability

UNIT 2 STRUCTURAL CHARACTERIZATION OF PROTEINS**9 Hrs.**

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spectroscopy, an overview of spectroscopic techniques for the analysis of protein secondary and tertiary structure; an overview of techniques for analysis of protein quaternary structure.

UNIT 3 PROTEIN DATABASES AND SEQUENCE ANALYSIS**9 Hrs.**

Databases for protein sequence and structure, Protein sequence analysis: sequence alignment, programs for sequence alignment, amino acid properties for sequence analysis

UNIT 4 PROTEIN STRUCTURE PREDICTION**9 Hrs.**

Overview on protein structure analysis, Secondary structure prediction-tools used, 3D Structure prediction-Homology modelling, threading and Ab initio methods

UNIT 5 PROTEIN ENGINEERING AND APPLICATIONS**9 Hrs.**

Strategies for protein engineering; Random and site- directed mutagenesis; Various PCR based strategies; Role of low-fidelity enzymes in protein engineering; Gene shuffling and Directed evolution of proteins; Protein backbone changes; Antibody engineering. Biotechnological and Biomedical Applications: Industrial, Environmental and Biomaterial applications, Applications in Nanotechnology, Biosensors, virus engineering, Engineered proteins and scaffold proteins as therapeutics.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyse and compare the amino acid sequence and structure of proteins, and relate this information to the function of proteins
- CO2 - Understand and differentiate several biophysical techniques used for characterisation of protein structure
- CO3 - Understanding protein databases that are storehouse to the latest information in protein research
- CO4 - Analyse the protein sequence for their structural properties
- CO5 - Use appropriate tools to predict the structure of proteins
- CO6 - Appraise different protein design strategies used to design completely new proteins tailored to specific tasks



SBTA1304	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To study about the ecology, pollution and control

UNIT 1 INTRODUCTION TO ECOLOGY

9 Hrs.,

Historical perspective, Our Environment: Atmosphere; Hydrosphere; Lithosphere; Scope of Ecology; Development and Evolution of Ecosystem; Principles and concepts of ecosystem; Structure of ecosystem; Strata of an ecosystem; Types of ecosystem; Cybernetics and Homeostasis; Biological control of chemical environment; Energy transfer in an ecosystem; Food chain, food web; Energy budget; Production and decomposition in a system; Ecological efficiencies; Trophic structure and energy pyramids; Principles pertaining to limiting factors; Biogeochemical cycles (N, C, P cycles)

UNIT 2 MICROBES AND ENVIRONMENT

9 Hrs.

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles (Biogeochemical cycles (N, C, P cycles); Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics

UNIT 3 ENVIRONMENTAL CHEMISTRY & POLLUTION

9 Hrs.

Water and water quality parameters Origin and effect of waste water on aquatic environment. Industrial water pollution ; Chemistry of waste water-DO,BOD,COD,TOC Chemistry of air and air pollutants; Sources; Sinks; Classification and effects of air pollutants on living and non-living things; Chemistry of soil: Formation; Constituents and properties of soils; Composition of types of soil; Chemical factors affecting the soil quality; Adsorption of contaminants in soil. Industrial waste; Urban waste; Chemical and metallic pollutants; Radioactive waste; Trace heavy metals; Pesticides; Fertilizers effect of modern agro-technology on quality of soil

UNIT 4 POLLUTION CONTROL & BIOPRODUCTS

9 Hrs.

Air Pollution Treatment: Treatment technologies, Biofilters and Bioscrubbers for treatment of industrial waste. Primary, secondary and tertiary treatment of wastewater—Comparison between aerobic and anaerobic processes, Activated sludge process – Trickle filter – Rotating biological contactors – Fluidized bed reactor – anaerobic digester, emerging process in waste water treatment and their applications - municipal and industrial wastewater treatment. Composting- types, systems, quality- vermicomposting. Biofertilizers – Biopesticides - Biofuel production - Bioethanol – Biohydrogen and Biodiesel

UNIT 5 BIOREMEDIATION & BIODEGRADATION

9 Hrs.

Bioremediation- *In situ* and *Ex situ*- bioventing, Biosparging and Phytoremediation. Role of microbes in improving soil fertility- Mycorrhiza. Microbial leaching of heavy metals - extraction of metals from ores- Bioaccumulation-Biosorption and Bioprecipitation of heavy metals. Aerobic and Anaerobic degradation of recalcitrants - aliphatic, aromatic polyaromatic - hydrocarbons.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Bring about an insight on the basic concepts of ecology
- CO2 - Describe the role of microbes in the environment
- CO3 - Outline the Source and effect of pollutants in the environment
- CO4 - Present an overview of important environmental technologies involved in treatment of pollutants and resource recovery.
- CO5 - Explain the different bioremediation processes
- CO6 - Insight into the mechanism of degradation of organic pollutants



Employability



Entrepreneurship



Skill Development

SBTA1401	ENZYME TECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To understand the working of different enzymes and applying the functions in industrial biotechnology

UNIT 1 INTRODUCTION TO ENZYMES

9 Hrs.

Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis., Role of co-enzymes and co-factors.

UNIT 2 ENZYME KINETICS

9 Hrs..

Michaelis - Menton kinetics, determination of Km, Lineweaver Burke plot, Eadie - Hofstee plot, Hanes-Woolf plot. Turnover number, Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, Irreversible inhibition and inactivation kinetics. Multi substrate enzyme catalysed reaction.

UNIT 3 ENZYME IMMOBILIZATION

9 Hrs.

Classification of enzyme immobilization, physical and chemical techniques for enzyme immobilization -adsorption, matrix entrapment, encapsulation, cross-linking, covalent bonding, advantages and disadvantages, Application of immobilized enzymes, mass transfer effect on immobilization, properties of immobilized enzymes.

UNIT 4 ENZYME SPECIFICITY AND EXTRACTION

9 Hrs.

Types of specificity, Active site- Fischer hypothesis and Koshland hypothesis, Extraction of soluble enzymes, membrane bound enzymes, purification procedures, criteria of purity.

UNIT 5 CLINICAL AND INDUSTRIAL APPLICATIONS OF ENZYMES

9 Hrs.

Application of enzymes in medicine and industry – Assay of plasma enzyme, enzyme biosensors, design of enzyme electrodes, Synzymes, Abzymes, Enzymes in genetic engineering

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - The knowledge on enzyme and enzyme reactions will be the helpful to understand various concepts in biotechnology.
- CO2 - Enzyme kinetics will give inputs to use enzyme in research and industry.
- CO3 - Methods of enzyme immobilization help in food, pharmaceutical and chemical industries to innovate a useful product to society.
- CO4 - Concepts on Isolation, Purification and characterization of enzymes will be helpful to work technologically.
- CO5 - Application of enzymes in industry.
- CO6 - Identify novel applications of enzymes in bioengineering.

SBTA1402	IMMUNOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To know the fundamentals of innate and acquired immunity.
- To understand how immune system fights and combats the infection and diseases.

UNIT 1 INTRODUCTION TO IMMUNOLOGY AND IMMUNE SYSTEM**9 Hrs.**

History and Scope of Immunology, Hematopoiesis, Innate and Acquired Immunity; Cells of the immune system, Primary and Secondary lymphoid organs. Maturation, structure, activation and differentiation of T and B cells.

UNIT 2 HUMORAL IMMUNITY**11 Hrs.**

Antigens: Characteristics and Types of Antigens, Factors affecting the immunogenicity, Haptens, Antigenic Determinants, Adjuvants, Immunoglobulins: Basic structures, classes and sub classes; Molecular Biology of Immunoglobulin synthesis, Antigenic determinants on Immunoglobulins. Monoclonal antibodies. Complement system - Alternate, Classical and Lectin pathways.

UNIT 3 CELL MEDIATED IMMUNITY**7 Hrs.**

Phagocytosis, Inflammatory mediators, Structure, types and function of MHC, Exogenous and Endogenous pathways of antigen processing and presentation; Cytokines - Characteristics, function and regulation of the immune response.

UNIT 4 IMMUNOTECHNIQUES**9 Hrs.**

Nature of Antigen Antibody Interactions, Precipitation reactions, Agglutination reactions - Immunofluorescence, Immunoelectroscopy, RIA, ELISA. Detection of bacterial endotoxins using immunological methods (LAL Test), Western Blot

UNIT 5 IMMUNOLOGICAL DISORDERS**9 Hrs.**

Hyper-sensitivity, Autoimmunity, Immunological Tolerance, Immunodeficiency diseases: Primary and secondary diseases, Transplantation immunology, Tumor immunology

Max.45 Hrs.**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Understand overall concept of immune system.
- CO2 - Acquire knowledge about different cells and organs involved in immune system.
- CO3 - Recognize effectors molecules fight against infectious diseases.
- CO4 - Demonstrate to produce monoclonal antibodies to diagnose and treat infectious diseases.
- CO5 - Apply suitable knowledge to develop acquired immunity to maintain health.
- CO6 - Implement immunotechniques to diagnose infectious diseases.

SCHA1411	CHEMICAL REACTION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To impart basic knowledge on the principles of different kinds of reaction, reaction kinetics and to introduce various types of reactors that are used in Chemical Engineering operations.

UNIT 1 CHEMICAL KINETICS**9 Hrs.**

Introduction to reactor, reaction system, chemical kinetics, rate equation, Elementary and non- elementary reactions. Molecularity and order, dependence of rate on concentration, temperature dependent term of a rate equation, concept of activation energy -Arrhenius theory, collision theory, transition state theory, determination of rate equation for non-elementary reactions. Methods to determine order of a reaction- Integral & differential method of analysis of data, Half-life method & Ostwald's isolation method.

UNIT 2 IDEAL REACTORS**9 Hrs.**

Introduction to Batch reactor, semi batch reactor, Plug flow reactor, Mixed flow reactor, Packed bed reactor, Concept of ideal flow, space time and velocity, performance or design equations for batch reactor, Plug flow reactor, Mixed Flow reactor.

UNIT 3 DESIGN OF MULTIPLE REACTOR SYSTEMS**9 Hrs.**

Mixed flow reactors in series and parallel connection, Plug flow reactors in series and parallel connection, reactors of different types in series, size comparison of reactors using performance charts.

UNIT 4 IDEAL AND NON-IDEAL FLOW**9 Hrs.**

Reason for non ideality, Residence time distribution, E curve, F curve, relationship between E and F curve, relationship between mean residence time and space time, State of aggregation- micro and macro fluid, Earliness or lateness of mixing, basic models for non ideal reactor like tanks in series model.

UNIT 5 CATALYSIS**9 Hrs.**

Introduction to catalysis, catalytic reactions, promoters, poisons, preparation of catalyst, Physical properties of catalyst: Surface area (BET isotherm), Pore volume distribution; Steps in a catalytic reaction, rate of catalytic reaction (adsorption, surface reaction and desorption as rate limiting steps).

Max.45 Hrs.

- CO1 - Develop rate laws for homogeneous reactions
- CO2 - Design of ideal reactors for single and complex reactions
- CO3 - Develop skills to choose the right reactor among single, multiple, recycle reactor, etc. schemes.
- CO4 - Predict and design the conversion in a non-ideal reactor using tracer information
- CO5 - Design reactors for fluid-solid reactions
- CO6 - Understanding the principles of catalytic reactions.

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS**7 Hrs.**

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING**7 Hrs.**

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**7 Hrs.**

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

UNIT 4 SMART MANUFACTURING**8 Hrs.**

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self-propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Emerging Technologies - Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD**8 Hrs.**

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS**8 Hrs.**

roduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : CaseStudies.

Max. 45 Hrs.

SBTA1501	GENETIC ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Genetic Engineering course explores the manipulation of DNA using various tools and methods for its diverse application in the field of industry, medicine, plant and animal Biotechnology.

UNIT 1 MOLECULAR TOOLS IN GENETIC ENGINEERING**9 Hrs.**

History, milestones and recent developments in Genetic Engineering; Steps involved in rDNA technology. DNA manipulative enzymes -Restriction enzymes: Endo & Exonucleases. Modifying enzymes- DNA & RNA polymerase, reverse transcriptase, terminal transferase; nucleases (DNases, RNases, S1) T4 polynucleotide kinase, Alkaline Phosphatase and ligase (E.coli & T4). Ligation (cohesive & blunt end ligation) – linkers, adaptor & homopolymer tailing.

UNIT 2 CLONING VECTORS**9 Hrs.**

Ideal properties of a cloning vector. Plasmid vectors -pBR322 and its derivatives, phage vectors (λ & M13), Cosmid vectors, Shuttle and expression vectors; Yeast vectors-YAC & BAC (E.coli); Gene transfer methods.

UNIT 3 CLONING STRATEGIES**9 Hrs.**

Screening and selection of recombinants; Hybridization methods-Southern, Northern, Western; Construction of genomic & c DNA libraries. Expression in bacteria, yeast, insects, plant & mammalian cells.

UNIT 4 TECHNIQUES IN GENETIC ENGINEERING**9 Hrs.**

DNA sequencing – Maxam Gilbert & Sanger's, Nicolson sequencing methods, Pyrosequencing. PCR - Principle, types and applications; Site directed mutagenesis. Gene mapping-definition and types. Restriction mapping, FISH. Molecular markers used for gene mapping .PCR based and Hybridization based methods- RFLP, AFLP, VNTR, STS.

UNIT 5 APPLICATIONS OF GENETIC ENGINEERING**9 Hrs.**

Strategies in plant and animal genetic engineering. Application of Genetically modified organisms; hazards and ethics associated with use of GMO. Production of recombinant proteins. DNA vaccines. Chromosomes engineering, targeted gene replacement, gene editing, gene silencing. Gene therapy, Human Genome Project.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Explain the steps involved in rDNA technology
- CO2 - Prioritize a specific cloning vector for cloning in prokaryotes and eukaryotes.
- CO3 - Express specific model organisms used for recombinant protein production
- CO4 - Consider the efficiency of PCR based cloning in comparison to traditional cloning strategies.
- CO5 - Show the prospects of gene editing
- CO6 - Evaluate the hazard and impact of genetically modified organism

SBTA1502	BIOPROCESS ENGINEERING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To develop skills of the students in design operation, medium design, fermentation process and metabolic stoichiometry.
- To understand the modern industrial biotechnological process, sterilization and growth kinetics of microorganisms.

UNIT 1 CONCEPTS OF BIOPROCESS**9 Hrs.**

Historical of bioprocess technology, concept of Bioprocess, Fermentation process-types, fermentor, basic parameters of fermentation process. Basic outline of upstream and downstream process. Isolation and preservation of industrially important organisms. Production of industrial important enzymes and their applications. Modes of operation including batch, fed-batch and perfused systems.

UNIT 2 DESIGN OF FERMENTATION PROCESS**9 Hrs.**

Medium requirement for fermentation processes; development of inocula for industrial fermentations. Different types of fermentation processes: aerobic and anaerobic processes and their application in the biotechnology industry. Construction of fermentor and ancillaries, solid-substrate fermentation and its applications. Media for fermentation processes, Types of media: microbial culture medium, plant and animal cell culture medium

UNIT 3 MEDIA AND STERILIZATION KINETICS**9 Hrs.**

Medium-simple and complex media, medium requirement for fermentation process, formulation of good medium and its optimization methods. Modes of media sterilization- FSIP and ESIP, modes of air sterilization, media sterilization by membrane filtration method. Thermal death kinetics, batch sterilization, equipment for continuous sterilization, air sterilization, Validation Issues.

UNIT 4 STOICHIOMETRY OF CELL GROWTH AND PRODUCT FORMATION**9 Hrs.**

Growth Stoichiometry and elemental balances, Product stoichiometry, degrees of reduction, theoretical prediction of yield coefficient, theoretical oxygen demand.

UNIT 5 MICROBIAL GROWTH KINETICS**9 Hrs.**

Phases of cell growth in batch cultures, quantifying cell growth, batch growth kinetics, environmental conditions affecting the growth kinetics, heat generation by microbial growth, quantifying growth kinetics: unstructured kinetic models for microbial growth, growth models of filamentous organisms, growth kinetics of Monod model.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Summarize the overall bioprocess technology and demonstrate the upstream and downstream process
- CO2 - Design of fermenter and fermentation media for the production of metabolites
- CO3 - Integrate Concepts and knowledge from various sterilization methods
- CO4 - Analyze the stoichiometry cell growth and evaluate Monod kinetics parameter
- CO5 - Evaluate an appropriate technique for novel downstream processing and its applications.
- CO6 - Determine the microbial growth rate by structure and unstructure models

SBTA1503	NANOBIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To produce and apply various types of nanostructured materials.
- To suggest methods for the characterization of nanomaterials.
- To use basic principles to solve biotechnical problems
- To assess risks of nanobiotechnology to society and environment.

UNIT 1 INTRODUCTION OF NANOTECHNOLOGY**9 Hrs.**

History of nanotechnology, definitions in nanotechnology, approaches in nanotechnology, generations of nanotechnology, properties and application of nanotechnology

UNIT 2 CHARACTERIZATIONS OF NANOMATERIALS**9 Hrs.**

Optical (UV-Vis/Fluorescence) –X-ray diffraction – Bragg's law, Imaging and size (Electron microscopy, light scattering, Zeta potential Surface and composition (EDSA, EDAX, AFM/STM etc) –Vibrational (FT-IR and RAMAN),

UNIT 3 PRODUCTION OF NANOPARTICLES**9 Hrs.**

Production of nanomaterials by physical, chemical and biological method - Fabrication- Characterization - Biopolymer derived nanomaterials (Chitosan, PHB, polysaccharides) - applications

UNIT 4 NANOMATERIALS AND DIAGNOSTICS/DRUG DELIVERY AND THERAPEUTICS**9 Hrs.**

Self-assembly of nanoparticles - Modified Nanoparticles - Peptide/DNA /Lipid Nanoparticles For Drug Delivery. Metal/Metal Oxide Nanoparticles for biological activity (antibacterial/anti-fungal/anti-viral/ anticancer), imaging and hyperthermia using nanomaterials

UNIT 5 TOXICITY EVALUATION OF NANOMATERIALS**9 Hrs.**

Evaluation of genotoxicity, cytotoxicity of nanoparticles using invitro and invivo systems. Nanoparticles disposal methods and risk management.

Max.45 Hrs**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Understand the evolution of Nanotechnology and its applications
- CO2 - Study the techniques used for characterization of nanomaterials
- CO3 - Production of nanoparticles by different methods
- CO4 - Understand the drug delivery system using nanotechnology
- CO5 - Understand the toxicity evaluation methods of nanoparticles
- CO6 - Understand the development of nanotechnology in biology

SBTA1504	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To understand drug metabolism pathway, thereby we able to come up with novel lead molecules.

UNIT 1 INTRODUCTION**9 Hrs.**

Development of Drug and Pharmaceutical Industry -Therapeutic agents, their uses and economics; Routes of drug administration. Selection criteria for route of administration.

UNIT 2 DRUG METABOLISM AND PHARMACOKINETICS**9 Hrs.**

ADME of Drugs, Drug metabolism- pharmacokinetics-action of drugs on human bodies, Factors in influencing metabolism

UNIT 3 IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS**9 Hrs.**

Bulk drug Manufacture: Types of Reactions in Bulk drug Manufacture and Processes. Special Requirements for Bulk Drug Manufacture and its regulatory aspects.

UNIT 4 PRODUCT FORMS AND DEVELOPMENT**9 Hrs.**

Compressed tables, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules sustained action dosage forms-parental solutions-oral liquids-injections-ointments-Topical Application, Preservation, analytical methods and test for various drugs and pharmaceuticals, Labeling, Packing, Packing Techniques, Quality Management, GMP.

UNIT 5 PHARMACEUTICAL PRODUCTS**9 Hrs.**

Therapeutic categories such as laxatives - analgesics - non steroidal contraceptives - external antiseptics - antacids and other, antibiotics - biological - hormones - vitamins with respect to system. Pharmaceutical Development: Introduction to drug regulations, pre clinical and clinical trials.

Max.45 Hrs**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Summarise the drug development process and pharmaceutical industry
- CO2 - Discuss the mode of drug interaction and contra interaction
- CO3 - Apply the chemical processes in Drug manufacturing process
- CO4 - Sketch the steps involved in the manufacturing process of various formulation
- CO5 - Asses the quality control and good manufacturing practices in the pharmaceutical industry
- CO6 - Know the mechanism of drug action in the human body

SBTA4003	MEDICAL GENOMICS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES:

The course has been designed to show how genomics will be used for patient care with genetic disorders, and the knowledge and skills required to treat them.

UNIT 1 Genetic disorders and therapy

9 Hrs.

Single gene disorders and Multifactorial disorders - conventional and contemporary methods: Pedigree analysis, Linkage mapping, Positional/structural and functional cloning; Bioinformatic analysis; Genetic polymorphism and disease susceptibility. Treatment of genetic disorders: Methods of therapy - Drug (recombinant proteins); Gene (Viral vectors, delivery methods, efficacy); Some examples (Thalassemia, Phenylketonuria, Cystic fibrosis).

UNIT II Diagnostic genetics

9 Hrs.

Cytogenetics/ Molecular methods; Screening for mutation/ chromosomal anomaly - Adult/Prenatal/New-born screening; Preimplantation screening (Assisted reproductive technology- in vitro fertilization and Embryo transfer); Forensic testing - DNA fingerprinting, paternity testing, individual identification. Genetic counselling; Prenatal/adult diagnosis of genetic disorders; Risks and benefits; Informed consent; Right of choice; Case studies.

UNIT III Functional genomics and animal models in human disease

9 Hrs.

cDNA/gene cloning; site-directed mutagenesis; mammalian tissue culture; cell line transfections; functional assays; Use of model organisms, methods for generation of transgenic animals/ knock-in, knockout models (microinjection, ES cell transformation); ENumutagenesis; RNAi approach.

UNIT IV CRISPR-Based Genome Engineering

9 Hrs.

Origins of CRISPR; CRISPR Knockout Basics (Experimental Design, Guide RNA design, Delivery into Cells, Genotyping, Validation); CRISPR Knockin (Inserting or Mutating DNA Sequences in the Genome); CRISPR Editing in Animal Models (Knockout and Knockin Strategies in Mice); CRISPR Screens (High throughput applications of CRISPR); CRISPR-Based Gene Therapy; The Future of CRISPR and Ethical Considerations (CRISPR in the Clinic, CRISPR Babies, Case-Studies)

UNIT V Pharmacogenetics

9 Hrs.

Genetic drug response profiles, the effect of drugs on Gene expression. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

CO 1- Evaluate the genetic basis of disease

CO 2-Choose a genetic test that is appropriate for a given clinical scenario

CO 3- Assess the evolution of genomic technologies

CO 4-Appraise the applications CRISPR technology for research, gene-therapy and the discovery of novel therapeutics

CO 5-Criticise ethical problems pertaining to the use of transgenic models in biomedical research

CO 6-Distinguish the effect of genetic differences between individuals in the outcome of drug therapy and in drug efficacy and toxicity.

SBTA1601	ANIMAL BIOTECHNOLOGY	L	T	P	C	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To Provide fundamentals Of Animal Cell Culture and its application
- To Offer The Knowledge About The Micromanipulation And Transgenic Animals

UNIT 1 ANIMAL CELL CULTURE**9 Hrs.**

Introduction, importance, history of cell culture development, Basic Tissue Culture Techniques; Media for animal cell culturing – serum free Media; Primary cell cultures, secondary cell Cultures, Their Maintenance And Preservation; cell lines and cloning - Somatic Cell Fusion; Cell Cultures for production of pharma products and for Organ Culturing.

UNIT 2 GROWTH AND SCALE UP**9 Hrs.**

Cell growth and growth kinetics of animal cells, Various Types Of Cultures microcarrier attached growth, suspension Cultures, Continuous Flow Cultures, Immobilized Cultures; hollow fibre reactor.

UNIT 3 TRANSGENIC ANIMALS**9 Hrs.**

Concepts Of Transgenic Animal Technology; Strategies For The Production Of Transgenic Animals - chimeric animals generation and cloning; Pronuclear injection - generation of knockout animals and generation cloned animals. Gene editing technologies TALEN, CRISPR Cas9. Importance In transgenic animals in Biotechnology; Stem Cell Cultures in the production of Transgenic Animals.

UNIT 4 MANIPULATION OF EMBRYO'S**9 Hrs.**

What Is Micromanipulation Technology; Equipment Used In Micromanipulation; Enrichment Of X And Y Bearing Sperms From Semen Samples Of Animals; Artificial Insemination And Germ Cell Manipulations; embryo cloning- quadriparental hybrid, nuclear transplantation (Dolly), embryonic stem cells, In Vitro Fertilization And Embryo Transfer; Micromanipulation Technology And Breeding Of Farm Animals.

UNIT 5 THERAPEUTICAL APPLICATION AND SAFETY GUIDELINES**9 Hrs.**

Recombinant Cytokines And Their Use In The Treatment Of diseases; Monoclonal Antibodies – immunotoxins - Ex vivo and In vivo gene therapy, vaccines production; molecular pharming - . Containment of Safety use and release of transgenic animals- biosafety guidelines – national, Institutional and International level.

Max.45 Hrs**COURSE OUTCOMES****On completion of course, student will able to**

- CO1 - Understand the cell culture techniques
- CO2 - Explain the importance of aseptic techniques of cell culture
- CO3 - Generalize the requirement need for cell culture
- CO4 - Recommend the methods of isolation and manipulation of embryo
- CO5 - Understand the importance of therapeutically applications and safety guidelines
- CO6 - Understand the knowledge about the Micromanipulation and Transgenic Animals

SBTA1602	BIO SAFETY, BIOETHICS AND IPR	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand biosafety and the importance of bioethics.
- To be able to distinguish the different IPR and biotechnological patent.

UNIT 1 INTRODUCTION TO BIOSAFETY**9 Hrs.**

Biosafety – definition, need, importance, applications, levels of biosafety and criteria for biosafety levels. NIH guidelines for biosafety. Regulations specific to biotechnology companies and research institutions. Biosafety guidelines in India. Role of institutional biosafety committee.

UNIT 2 IMPLICATIONS OF BIOSAFETY**9 Hrs.**

Guidelines for research with transgenic organisms. Environmental impact of genetically modified organisms (beneficial and hazardous impact), Field trials with GMO, Containment levels. Biosafety protocol, Cartagena Biosafety protocol, Mechanism of implementation of biosafety guidelines. Biosafety and politics. Biosafety database.

UNIT 3 INTRODUCTION TO BIOETHICS**9 Hrs.**

Bioethics – need, applications. Impact of bioethics to the environment and society. Bioethical issues pertaining to various aspects of Biotechnology. Bioengineering ethics, responsible researchers, research ethics, ethical decision making. Biowarfare and biopiracy.

UNIT 4 INTELLECTUAL PROPERTY RIGHTS**9 Hrs.**

Forms of Intellectual property – patent, copyright, trademark, design, trade secret, domain name and geographical indications. WTO treaties, GATT articles, main features of TRIPS agreement, practical aspects of WIPO. IPR related legislatures in India.

UNIT 5 PATENT**9 Hrs.**

History of Indian patent system and law. Patenting authority. Different types of patent. Requirements and procedure for patenting. Patentable and Non-patentable things. Patent search and patent co-operation treaty (PCT). Farmer's right and plant breeders right. Importance, social consequences and controversies on biotechnology patents.

Max.45 Hrs**COURSE OUTCOMES**

On completion of course, student will able to

- CO1 - Define biosafety, bioethics and intellectual property rights.
- CO2 - Discuss the different regulations pertaining to biosafety.
- CO3 - Categorize the various forms of IPR.
- CO4 - Appraise the importance of bioethics in biotechnology.
- CO5 - Elaborate the different patents and the process of patenting.
- CO6 - Interpret biotechnological novelty as patents.

SBTA1603	DESIGN AND OPERATION OF BIOREACTORS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To develop knowledge and technical's skills on bioreactors and its various types.
- To make understand the knowledge on growth parameters such as structure and unstructured models

UNIT 1 INTRODUCTION TO BROAD SCOPE OF BIOCHEMICAL ENGINEERING**9 Hrs.**

Concept of Bioreactors, Overview of SLF and SSF. Medium optimization-Plackett Burman method. Response surface methodology, Introduction to bioreactor configuration-Basic mode of operation batch, fed-batch and continuous reactor-bioreactor lay out-Kinetics of batch and continuous culture. Criteria of scale up and scale down of bioreactor.

UNIT 2 IDEAL CONTINUOUS STIRRED TANK BIOREACTOR**9 Hrs.**

Material balance-Evaluation of Monod Kinetic parameter, Alternatives to Monod equation-Blackman, Tessier, Moser, Contois equation -Comparison of batch and CSTB-Multiple CSTB connected in series-CSTB with cell recycling.

UNIT 3 GENERAL CHARACTERISTIC OF MODELS:**9 Hrs.**

Basic concept of Linear model, dynamic, lumped, continuous, white or black box model. Unstructured and structured models. Models with growth inhibitors- Substrate inhibition, Product inhibition-Competitive and Noncompetitive product inhibition.

UNIT 4 AGITATION AND AERATION DESIGN**9 Hrs.**

Henry's Law - mass transfer, Two film Theory, Definitions of oxygen Transfer Rate, Oxygen Uptake Rate, Specific Oxygen Uptake Rate. Mass transfer and rheology: Rheology of broths - impact on transfer processes Oxygen transport from the bubble to the cell.

UNIT 5 DESIGN CONSIDERATIONS**9 Hrs.**

Animal and plant cell bioreactors. Determination of k_La - Correlation for k_La . Introduction to Single Use, Bioreactors (SUBs),

Max.45 Hrs**COURSE OUTCOMES****On completion of course, student will able to**

- CO1 - Study of basic working principle of bioreactors and optimization of medium preparation
- CO2 - Design and operation of industrial bioreactors pipeline and working process
- CO3 - Evaluate the various microbial growth kinetics and comparative analysis of bioreactors
- CO4 - Discuss and evaluating the microbial growth determination models
- CO5 - Critique on the validity of experimental data and measurements of mass transfer rate
- CO6 - Application and Operation of industrial bioreactors for various economical important products

SBTA3005	MEDICAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course will provide students with an historical perspective in the fast emerging medical biotechnology and the innovative processes that ensures the success of such endeavors.

UNIT 1 BASIC CONCEPTS AND TOOLS**9 Hrs.**

Understanding human body, Genomics, Proteomics, Genetic disorders, Drugs, Pharmacogenomics, Pharmacokinetics.

UNIT 2 SIGNALING MECHANISMS**9 Hrs.**

Receptor mediated signal transduction – primary messenger – hormones and drugs- secondary messenger and neurotransmitters. G- Protein coupled receptors – cyclic AMP –calcium ions – Nitric oxide (NO) – prostaglandin and inositol triphosphates.

UNIT 3 DIAGNOSTICS**9 Hrs.**

Hematology, Biochemistry (Serum & Tissue), Histology (Biopsy and Autopsy) and Endocrinology. Diagnosis of Bacteria (Mycobacterium), DNA virus (HBV/H1N1), RNA virus (HIV/HCV), Parasite (Malaria).

UNIT 4 TREATMENT AND PREVENTION**9 Hrs.**

Traditional medicine (AYUSH), Chinese and Modern medicine, Antibacterial, Antiviral, Antibiotics, use of interferon, immunomodulators. Active and passive immunization, vaccines and toxoids, Food as medicine-Nutraceuticals.

UNIT 5 THERAPEUTIC DEVELOPMENTS AND DRUG DESIGNING**9 Hrs.**

Basics of Regenerative medicine, Nanomedicine, Combinatorial antibody designing, Gene therapy, Anti sense therapy-RNAi. Drug designing process, receptor–ligand interaction, ligand docking-Bioinformatics tools.

Max.45 Hrs**COURSE OUTCOMES****On completion of course, student will able to**

- CO1 - Develop an ability to use appropriate knowledge to identify and analyze the molecular basis of disease & emerging technology.
- CO2 - Conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions
- CO3 - Design solutions for complex, open-ended problems that meet specified needs with appropriate attention to health and safety risks
- CO4 - Create, select, apply, adapt, and extend appropriate techniques, resources, and modern tools
- CO5 - Work effectively as a member and leader in teams, preferably in a multi-disciplinary setting
- CO6 - Address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge in Medical & Pharmaceutical fields

SBTA4002	Synthetic biology	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course objectives

The course familiarizes students to the rapidly developing field of synthetic biology. The components of synthetic biology are introduced and its commercial applications are elaborated.

Unit I : Introduction to Synthetic biology

Introduction to synthetic biology. Background of Gene Regulatory Mechanisms (Gene Parts- Gene Structure, Promoters, Terminators, Enhancers, Inducers, Repressors, Transcription Factors, Co-factors, transcriptional and post-transcriptional regulation, post-translational modifications). Genetic Engineering and Genome Editing

Unit II : Elements of synthetic biology - Tools

Gene shuffling for large scale pathway assembly and engineering; Choices for microbial hosts for industrial applications— bacteria, yeast, insect. Gene editing methods – CRISPR/ Cas; Gene sequencing – Pyrosequencing, Nanopore sequencing.

Unit III : Bacterial circuits and Biobricks

Bacterial circuits: feedback, feed-forward, toggle switch, signal propagators and band filter, synchronized oscillators. Introduction to Bio Bricks & its applications. Microarrays & systems biology- a basic introduction

Unit IV : Mathematical modeling, simulation & applications

Noise in Gene Expression. Mathematical Modeling and Simulation. Biosensors. Application of software tools for modelling gene expression. Commercial Applications - Biomedicine, Biomaterials, Biofuels and Bioremediation; Global events & competitions- iGEM, synbiobeta.

Unit V : Regulations & ethics

Safety & bioethics, legal & IP elements involved in synthetic biology applications for human, animals and plants.

Max.45 Hrs

Course outcome

On completion of the course, the student will be able to;

CO1 : Define synthetic biology and outline its components.

CO2 : Paraphrase the biological mechanisms as circuits.

CO3 : Articulate on the elements of synthetic biology

CO4 : Illustrate bacterial circuits and biobricks

CO5 : Appraise on the applications, regulations and ethics of synthetic biology

CO6 : Design biobricks and novel metabolic pathways.

SBTA3007	FOOD PROCESSING TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To impart knowledge of various areas about the food safety and processing technology.

UNIT 1 PROPERTIES OF FOODS AND PROCESSING THEORY

9 Hrs.

Properties of liquids, solids and gases - Material transfer - Fluid flow - Heat transfer - Water activity - Effects of processing on sensory characteristics of foods - Effects of processing on nutritional properties - Food safety, good manufacturing practice and quality assurance : HACCP, Hurdle technology - Process control Automatic control, Computer-based systems.

UNIT 2 AMBIENT-TEMPERATURE PROCESSING

9 Hrs.

Raw material preparation : Cleaning, Sorting, Grading, Peeling - Size reduction in solid , liquid foods – mixing and forming – separation and concentration of food components – fermentation and enzyme technology – Irradiation – processing using electric fields, high hydrostatic pressure, light and ultrasound.

UNIT 3 PROCESSING BY APPLICATION OF HEAT

9 Hrs.

Heat processing using steam and water – Blanching – Pasteurization – Heat sterilization – Evaporation and distillation – Extrusion : Heat processing using hot air – Dehydration – Baking and roasting : Heat processing using hot oils – Frying : Heat processing by direct and radiated energy – Dielectric , ohmic and infrared heating.

UNIT 4 PROCESSING BY REMOVAL OF HEAT

9 Hrs.

Chilling – Controlled or modified atmosphere storage and packaging – Freezing – Freeze drying and Freeze concentration,

UNIT 5 POST – PROCESSING OPERATIONS

9 Hrs.

Coating and enrobing – Packaging – Types of packaging materials – printing – interactions between packaging and foods – environmental considerations – Filling and sealing of containers – materials handling, storage and distribution.

Max.45 Hrs

COURSE OUTCOMES

On completion of course, student will able to

- CO1 - Learning of properties of food and food safety.
- CO2 - Knowledge about the food processing by using ambient temperature
- CO3 - Study of processing of food by using heat
- CO4 - Processing of food by removal of heat using direct and radiant energy
- CO5 - Scrutinizing of Post processing of food
- CO6 - Gain wide knowledge about the processing technology of food

SBTA4004	Research Methodology in Biotechnology	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To acquaint the students with key concepts and tools of data analysis techniques.

UNIT 1: BASIC CONCEPTS OF PROBABILITY AND STATISTICS

9 Hrs.

Rules of probability, discrete and continuous probability distribution. Moments: Mean, variance and covariance. Bayes theorem and likelihood. Statistical tests – t-test, ANOVA, Chi square test.

UNIT 2: BASIC CONCEPTS OF LINEAR ALGEBRA

9 Hrs.

Vector and vector operations, matrix and matrix operations. Determinant and inverse of matrix. Eigen value and eigenvector. Linear system of equations, singular value decomposition.

UNIT 3: CORRELATION AND REGRESSION

9 Hrs.

Correlations, linear regression, multiple linear regression, nonlinear regression and logistic regression.

UNIT 4: CLUSTERING, CLASSIFICATION AND HIGHER DIMENSIONAL DATA

9 Hrs.

Distance measures for clustering, k-means clustering, hierarchical clustering, decision tree classifier, support vector machines. Higher dimensional data in biology, Principal component analysis, t-SNE, diffusion maps.

UNIT 5: Research and publication

9 Hrs.

Forming a Hypothesis, Techniques of Scientific Measurement, Testing of hypothesis, Methods of Theoretical Research, The Art of Scientific Communication, Presentation in Seminars and Conferences, Sponsored Research, Ethical Conduct in Science.

Max.45 Hrs

COURSE OUTCOMES

On completion of course, student will able to

- CO1 –Interpret scientific data using statistical methods.
- CO2 –Articulate biological data as algebraic equations
- CO3 –Correlate and deduce inference from data.
- CO4 –Categorize data to infer scientific knowledge.
- CO5 –Write a research report and analyze ethical issues.
- CO6 –Write a research proposal following ethical norms.

SBTA3001	MARINE BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To know the marine organisms of interest in biotechnology, their basic functions and role in the marine ecosystems; to understand the essential elements related to aquaculture and fish genetics and to acquire knowledge on marine natural products and fishery by-products; and also, to apply biotechnological methods for the conservation and protection of marine environment

UNIT 1 INTRODUCTION TO MARINE ECOSYSTEMS AND MICROBIAL DIVERSITY

9 Hrs.

Physical and chemical properties of sea water. Zonation of sea: Euphotic zone, Bathyal zone, Abyssal zone, Benthic zone, Deep sea. Marine ecosystems and biodiversity: Estuary, Seagrass, Seaweed, Salt marsh, Mangroves and Coral reef. Marine microbial diversity: Marine microbial habitats, Microbial distribution in the ocean, Factors that impact marine microbial diversity. Interactions between marine microbes and other living organisms.

UNIT 2 AQUACULTURE AND FISH GENETICS

9 Hrs.

Aquaculture: Definition- Criteria of selection of aquaculture species. Culture practices of marine Fish, Shrimp, Crab, Lobster, Oyster, and Seaweed. Fish genetics: Gynogenesis, Androgenesis, Polyploidy, Artificial insemination, Eye stalk ablation and Cryopreservation of fish gametes.

UNIT 3 ECONOMIC IMPORTANCE OF MARINE ORGANISMS

9 Hrs. Production

of live-feeds in marine aquaculture: Rotifers, Artemia, Copepods and Microalgae. Biofuel production. Marine enzymes, Production of omega-3 fatty acids from marine organisms. Marine pharmacology: New and novel antibiotics from marine organisms. Secondary metabolites from marine bacteria, actinomycetes and marine endophytic fungi. Prebiotics and Probiotics for aquaculture.

UNIT 4 MARINE AND FISHERY BY-PRODUCTS

9 Hrs.

Marine algal by-products: Chitin, Chitosan, Agar, Alginates, Carrageenan and Heparin. Fishery by-products: Fish oil, Isinglass, Fish glue, Fish silage, Fin rays,

UNIT 5 MARINE ENVIRONMENT PROTECTION

9 Hrs.

Marine Pollution. Human impacts on marine microbial diversity - Usage of marine microbes to ameliorate environmental deterioration. Control of oil spills and bioremediation. Effects of bio-fouling and bio-deterioration on marine structures. Protection methods against corrosion and fouling. Red tides: Causative factors and effects on the organisms of marine environment.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of course, student will able to

- CO1 - Learn the importance of marine ecosystems and microbial biodiversity
- CO2 - Develop the aquaculture practices of marine fish, shrimp, crab, lobster, edible oyster, pearl oyster and seaweeds
- CO3 - Devise the various fish genetic techniques involved in aquaculture
- CO4 - Formulate the production methodologies for economically and pharmaceutically important products from marine organisms
- CO5 - Generate the production strategy of various seaweed and fishery by-products and its applications
- CO6 - Evaluate the human impacted pollution in the marine environment and the usage of marine microbes to ameliorate environmental deterioration

SBAA4002	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge about the fundamentals of management.
- To understand the tools and techniques of the various aspects of management.
- To apply management concepts in decision making.

UNIT 1 MANAGEMENT THEORIES

9 Hrs.

Definition of management, science or art, **manager vs entrepreneur**, Types of managers - managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; **Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management**

UNIT 2 PLANNING, DECISION MAKING AND ORGANISING

9 Hrs.

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and Decentralization, job design,

UNIT 3 STAFFING AND LEADING

9 Hrs.

Human resource management, HR Planning, Recruitment selection, training & development, performance management, career planning and management, Directing individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 4 CONTROLLING AND REPORTING

9 Hrs.

Controlling, system and process of controlling, budgetary and non-budget control technique, use of computer and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

UNIT 5 VALUES AND ETHICS

9 Hrs.

Human Values – Natural acceptance - Ethics – Definition- Objectives - Virtues – Challenges in the work place - Engineering ethics - Scope - Moral issues and judgment - Moral development theories – Engineers as responsible experimenters - Codes of ethics - Industrial standards - Global Issues: Environmental ethics- Computer ethics - Ethics and codes of business conduct in MNC.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Describe the evolution and development of management concepts.
- CO2 - Understand the functions of management.
- CO3 - Apply the concepts and develop key competencies for managing human resources.
- CO4 - Analyze appropriate management techniques for Controlling and Reporting.
- CO5 - Evaluate the various aspects of decision making and demonstrate critical thinking.
- CO6 - Elaborate the importance of the ethical dimension in workplace.

SBTA3003	TRANSLATIONAL BIOTECHNOLOGY FROM IPR TO LICENSING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To emphasize the role of Biotechnology for sustainable development
- To highlight the role of Biotechnology in product production
- To analyze the needs and success of Biotech companies
- To develop effective skills for scientific documentation and communication
- To discuss principles and significance of Intellectual Property Rights

UNIT 1 BIOTECHNOLOGY IN DEVELOPMENT

9 Hrs.

Classical and modern biotechnological concepts in products development: therapeutic, environmental, agricultural, energy utilization. Manipulation of genetic information for sustainable development.

UNIT 2 BIOTECHNOLOGY IN PRODUCT PRODUCTION

9 Hrs.

Biotechnology in multidisciplinary undertaking: entrepreneurship, economic, legal and ethical considerations in the development and scale up production of a product.

UNIT 3 VIRTUAL BIOTECH COMPANY

9 Hrs.

Creation of a virtual biotech company based on the societal needs: data collection, incubation of idea, design of business plan, funding, regulatory authority interactions, partnerships, collaborators – (Industrial visits and interactions).

UNIT 4 SCIENTIFIC COMMUNICATIONS

9 Hrs.

Communicating science: documentation, strategies to effectively communicate the scientific data to the non scientific stakeholders, plagiarism, online communication, verbal communications skills through (seminars)

UNIT 5 INTELLECTUAL PROPERTY RIGHTS

9 Hrs.

Intellectual property rights: patents, copy rights, trade marks, infringements. Guidelines involved in patent process in India.

Max.45 Hrs

COURSE OUTCOMES

On completion of course, student will able to

- CO1 - Comprehend the diverse application of biotechnological process
- CO2 - Create awareness on the global scenario on various aspects in technology transfer
- CO3 - Design of a model biotech company for sustained development
- CO4 - Address the conceptual ideas to the diverse stakeholders
- CO5 - Protection of the intellectual property
- CO6 - Understand the steps involved in the conversion to licensing

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11.	S81BLH12	Enzyme and Protein engineering	42
12.	SBTB5101	Bioprocess Engineering	43
13.	SBTB5102	Research Methodology and IPR	44
14.	S81BLH21	Advanced Plant and Animal Biotechnology	45

S81BLH11	BIOCHEMISTRY AND METABOLIC ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

- By the end of the course, students should be able to
- Develop a strong foundation in biochemistry, cellular metabolism, and metabolic engineering principles.
- Critically analyze and apply their knowledge to real-world problems in the field of biochemistry and metabolic engineering.

UNIT 1 INTRODUCTION TO BIOCHEMISTRY

9 Hrs.

Overview of biochemistry and its importance in understanding cellular processes. Biomolecules: structure, function, and properties of carbohydrates, lipids, proteins, and nucleic acids. Enzymes: classification, kinetics, and regulation. Metabolism: an introduction to metabolic pathways, catabolism, and anabolism. Lab exercise: Estimation of protein (Lowry method), Estimation of DNA.

UNIT 2 CELLULAR METABOLISM

9 Hrs.

Energy metabolism: ATP and its role as a universal energy currency. Glycolysis: pathway, regulation, and energy yield. Citric Acid Cycle (Krebs cycle): steps, regulation, and energy production. Oxidative phosphorylation: electron transport chain, ATP synthesis, and respiratory control. Photosynthesis: light reactions and carbon fixation. Lab exercise: Enzyme kinetics studies.

UNIT 3 METABOLIC PATHWAYS AND REGULATION

9 Hrs.

Metabolic interconversions: gluconeogenesis, glycogen metabolism, and fatty acid metabolism. Amino acid metabolism: biosynthesis and degradation pathways. Nucleotide metabolism: synthesis and salvage pathways. Metabolic regulation: allosteric control, hormonal regulation, and signal transduction pathways. Lab exercise: Kinetic model development in COPASI

UNIT 4 METABOLIC ENGINEERING PRINCIPLES

9 Hrs.

Introduction to metabolic engineering: goals, strategies, and applications. Rational strain design: optimization of metabolic pathways for improved production of desired compounds. Synthetic biology tools: genetic manipulation techniques and pathway engineering. Metabolic flux analysis: understanding and manipulating metabolic fluxes in engineered organisms. Case studies: examples of successful metabolic engineering projects. Lab exercise: Chemostat cultivation for carrying out metabolic flux analysis

UNIT 5 EMERGING TOPICS IN BIOCHEMISTRY AND METABOLIC ENGINEERING 9 Hrs.

Systems biology: integration of computational modeling and experimental data for understanding complex biological systems. Metabolomics: techniques for studying small molecule metabolites and their role in cellular processes. Bioinformatics: computational approaches for analyzing and interpreting large-scale biological data. Bioprocessing and bioreactor design: scale-up strategies for industrial production of biofuels, pharmaceuticals, and other compounds. Ethical and societal considerations in biochemistry and metabolic engineering. Lab exercise: Bioconductor package for metabolomics.

COURSE OUTCOMES

On completion of the course, the students should be able to

CO1 - Understand the fundamental principles of biochemistry, including the structure, function, and properties of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.

CO2 - Explain the key metabolic pathways involved in cellular metabolism, including glycolysis, the citric acid cycle, oxidative phosphorylation, and photosynthesis, and understand their regulation and energy production.

CO3 - Analyze and interpret the interconversions of metabolites in various metabolic pathways, including gluconeogenesis, glycogen metabolism, fatty acid metabolism, amino acid metabolism, and nucleotide metabolism.

CO4 - Apply the concepts of metabolic regulation to understand how enzymatic activity is controlled through allosteric control, hormonal regulation, and signal transduction pathways.

CO5 - Apply the principles of metabolic engineering to design and optimize metabolic pathways for the production of desired compounds, using rational strain design and synthetic biology tools.

CO6 - Discuss emerging topics in biochemistry and metabolic engineering, such as systems biology, metabolomics, bioinformatics, bioprocessing, and bioreactor design, and understand their applications and implications in the field.

S81BLH12	ENZYME AND PROTEIN ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

To give an insight into the essential concepts of engineering proteins and enzymes and apply them for future research and solve problems in various fields.

UNIT 1 PROTEIN ARCHITECTURE AND CHARACTERIZATION

9 Hrs.

Hierarchical representation of proteins, structural classification of proteins, protein folding and protein stability. Peptide sequencing - Sanger and Edman methods. Characterization of Protein structure: Crystallography and X-Ray Diffraction, Spectroscopy (UV-VIS, NMR and Fluorescence Spectroscopy). **Lab Exercise:** Separation and Identification of amino acids by circular paper chromatography, Molecular weight determination of proteins

UNIT 2 ENZYMES

9 Hrs.

Enzyme nomenclature, classification of enzymes, Specificity, Turn over number, Enzyme units (IU and Katal), Active site, Fischer's Lock and key model, Koshland's Induced fit hypothesis, Activation energy, Factors affecting enzyme activity, Mechanisms of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis, Role of co-enzymes and co-factors **Lab Exercise:** Enzyme assay, Effect of pH on Enzyme activity, Effect of temperature on Enzyme activity

UNIT 3 ENZYME KINETICS

9 Hrs.

Michaelis Menten equation, Lineweaver, Burk plot, Eadie Hofstee, Hanes Woolf Plots - Km and Vmax, Bi-substrate reactions, Enzyme Inhibition - Irreversible, Reversible-Competitive, Uncompetitive and Non-Competitive inhibition **Lab Exercise:** Determination of Km using MM Plot, Determination of Km using LB Plot

UNIT 4 ENZYME PURIFICATION AND APPLICATIONS

9 Hrs.

Production and purification of crude enzyme extracts from plant, animal and microbial sources; Specific activity. Techniques for Immobilization of enzymes and Overview of applications of immobilized enzyme system. Abzymes and their applications. Enzyme electrodes, biosensors and their applications in industry, healthcare and environment, ELISA, EMIT **Lab Exercise:** Salting in, Salting out, Dialysis, Determination of specific activity of enzyme

UNIT 5 PROTEIN ENGINEERING AND COMPUTATIONAL STUDIES

9 Hrs.

Overview of protein engineering strategies: Random and site-directed mutagenesis, Various PCR based strategies. Antibody engineering, Industrial, Environmental and Biomedical applications. Protein databases. Sequence Analysis, Structure prediction. **Lab Exercise:** Retrieval of protein sequence from database, Pair-wise sequence alignment, Multiple sequence alignment

COURSE OUTCOMES

On completion of the course, student will be able to:

- CO1** - Compare the levels of protein structure relating this information to the function of proteins
- CO2** - Analyze the mechanism of action of various enzymes
- CO3** - Elucidate the importance of Km and Vmax in enzyme kinetics and inhibition
- CO4** - Interpret the vital role of enzymes in industry and medicine
- CO5** - Apply appropriate computational databases and tools to predict the sequence and structure of proteins
- CO6** - Appraise different protein design strategies used to design completely new proteins tailored to specific tasks

SBTB5101	BIOPROCESS ENGINEERING	L	T	P	EL	Credits	Total marks
		3	0	0	0	3	100

COURSE OBJECTIVES:

To understand the fundamental principles of bioprocess engineering to gain the knowledge in downstream processing.

UNIT 1 PRINCIPLE OF BIOPROCESS 9 Hrs.

Rate law, zero and first-order kinetics, Ideal reactors– batch, mixed flow, and plug flow, Enzyme immobilization, diffusion effects – Thiele modulus, effectiveness factor, Dam Koehler number, Kinetics of Batch and continuous microbial growth.

UNIT 2 DESIGN OF MEDIA AND STERILIZATION 9 Hrs.

Design of media- Plackett burman and Response Surface model, Types of media: microbial culture medium, plant and animal cell culture medium. Media sterilization; kinetics of thermal death of cells & spores, design of batch and continuous thermal sterilization, sterilization of air and filter design, Radiation and chemical sterilization.

UNIT 3 DESIGN OF BIOREACTORS 9 Hrs.

Batch, fed-batch and continuous processes: Operation of batch, continuous and fed-batch processes and industrial applications, Comparison of batch, fed-batch and continuous processes, Multiple CSTR series.

UNIT 4 MASS TRANSFER 9 Hrs.

Rheology of fermentation fluids: Newtonian and non-Newtonian fluids, Aeration and agitation, power requirement for gassed and un-gassed systems, time calculation for mixing. Mass transfer in bioreactors: Oxygen transport from the bubble to the cell. Measurement of k_La , Factors influencing mass transfer.

UNIT 5 DOWNSTREAM PROCESSING 9 Hrs.

Downstream Process steps, salting out, Ultrafiltration principle and applications, dialysis and its applications, Chromatography: TLC, HPLC, Gel Permeation, Ion Exchange chromatography, Crystallization, Lyophilization and Drying.

COURSE OUTCOMES

On completion of course, student will be able to

- C01** - Understand the principle of bioprocess technology.
- C02** - Design of fermentation media for desired product.
- C03** - Interpret filtration and heat sterilization.
- C04** - Evaluate microbial growth kinetics by Monod model.
- C05** - Determine the mass transfer coefficient by dynamic gassing out method.
- C06** - Compare the working principle of Ion and Gel Permeation chromatography.

SBTB5102	RESEARCH METHODOLOGY AND IPR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on formulation of research problem, research methodology, and ethics involved in doing research and importance of IPR protection.

UNIT 1 RESEARCH METHODOLOGY 9 Hrs.

Meaning of research problem, Sources of research problem. Criteria characteristics of a good research problem. Errors in selecting a research problem. Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism. Research ethics.

UNIT 2 RESULTS AND ANALYSIS 9 Hrs.

Importance and scientific methodology in recording results. Importance of negative results. Different ways of recording, industrial requirement, artifacts versus true results. Types of analysis (analytical, objective, and subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT 3 TECHNICAL WRITING 9 Hrs.

Effective technical writing, how to write a manuscript/responses to reviewers comments, preparation of research article/research report, writing a research proposal, presentation and assessment by a review committee.

Unit 4 INTELLECTUAL PROPERTY RIGHTS 9 Hrs.

The concept of Intellectual property rights, Evolution and development of concept of IPR. Patents, Designs, Trade Mark, Copyright, Trade secrets, utility models, IPR and Bio diversity. Role of WIPO and WTO in IPR establishments. Functions of UNESCO in IPR maintenance. Protection of GMO's IP as a factor in R&D, IP's of relevance to biotechnology.

UNIT 5 PATENTS 9 Hrs.

Origin of the patent regime. Early patents act & Indian pharmaceutical industry. Types of patents, Patent Requirements, objectives and benefits. Concept, features of patent, Inventive step, Specification, Patentable subject matter. Application preparation, filing and process, E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

COURSE OUTCOMES

On completion of the course, student will be able to

- C01** - Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- C02** - Understand research problem formulation & Analyze research related information and Follow research ethics
- C03** - Correlate the results of any research article with other published results. Write a review article in the field of engineering.
- C04** - Appreciate the importance of IPR and protect their intellectual property.
- C05** - Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D,
- C06** - Create the new and better products, and in turn brings about, economic growth and social benefits

S81BLH21	ADVANCED PLANT AND ANIMAL BIOTECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVES: This course will provide students with the recent knowledge of genetic engineering. At the end of the course, a successful student will be able to

- Understand and explain the concept of Plant & Animal Tissue culture techniques, applications and limitations.
- Apply learned knowledge to their future research.

UNIT 1 MOLECULAR BIOLOGY OF AGROBACTERIUM MEDIATED DNA TRANSFER 9 Hrs.

Ti plasmid Vectors- Binary and co-integrated vectors- Transformation strategies in plants – Agrobacterium tumefaciens & Agrobacterium rhizogenes. Plant viruses as vectors. Physical method of transfer-Biolistics –Electroporation. Transposons in transgenic plants – their uses – Terminator gene technology, RNAi, Metabolic Engineering – Modification of plant Nutritional content – Amino acids and lipids as Bioreactor- polymers and foreign proteins in seeds. **Lab Exercises:** Plant tissue culture media preparation, Micropropagation, Agrobacterium mediated Transgenesis Isolation of genomic DNA from plant source, Isolation of plasmid DNA, Estimation of DNA by spectrophotometry, Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, Detection of DNA in Polyacrylamide Gels by Staining.

UNIT 2 SELECTABLE MARKERS, REPORTER GENES 9 Hrs.

Promoters used in Plant vectors genetic engineering for - heat, drought and saline tolerance (Osmogenes) - Virus resistance. - Pest resistance - Herbicide resistance - Herbicide tolerance - Delayed fruit ripening - Fungal and bacterial resistance - Secondary metabolite production-Production of therapeutic proteins- antibodies- vaccines edible Vaccines hormones- Golden Rice- Biolistic in transgenic plants. Marker free transgenic plants. Cotransformation-Transgenic silencing. Molecular aspects of nitrogen fixation. **Lab exercise:** Direct organogenesis, Indirect organogenesis, Anther culture Embryo culture

UNIT 3 CHLOROPLAST GENETIC ENGINEERING CHLOROPLAST GENOME 9 Hrs.

Transplastomic plants – Mitochondrial genome- Legal protection and IPR- patent Co-operation Theory (PCT) - Indian and International Agencies involving in IPR and Patenting – IPR in India- WTO agreement. **Lab exercise:** Somatic embryogenesis, Synthetic seeds Protoplast culture Heat shock /UV stimulations and analyse the gene response studies using PCR Techniques

UNIT 4 HISTORY SCOPE AND PROSPECT OF ANIMAL CELL CULTURE 9 Hrs.

History of animal cell culture and development, Development of primary culture, Development of cell line by enzymatic disaggregation, Culture media and growth conditions. Cell type and characterization, origin of animal cell line, maintenance and characterization of different cell lines, Marker gene characterization. Growth and scale up: Cell growth characteristics and kinetics, Micro-carrier attached growth, Cell culture in continuous, perfusion and hollow fiber reactor, Mass transfer in mammalian cell culture. Technology – Present and future: Hybridoma technology/Monoclonal antibody technology, Vaccine production, Organ culture, Transfection of animal cells, Future tissue engineering. **Lab exercise:** Preparation of glasswares, cell culture medias, Additives and Reagents- Preparative Calculations, Preparation of Primary cell culture/Cancer cells, Estimation of viability by Dye exclusion studies. Subculturing of adherent and Suspension cells, Preservation and Revival of cell lines

UNIT 5 TRANSGENIC AND KNOCK OUT ANIMALS 9 Hrs.

Methodology, Embryonic Stem Cell method, Microinjection method, Retroviral vector method, Applications of transgenic animals Gene Therapy: Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpes simplex virus vector system, Non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents. 6. In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involved in IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA. Stem cells: Classification and types, Sources, Markers, Differentiation signals, application, iPSC **Lab exercise:** Electroporation-Mediated Genome Editing of zebrafish embryos, Production of transgenic animals, MTT Based Cytotoxicity assay, Gene Expression techniques using qRT-PCR techniques.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Understand the concepts and Molecular techniques of plant tissue culture
- CO2** - Understand the basic methods of mapping and cloning plant genes.
- CO3** - Generate the ability to create genetically modified plants by means of plant breeding and genetic engineering with improved quality traits.
- CO4** - Learn about animal cell culture technique in laboratory & large scale.
- CO5** - Learn about various techniques in animal biotechnology.
- CO6** - Learn about IVF & Stem cells techniques and its importance

SBTA5301	NANOTECHNOLOGY AND NANOBIO TECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Basic structure, function and application of diverse nanomaterials.

UNIT 1 INTRODUCTION TO NANOTECHNOLOGY**9 Hrs.**

History, development and generations of nanotechnology, MEMS and NEMS, Application of nanoscience & nanotechnology. Properties of nanomaterials, **characterization methods-Diverse nanomaterials, CNTs, fullerenes, quantum dots.**

UNIT 2 FABRICATION METHODS**9 Hrs.**

Top down and bottom up methods, self assembly, lithography methods. Principle, working mechanism, instrumentation and application of diverse lithography methods. **Synthesis of nanomaterials-physical, chemical & biological methods**

UNIT 3 NANOPARTICLES**9 Hrs.**

Overview of nano structures in protein and nucleic acids – cellular nano- structures – cell –surface layers- bio molecular motors- Actin fibers-Microbial nano particles – bacterial nano magnetosomes-bacterial cell –surface layer (S-layer), Bacteriorhodopsin Biological nanopores and nanocontainer – protein nanopores- liposome nano- containers, biopolymer nano containers – Nano capsules- application in Drug and gene target delivery.

UNIT 4 NANOMATERIALS**9 Hrs.**

DNA – protein conjugative nano structures – oligonucleotide- enzyme conjugates, non covalent DNA – streptavidine conjugates, DNA- gold nano conjugates- Introduction to bioelectronics and biosensing devices-nano circuitry.

UNIT 5 APPLICATIONS AND TOXICITY OF NANOMATERIALS**9 Hrs.**

Nano analytics- Nano Lab- on- Chip devices – Micro contact printing- DNA array – Nano molecular labels- Quantum Dots, protein labels, Molecular Beacons-Nanotoxicity, environmental and biological toxicity assessments.

Max.45 Hrs**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1 - Understand basic principles of nano and micro system.
- CO2 - Study the routes for the nanomaterial synthesis.
- CO3 - Explore the nanotechnology principles in nanodevices design and applications.
- CO4 - Familiar with the specific interactions of biological molecules in nano devices development.
- CO5 - Determine the toxicity assessment and application of nanotechnology.
- CO6 - Establish nanopinciples for the welfare of society

SBTA5302	PLANT AND ANIMAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To give an understanding on the application of biotechnology in Agriculture.
- To familiarize the students with the concepts in plant and animal tissue culture and their transformation techniques.

UNIT 1 PLANT GENOMES AND PLANT TISSUE CULTURE**9 Hrs.**

Definition, Structure and organization of plant genome, Chloroplast and Mitochondrial genome, Totipotency, Plasticity and cytodifferentiation, Culture environment, Plant Tissue culture media and its components, Methods of sterilization, Different types of cultures -Shoot, callus, cell suspension and protoplast cultures, Factors affecting in vitro culture, Organogenesis, Micropropagation (Clonal Propagation), Somatic embryogenesis and synthetic seeds.

UNIT 2 TISSUE CULTURE TECHNIQUES**9 Hrs.**

embryo rescue techniques and importance of embryo culture, In vitro pollination and fertilization, Production of haploid plant through Androgenesis and Gynogenesis, Protoplast isolation and culture techniques, somatic hybridization and production of somatic hybrids and cybrids, Selection systems for somatic hybrids / cybrids and their characterization, Cause and use of somoclonal variations, In vitro production of secondary metabolites cell suspension, root and hairy root cultures, Importance of germplasm conservation and methods.

UNIT 3 PLANT TRANSFORMATION TECHNIQUES AND PRODUCTION OF TRANSGENIC PLANTS**9 Hrs.**

Genetic Transformation methods for production of transgenic plants (Direct, Indirect) with special emphasis on chloroplast transformation, protoplast transformation methods and normal methods using particle bombardment. Methodologies adopted in the following transgenic plants- increased shelf life of fruits (Flavr savr tomatos), increased biomass production (nif gene transfer) nutritional enhancements (Vitamins, proteins), Production of genetically modified plants for herbicide resistance (round up crops), pest resistance (Bt and other resistance gene candidates), stress tolerance (salt and draught), and horticultural quality (Designer flowers), Molecular farming for therapeutic protein (Plantibodies, Plantigens, Edible Vaccines), Protection of intellectual property(Seed terminator technology). Application of nanotechnology in agriculture.

UNIT 4 INTRODUCTION TO CELL LINES**9 Hrs.**

Celllines and their Types, Primary and secondary cell culture, Transformation, Immortalization, Maintenance of cell lines, Characterization of cell line: Media preparation and preservation, Measurement of cell growth: Direct observation, Enzyme assays and nucleic acid assays, Histological studies: Slide preparation, Nuclear and cytoplasmic staining.

UNIT 5 APPLICATION AND SAFETY REGULATIONS**9 Hrs.**

Stem cell culture and its types, Embryogenic stem cells and their application, Cryopreservation of gametes and embryos (Animal and Human), invitro fertilization, and embryo transfer. Microinsemination-PZD, ICSI, SUZI, MESA. Transgenic animal: methods of gene delivery-Application of transgenic animals, Safety regulation for transgenic animals, Current issues related to transgenic animals.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand basic techniques in plant and animal tissue culture.
- CO2 - Apply modern techniques in plant tissue culture.
- CO3 - Explain the structure and organization of plant genome.
- CO4 - Identify suitable genetic transformation techniques for plants, animals and their applications.
- CO5 - Analyze the impact of transgenic plants.

SBTA7009	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To provide an awareness on different types of pollution and provide insight into advanced techniques available for treatment.
- To enable students to gain knowledge about alternate sources of energy.

UNIT 1 ENVIRONMENTAL POLLUTION**9 Hrs.**

Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Major sources; Impacts of Environmental Pollution at local regional and global level Concept of Pollution; (Air pollution, Water Pollution, Soil Pollution), Major pollutants and their sources, , episodes and disasters; Effects of air pollution on human health, animals, plants, material and climate;

UNIT 2 MICROBES AND ENVIRONMENT**9 Hrs.**

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication; Quorum sensing system; Quorum sensing

UNIT 3 POLLUTION CONTROL TECHNOLOGIES**9 Hrs.**

Control of Air pollution: Biofilters and Bioscrubbers for treatment of industrial waste, Water pollution: Aerobic digestion, Anaerobic digestion, Denitrification, Anoxic digestion, the activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, Design of a trickling biological filter, Design of anaerobic digester, industrial waste management, e-waste radioactive and nuclear power waste management- Solid waste management.

UNIT 4 BIOREMEDIATION**9 Hrs.**

Bioremediation; In situ and Ex situ bioremediation; Constrains and priorities of bioremediation; Evaluating Bioremediation. Biodegradation: Microbiology of degradation and its mechanism, Factors affecting process of biodegradation; Bioaugmentation, Biosorption, Bioleaching, Metabolic pathways for Biodegradation for specific organic pollutants. Xenobiotics: Persistence and biomagnification of xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cyt P 450 mediated reactions; Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation.

UNIT 5 BIOENERGY**9 Hrs.**

Alternate Source of Energy-Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen, Bioelectricity through microbial fuel cell, energy management and safety.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Introduces pollution and its effects.
- CO2 - Provides information about the role of microorganisms in the environment.
- CO3 - Exposes the students to various pollution control technologies available.
- CO4 - Explains Bioremediation and biodegradation in detail.
- CO5 - Elucidates biodegradation process and mechanism.
- CO6 - Discusses different alternate source of energy.

SBTA7013	FOOD AND NUTRACEUTICALS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVE

- To explore the bio sources for extraction of nutraceutical.

UNIT I INTRODUCTION TO NUTRACEUTICAL**9 Hrs.**

Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, functional foods and Phyto nutraceuticals. Scope involved in the industry, Indian and global scenario

UNIT II NUTRACEUTICALS OF PLANT AND ANIMAL ORIGIN**9 Hrs.**

Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Extraction and purification, applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmeceuticals and aquaceuticals. Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment.

UNIT III MICROBIAL AND ALGAL NUTRACEUTICALS**9 Hrs.**

Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources. Symbiotic for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

UNIT IV BIOTECHNOLOGY IN PHYTO NUTRACEUTICALS**9 Hrs.**

Role of medicinal and aromatic plants in nutraceutical industry – propagation - conventional and tissue culture, cultivation, post harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement, plant genomics and metabolomics. Biofortification and nutritional enhancement. GM foods with enhanced nutraceutical properties. Golden rice, GM Tomatoes.

UNIT V PRODUCT DEVELOPMENT AND CLINICAL TRIALS**9 Hrs.**

Activity screening, formulations of energy drinks, bars, sports drinks, fortified products, geriatric products, veterinary products, immune boosters, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials. Basic Principles of toxicology – oral toxicity, sub-acute, acute toxicity and chronic toxicity. Toxic dose, toxic-kinetics, LD50, dose-response relationships, local v/s systemic toxicity, antagonism and synergism.

Max. 45 Hrs**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Classify the nutraceutical components.
- CO2 - Explore the plant and animal source for nutraceutical compound.
- CO3 - Investigate the microbial and algal source for nutrient value compound.
- CO4 - Role of biotechnology in production of nutraceutical compound.
- CO5 - Summarize the nutraceutical development process and clinical trials.
- CO6 - Construct the biotechnology process for the production of nutraceutical compound from bio-origin.

B.Sc. Biotechnology			
1.	SB BB1102	Cell And Molecular Biology	51
2.	SB BB1201	Molecular Genetics	52
3.	SB BA1301	Genetic Engineering	53
4.	SB BB1302	Immunology	54
5.	SB BA1302	Introduction to Molecular Biology & Genetics	55
6.	SB BA1303	Concepts in Biotechnology	56
7.	SB BA1304	Analytical techniques	57
8.	SB BA1401	Environmental and Agricultural biotechnology	58
9.	SB BA1402	Basic Industrial Biotechnology	59
10.	SB BA1403	Food Biotechnology	60
11.	SB BA1404	Enzyme Technology	61
12.	SB BA4001	Bioethics, Biosafety and IPR	62
Skill Development			
1.	SB BA1301	Genetic Engineering	53
2.	SH SB1102	General English-I	63
3.	SH S1210	General English-II	64

SBBB1102	CELL AND MOLECULAR BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES

➤ To provide in-depth knowledge of cell structure, components and nucleic acids as genetic material and the central dogma of a cell

UNIT 1 FUNDAMENTALS OF CELL STRUCTURE**9 Hrs.**

Discovery of cells; Basic properties of cells; Different classes of cells Prokaryotic and eukaryotic cells. Cell division: Cell cycle; mitosis; meiosis, binary fission. Chemical composition and fluidity of membranes; dynamic nature of membranes; transportation across cell membrane; membrane potentials; extracellular matrices structure and function; cytoskeleton structure and function.

UNIT 2 CELLULAR ORGANELLES IN METABOLISM**9 Hrs.**

Mitochondria structure and function; Chloroplast structure and function. Structure of nucleus nuclear membrane, nucleolus, chromatin, structure of nucleic acids. Endoplasmic reticulum smooth & rough; function of endoplasmic reticulum; Golgi complex structure and function; Ribosomes Types, structure and function; Morphology and functions of peroxisomes and glyoxisomes; Plant cell vacuoles..

UNIT 3 TRANSPORT ACROSS CELL MEMBRANE**9 Hrs.**

Passive and active transports, Permeases, Sodium -potassium pumps, Ca²⁺ ATPase pump, ATP dependant proton pumps, co-transport, symport, antiport, Endocytosis and Exocytosis. Introduction to intra and extra cellular products of medicinal use.

UNIT 3 TRANSPORT ACROSS CELL MEMBRANE**9 Hrs.**

Passive and active transports, Permeases, Sodium -potassium pumps, Ca²⁺ ATPase pump, ATP dependant proton pumps, co-transport, symport, antiport, Endocytosis and Exocytosis. Introduction to intra and extra cellular products of medicinal use.

UNIT 4 NUCLEIC ACID AS GENETIC MATERIAL**9 Hrs.**

Introduction and History of Microbial Genetics. DNA as a Genetic material. Physical structure and Chemical composition of DNA RNA and its types RNA as a Genetic material. DNA Replication Types and Experimental proof of replication – Enzymes involved in DNA replication

UNIT 5 CENTRAL DOGMA**9 Hrs.**

Prokaryotic Transcription, Translation. Genetic code Regulation of gene expression in prokaryotes lac Operon. Gene transfer mechanisms Transformation, conjugation and Transduction. Plasmid Characteristics and types.

COURSE OUTCOMES:

C01: Learn the structure and functions of cells, nucleic acids as genetic material.

C02: Understand the cell cycle process, Basic of DNA replication in prokaryotes and eukaryotes

C03: Familiarize the cellular components and gene organization and mechanisms of control the gene expression in various organisms.

C04: Understand the role of cellular components in metabolism

C05: Understand the various processes and the importance of biological macromolecules

C06- Demonstrate the importance of cellular components and molecular aspects of biology

SBBB1201	MOLECULAR GENETICS	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES-

The course aims to give an understanding on the fundamentals of molecular genetics and thereby a deep understanding about regulation of gene expression

UNIT1 GENE EXPRESSION**9 Hrs**

Genetic code: Brief account, Protein Synthesis in prokaryotes and eukaryotes .Transcription, Rho dependent and Rho Independent termination), Post Transcriptional modifications, Translation, Regulation of Gene expression:- Inducible operons – Galactose, Repressible operon – Tryptophan

UNIT2 GENOME ORGANISATION AND FINE STRUCTURE OF THE GENE 9 Hrs.

Prokaryotic genome:- Chromosomal and plasmid, Eukaryotic genome:- Chromosomal and organellar , Fine structure of the Gene: Cistron, muton and recon, Bacterial Genetics Properties and evolution of genetic material, flow of genetic information,.Organization of viral,bacterial genomes and Eukaryotic genome , Mutation: Types and detection:

UNIT-3 REPLICATION**9 Hrs.**

:Prokaryotic and Eukaryotic DNA polymerases, Replicons, origin and termination, Replisome, Genes controlling replication,

UNIT4 TRANSCRIPTION AND TRANSLATION**9 Hrs.**

Prokaryotic RNA polymerase, sigma factors, initiation and termination, Eukaryotic RNA polymerases and their promoters, Processing of transcripts. Translation:General mechanism, Role of rRNA in translation

UNIT5 REGULATION OF GENE EXPRESSION**9 Hrs.**

Regulation of gene expression, Regulation of transcription, Operon and regulon , Positive and negative regulation, Enhancers and promoters, Transcription factors: types, DNA binding motifs , Regulation by attenuation and anti-termination, Post transcriptional regulation, Alternative splicing, Transport and targeting of RNA, Post- transcriptional gene silencing ,Translational control and targeting of proteins, Mechanism of steroid hormone and stress induced gene expressions

Course outcomes

On completion of the course, student will be able to

C01- introduce the concept of genetics

C02 -understand the structural organization of gene in prokaryotes and eukaryotes

C03- explore the rearrangements and anomalies in genetic material

C04 -describe the mutations and repair

C05 -study the regulation of gene expression

C06 –understand the control at transcription and translation level

SBBA1301	GENETIC ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- The course aims to give an understanding on the fundamentals of r-DNA technology and thereby a deep understanding about deliberate manipulation of genetic material for the benefit of mankind.
- It also aims to understand the possible dangers in doing the same without much of fore thoughts.

UNIT1 rDNATECHNOLOGY AND TOOLS INVOLVED IN GENETIC MANIPULATIONS 9 Hrs.

Introduction to rDNA technology- pros and cons of genetic engineering. Restriction modification system, Restriction enzymes function, classification (Based on recognition and restriction sequence:-type I, II and III; based on buffer salt concentration: - low, medium and high; based on pattern of restriction:-sticky (5' and 3') and blunt end cutters). Other DNA modifying enzymes and its functions/uses in r-DNA technology (DNA Polymerases, Klenow fragment, Ligase, S1 Nuclease, Mung Bean nuclease, Alkaline Phosphatase, Terminal Transferase, Polynucleotide kinases, alkaline Phosphatases (CIP, SAP and TAP), RNase A, RNase H, DNase 1, Exonucleases, Reverse Transcriptase)

UNIT2 BIOLOGY OF CLONING VECTORS

9 Hrs

Ideal features of vectors; Plasmids (Types, copy number, properties, origin of replication and incompatibility group, plasmid amplification), bacteriophages eg λ (Life cycle, genome organization, feasibility as a cloning vehicle), Types of Cloning Vectors (structure and general features of General Purpose cloning vectors, shuttle vectors), Examples of cloning vectors (pBR322, pUC series of vectors, λ insertional and replacement vectors), derivatives of phages and plasmids (cosmids, phagemids, phasmids) cloning vectors for large DNA fragments using YACs, PACs and BACs.

Unit-3 INTRODUCTION TO r-DNATECHNOLOGY

9 Hrs

General strategies for isolation of genomic and plasmid DNA; Strategies for isolation of gene of interest (restriction digestion, PCR), Creation of r-DNA (Restriction Digestion, modification of vector and insert, linker, adaptors, homopolymer tailing, ligation, PCR Cloning, Selectable and screenable markers, reporter genes)

UNIT4 GENE TRANSFER TECHNIQUES

9 Hrs

Selection of host and vector, Host Organisms and its genotypes- Prokaryotic and eukaryotic systems, Methods of gene transfer- Physical (micro injection, gene gun/biolistic, electroporation), Chemical (Calcium chloride, Calcium phosphate precipitation method, liposome mediated) and Biological methods (*Agrobacterium* and viral).

UNIT5 IDENTIFICATION OF GENETIC TRANSFORMANTS AND THEIR APPLICATIONS

9 Hrs

Methods for clone identification-direct screening (insertional inactivation of marker gene, visual screening methods), indirect screening (PCR and hybridization- based techniques-colony PCR/ hybridization and dot blot hybridization), hybridization techniques - Southern blotting, Northern blotting, Western blotting. Examples of Transgenic plants and animals, current status of commercial r-dna products, Bio-safety measures and regulations for rDNA work

Course outcomes

On completion of the course, student will be able to

- CO1- introduce the concept of tools used in genetics
- CO2 -understand the structural organization of vectors; plasmids
- CO3- explore the rearrangements and anomalies in genetic material
- CO4 -describe the mutations and repair
- CO5 -study the genetic gene transfer techniques
- CO6 –understand the genetic transformation techniques

SBBB1302	IMMUNOLOGY	L	T	P	EL	Credits	Total Marks
		3	1	0	2	3	100

COURSE OBJECTIVES

- To know the fundamentals of Immunity and understand how immune system fights and combats the infection and diseases

UNIT 1 IMMUNITY**9 Hrs.**

History of Immunology – Host-parasite relationship – Immunity – Innate and acquired Immunity – Humoral and Cell mediated Immunity

UNIT 2 CELLS AND ORGANS OF THE IMMUNE SYSTEM**9 Hrs.**

Structure, Functions and Properties of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone marrow, Bursa of Fabricius, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

UNIT 3 ANTIGENS & ANTIBODIES**9 Hrs.**

Antigens – Types, properties, Immunoglobulins – Structure, types and functions, Monoclonal Antibodies, Complement pathways - Classical and alternative

UNIT 4 ANTIGEN – ANTIBODY REACTIONS**9 Hrs.**

Agglutination, Precipitation, Complement fixation, Immunofluorescence – ELISA, RIA

UNIT 5 AUTOIMMUNITY, HYPERSENSITIVITY AND TRANSPLANTATION**9 Hrs.**

Autoimmunity, Hypersensitivity, Immunohaematology, Transplantation immunology, Tumor immunology

Course Outcomes

On completion of the course, the student will be able to

C01 -Understand the principles and mechanism of immunity

C02-Discuss the immune cells and organs alongside their structure and functions

C03-Distinguish antigens and antibodies, their basic structure and functions

C04-Summarize the various clinically important antigen antibody reactions

C05-Discuss the various medically important immunological disorders

C06-Discuss on the role of immune system in tumor biology

SBBA1302	INTRODUCTION TO MOLECULAR BIOLOGY & GENETICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- This course provides you with further knowledge associated with molecular biology and inheritance at the molecular, cellular and phenotypic levels.

UNIT 1 INTRODUCTION**9 Hrs.**

Introduction and History of Microbial Genetics. DNA as a Genetic material. Physical structure and Chemical composition of DNA – RNA and its types RNA as a Genetic material. DNA Replication – Types and Experimental proof of replication – Enzymes involved in DNA replication

UNIT 2 CENTRAL DOGMA**9 Hrs.**

Prokaryotic Transcription, Translation. Genetic code – Regulation of gene expression in prokaryotes – lac Operon. Gene transfer mechanisms – Transformation, conjugation and Transduction. Plasmid – Characteristics and types.

UNIT 3 MENDELIAN GENETICS**9 Hrs.**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

UNIT 4 INHERITANCE**9 Hrs.**

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex-linked inheritance. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

UNIT 5 MUTATION**9 Hrs.**

Mutation – types of mutation – Molecular basis of mutation – Mutagenesis, Detection of mutants – Ames test, DNA repair mechanisms. Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 - Study the detail of genetic material of our living system-DNA replication, transcription and translation and explain how they relate to each other.

CO2 - Understand the Basic of DNA replication in prokaryotes and eukaryotes.

CO3 - Study the details of gene organization and mechanisms of control the gene expression in various organisms.

CO4 - Understand the applications of molecular biology in the modern world.

CO5 - Through this course the students are exposed to importance of biological macromolecules

CO6 - Understanding the molecular aspects of the biology.

SBBA1303	CONCEPTS IN BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

This course aims at making the students understand the basics of biotechnology and its various fields

UNIT 1 BIOTECHNOLOGY:ANOVERVIEW**9 Hrs.**

What is Biotechnology? – an interdisciplinary pursuit, old Vs new biotechnology, scope and importance, commercial potential, public perception of Biotechnology, Biotechnology in India and Global. Branches of biotechnology.

UNIT 2 ANIMAL & PLANT BIOTECHNOLOGY**9 Hrs.**

Biotechnology methods of crop improvement- plant tissue culture. Transgenic plants, applications of transgenic plants, transgenesis, transgenic animals,

UNIT 3 INDUSTRIAL BIOTECHNOLOGY**9 Hrs.**

Isolation and screening of micro-organisms, Bioreactors, food and beverage fermentation, production of antibiotics (β - lactum antibiotic), vitamin B12, Enzyme- amylase, protease, Biotransformation, SCP and its economical implications.

UNIT 4 MEDICAL BIOTECNOLOGY**9 Hrs.**

Conventional vaccines, recombinant vaccines, DNA vaccines, monoclonal antibodies and their applications, interferons, drug designing, genetherapy, forensic medicine applications in human genetic research.

UNIT 5 ENVIRONMENTAL BIOTECHNOLOGY AND BIOETHICS**9 Hrs.**

Novel and better bioinsecticides. Biofertilizers, Biodegradation of Xenobiotic compounds. Legal aspects genetically manipulated organisms and environment, biosafety, Social, moral and Ethical Considerations, IPR.

COURSE OBJECTIVES**Max. 45 Hours**

On completion of the course, the students will be able to

CO1 - Explain the current scenario about biotechnology

CO2 - Describes the biotechnological methods in crop development and transgenic animal production

CO3 - Highlighting the application of industrial biotechnology

CO4 - Demonstrate the healthcare application of biotechnology

CO5 - Implementation of biotechnology in the protection of environment

CO6 - Discuss the ethical issues of biotechnology

SBBA1304	ANALYTICAL TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding the principle and application of various instruments used in Biotechnology industries.

UNIT1 MICROSCOPY**9 Hrs.**

Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

UNIT 2 LAB EQUIPMENT**9 Hrs.**

Autoclave, Hot air oven, Incubator, Water Bath, Laminar air flow, BOD incubator, Centrifuges – Bench top, High speed, Ultra centrifuge, density gradient centrifugation, pH meter, Conductivity meter, Lyophilizer, McIntosh anaerobic jar, Biosensor, Metabolic shaker.

UNIT 3 CHROMATOGRAPHY AND ELECTROPHORESIS**9 Hrs.**

Principles and applications of Chromatography – Paper, Thin layer, Column, Ion-exchange, Gas and HPLC – Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gelelectrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gelelectrophoresis..

UNIT –IV PHOTOMETRY**9 Hrs.**

Colorimetry, Turbidometry, Spectrometry – UV & Visible spectrophotometer. Flame photometry- Micronutrient analysis.

UNIT BIOCHEMISTRY ANALYSIS**9 Hrs.**

Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality, PPM- Ammonium sulphate precipitation.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1 – Explain in detail about microscopic techniques
- CO2 – Discuss the different analytical instruments used in laboratories
- CO3 – Understand various chromatographic methods
- CO4 – Describe Photometric techniques
- CO5 – Understand various analytic methods in biochemistry
- CO6 – Demonstrate the biochemical calculation used to prepare buffers

SBBA1401	ENVIRONMENTAL AND AGRICULTURAL BIOTECHNOLOGY	L	T	P	Credits	TotalMarks
		3	0	0	3	100

COURSE OBJECTIVE

The primary objective is to exploit biotechnology principles for the sustained environment and agriculture

UNIT1 ENVIRONMENT AND WASTE TREATMENT PROCESS

9 Hrs.

Basic concepts of Environment and ecosystem- Effluents and sewages- Sewage treatment processes- Physical, chemical and biological. Biological processes for domestic and industrial waste water treatments: Aerobic system –activated sludge processes- Trickling filters–biological filters–fluidized bed reactors (FBR)

UNIT2 WASTE MANAGEMENT

9 Hrs.

Anaerobic biological treatment – contact digestion – packed column reactors - Methanogenesis. Methanogenic, acetogenic, and fermentative bacteria – technical process conditions, Solid waste management-Landfills, composting, earthworm treatment, recycling and processing of organic residues. Hazardous wastes: source management and safety.

UNIT3 BIODEGRADATION OF PESTICIDES

9 Hrs.

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution.

UNIT4 MICROBIAL LEACHING AND BIOREMEDIATION

9 Hrs.

Microbial leaching and mining: Extraction of metals from ores; recovery of metals from solutions. Microbial petroleum extraction; Microbial desulfurization of coal wasteland; Uses and management; bioremediation and bio restoration of contaminated lands. -Phytoremediation– bioventing–and bioparging – liquid phase.

UNIT5 BIOFERTILIZERS AND SUSTAINABLE ORGANIC AGRICULTURE

9 Hrs.

Bioinoculant Technology - Bioinoculants- various types- biofertilizer, bio-manures and biopesticides-their importance in sustainable agriculture - organic farming and environmental health Historical development of Bioinoculants technology-Biofertilizers-Bacteria, fungi and algal biofertilizers.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

CO1-Understanding the importance of various waste water treatment process

CO2-Bioprocess of domestic and industrial effluent and its environmental impact towards ecosystem

CO3- Understand the use of microbial species to clean up soil and contaminated groundwater

CO4-Understanding how pesticides are turned into useful products through various bioprocess methods

CO5-How to restore or bring back the contaminated lands to its near original state through diverse microorganisms

CO-6 Understanding how biofertilizers improve the soil nutrients in promoting the plant growth

SBBA1402	BASIC INDUSTRIAL BIOTECHNOLOGY	L	T	P	Credits	TotalMarks
		3	0	0	3	100

COURSE OBJECTIVE

- The importance of microorganism in industries and product its application

UNIT1 INTRODUCTION TO INDUSTRIAL BIOPROCESS

9 Hrs.

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- Abrief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting-block diagrams, pictorial representation.

UNIT2 PRODUCTION OF METABOLITES

9 Hrs.

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT3 DEGRADATION OF POLLUTANTS

9 Hrs.

Microbes role in degradation of pollutants, genetically modified microorganism-super bugs, advantage of biodegradation than the conventional method.

UNIT4 PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

9 Hrs.

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer,SCP&Mushroomculture.

UNIT5 PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS

12Hrs.

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

Max.45 Hours

COURSE OUTCOMES

On completion of the course, the student will be able to

CO1-How microorganism, enzymes and natural sources are used to produce cost effective energy and consumer needs especially life-saving medicines.

CO2-Importance of primary and secondary metabolites that are directly or not directly involved in normal growth of the organism

CO3-How microbial organism transform the substance through various processes

CO4-The industrial importance of biopreservatives, biopolymers, biodiesel and biopesticides.

CO5- Fundamental understanding of protein cloning and over expression in ecoli.

CO6- Exposure to various bioprocess methods and laboratory techniques

SBBA1403	FOOD BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE**UNIT1 MICROORGANISMS IN FOOD****9 Hrs.**

Bacteria, fungi & yeast, role and significance. Enzymes in food preparation. Food carcinogens & mutagen (N-Nitrosamines, Acrylamide & their mode of action).

UNIT2 NUTRITIONAL BOOSTS AND FLAVOR ENHANCERS**9 Hrs.**

Antioxidants. Food colors (natural & artificial food colourants). Food flavoring agents. Properties & function of Emulsifiers & Stabilizers in food. Food Sweeteners-Saccharine, Acesulfame, Aspartame & Sucralose).

UNIT3 FOOD BORNE DISEASES AND CONTROL**9 Hrs.**

Food borne diseases. Food Allergens. Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods.

UNIT4 FERMENTATION**9 Hrs.**

Fermented food: pickles, yogurt, cheese, Beverages: Beer, wine and distilled spirits.

UNIT5 FOOD PRESERVATION**9 Hrs.**

Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Radiation, Radappertization, Radicidation, and Radurization of Foods. Stability Food Preservation with Low Temperatures, Food Preservation with High Temperatures, Preservation of Foods by Drying.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

CO1- Learning cultures to make food from yeast to cheese and probiotics

CO2- Understanding fermentation engineering and fermentations to make food ingredients

CO3- Basic analytical techniques for identifying microorganisms in food

CO4- Fermentations to make enzymes for the food industry

CO5- From the sink to the river, from biowaste to mushrooms and methane

CO6-Advanced research techniques on identifying artificial food colorants, food safety and sampling methods

SBBA1404	ENZYME TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

The primary objective is to provides the theory and knowledge relevant to the enzymology principles including fundamental properties of enzymes, enzyme catalytic mechanisms and enzyme kinetics.

UNIT1 INTRODUCTION TO ENZYMES**9 Hrs.**

Nature and function of enzymes, Enzyme nomenclature, classification of enzymes, mechanisms of catalysis -Acid base catalysis, electrostatic catalysis, covalent catalysis and enzyme catalysis. Role of co-enzymes and co-factors.

UNIT2 ENZYME KINETICS**9 Hrs..**

Michaelis - Menton kinetics, determination of Km, Lineweaver Burke plot, Eadie - Hofstee plot, Hanes-Woolf plot. Turnover number, Enzyme inhibition -Types of enzyme inhibition, competitive inhibition, uncompetitive inhibition, non-competitive inhibition, Irreversible inhibition and inactivation kinetics. Multisubstrate enzyme catalysed reaction.

UNIT3 ENZYME IMMOBILIZATION**9 Hrs.**

Classification of enzyme immobilization, physical and chemical techniques for enzyme immobilization -adsorption, matrix entrapment, encapsulation, cross-linking, covalent bonding, advantages and disadvantages, Application of immobilized enzymes, mass transfer effect on immobilization, properties of immobilized enzymes.

UNIT4 ENZYME SPECIFICITY AND EXTRACTION**9 Hrs.**

Types of specificity, Active site- Fischer hypothesis and Koshland hypothesis, Extraction of soluble enzymes, membrane bound enzymes, purification procedures, criteria of purity.

UNIT5 CLINICAL AND INDUSTRIAL APPLICATIONS OF ENZYMES**9 Hrs.**

Application of enzymes in medicine and industry – Assay of plasma enzyme, enzyme biosensors, design of enzyme electrodes, Synzymes, Abzymes, Enzymes in genetic engineering.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1- understanding the diverse range of reactions to predict the metabolism of living organisms
- CO2- learning enzyme immobilization through various chemical and physical laboratory techniques
- CO3- separation, extraction and purification of soluble membrane bound enzymes
- CO4- industrial applications of enzyme, especially pharmaceuticals
- CO5- expose to various enzyme kinetics methods, its reaction rate and inhibition.
- CO6- basic understanding of nomenclature, mechanism and classification of various enzymes

SBBA4001	BIOETHICS, BIOSAFETY AND IPR	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

To understand importance of bioethics and biosafety and to understand legal social and economic impacts of biotechnology.

To understand regulatory guidelines and their importance. To understand importance of patent and to understand procedure to apply for patent.

To understand procedure of assessment of biosafety for biotech foods and to understand ethical implications of biotechnology.

UNIT 1 ETHICS AND BIOETHICS

9 Hrs.

Definition of ethics and Bioethics, Ethics in Biotechnology (positive and negative effects with classical examples - Rice with Vitamin A, No-till Agriculture, cotton without insecticide, reduced need for fertilizer, biological pest control, slowripening fruits and controlled ripening, fast growing trees and fishes.

UNIT 2 GENETICALLY ENGINEERED ORGANISMS

9 Hrs.

Awareness education on genetically engineered organism - Transgene instability, gene flow, resistance/ tolerance of target organism, increase weedlessness, risks and uncertainty associated with Biotechnology. Containment levels and their impact on Environment- Containment- definition, types of containment, summary of recommended Biosafety levels for infectious agents, detail checklist-premises and lab equipment, Animal facilities, environment.

UNIT 3 GOOD LABORATORY PRACTICES, INTELLECTUAL PROPERTIES AND PATENTS

9 Hrs.

Gene technology laboratory. GLP and Bioethics- introduction, national Good Laboratory Practices (GLP), the GLP authority functions, Good Laboratory Practices- necessity, aspiration and responsibility. Procedure to apply patent, other intellectual properties viz copy rights, Rights, Plant breeder's rights, trade secrets/ trade symbol etc. WTO, TRIPS, PCT and GATT. IPR problems and its hindrance.

UNIT 4 GOOD CLINICAL PRACTICES

9 Hrs.

Ethics in clinical trials and Good Clinical Practices (GCP) - Definition of clinical trials and GCP, general information about clinical trials, need to conduct clinical trials, faces of clinical trials, institutional set ups for conducting clinical trials, ethics in clinical Biotechnology

Max. 45 Hours

Course Outcomes:

On completion of the course, student will be able to

CO1 – Describe various ethical issues

CO2 – Understand the role of ethics in genetic laboratory

CO3 – Recognize different levels of biosafety measures

CO4 – Explain the good laboratory practices to follow in a genetic laboratory

CO5 – Demonstrate various good clinical practices and its role in clinical trials

CO6 – Explore various levels of biosafety measures to follow in a laboratory

SHSB1102	GENERAL ENGLISH I	L	T	P	EL	CREDITS	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues
- To prepare the students to effectively communicate by applying reflective thinking practices
- To provide an opportunity to the students to improve their vocabulary
- To create and apply lateral and critical thinking
- To learn academic writing strategies

UNIT I

9 Hrs.

Listening to identify vocabularies- Self Introduction - Developing dialogue between characters -Talking about neighbours, family members, likes and dislikes, Reading Comprehension strategies- Parts of Speech- Kinds of Sentences Connectives and Discourse markers - Rearranging the Jumbled sentences, E-Mail Writing.

UNIT II

9 Hrs.

Listening for Inference- Just a Minute speech- Types of words- Compound words, abbreviations and acronyms, Word Association- Tenses and its Types- Voice- Impersonal Passive- Rules of Passive voice formation - Transcoding - Encoding and Decoding- Bar chart, Pie Chart

UNIT III

9 Hrs.

Listening to telephonic talk to fill blanks- Giving information- travel, hotel booking, making enquiries about availability of seats for admission, asking about courses - Question Tags – Open ended and Close ended questions, Concord, Single - Line Definition - Note Making - Preparing checklists

UNIT IV

9 Hrs.

Listening to summarise the information- Reading and identifying the topic sentence, - Editing - Punctuation- Error Corrections, Drafting a brochure/Advertisement.

UNIT V

9 Hrs.

Listening to Movie reviews and book reviews, Listening and summarizing- Giving impromptu talks - Reading and Summarizing -Types of words- Homonyms, Homophones, eponyms, acronyms- Writing a Paragraph, Descriptive Essay, Dialogue Writing.

COURSE OUTCOMES

On the completion of the course, the student will be able to

C01 - Remember knowledge of linking words related to both spoken and written discourse

C02 - Understand collocations, words to express one's point of view in both writing and speaking

C03 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given

C04 - Analyse critical thinking skills by framing questions related to elements of reasoning

C05 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation

C06 - Equip the students with the required Professional Skills

SHSB1201	GENERAL ENGLISH- II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES:

- To provide opportunities for students to read and respond to representations of current issues through texts that present themes and topics that are familiar, insightful and informative.
- To provide an opportunity to the students to improve their vocabulary To develop skills relating to creative writing.
- To provide an opportunity to the students to improve their Spoken Language. To comprehend the overall idea of a written and oral context.

UNIT I**9 Hrs.**

Listening for details, Speaking - making a presentation, reading for details and Global Comprehension Vocabulary Binomials, Types of Words- Synonyms, Antonyms that describe people, things and their actions - Paired Expressions -Letter Writing - Informal Letters- Letter to a Friend / Family Members - Creating blogs to post written materials.

UNIT II**9 Hrs.**

Listening for details - Speaking: Giving Interview, Public Speech based on specific topics given. Reading for Comprehension and for overall idea - Vocabulary: phrases - Sentence Pattern – Contextual guessing of words– Singular, Plural– Letter writing- Formal letters- Inviting dignitary for a function, Application for job with resume.

UNIT III**9 Hrs.**

Listening for details - Telephonic conversation – Speaking: Narrating a Story - Vocabulary: positive and negative connotations - Language Focus: Adjective- Degrees of Comparison, Direct and Indirect Speech - Types of Sentences (simple, compound, complex) - Collocations - Letter to the Editor (Social Issues) – Hints Development.

UNIT IV**9 Hrs.**

Listening for Overall information - Making requests and suggestions - Speaking: Group Discussion - Vocabulary: Homonyms and Homophones - Language Focus: Transitive and Intransitive verbs - Writing: Precis writing, Story Writing - Process description (Flow chart)

UNIT V**9 Hrs.**

Listening for specific details - Speaking using imagination. Reading to identify facts - Language focus: Modal Auxiliary Verbs Writing: Imaginative writing by predicting, Argumentative Essay, Writing a Book or Film review. Vocabulary: Countable and Uncountable Nouns, foreign nouns and framing of plurals.

Max. 45 Hrs.**COURSE OUTCOMES:**

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

C01 - Remember knowledge of linking words related to both spoken and written discourse

C02 - Understand collocations, words to express one's point of view in both writing and speaking

C03 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given

C04 - Analyse critical thinking skills by framing questions related to elements of reasoning

C05 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation

C06 - Equip the students with the required Professional Skills

B.Sc. Microbiology			
	SMBB1101	General Microbiology	66
	SBBA1302	Introduction to Molecular Biology & Genetics	67
	SBBA1303	Concepts in Biotechnology	68
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	SMBA1401	Medical Bacteriology	70
	SMBA1402	Medical Virology	71
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	SMBA1404	Phycology and Medical Parasitology	73
	SBBA4002	Medical Laboratory techniques	74

SMBB1101	GENERAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES

- This course is aimed give an understanding about the basics of microbiology dealing types of microbes, classification & characterization

UNIT 1 HISTORY AND CLASSIFICATION**9 Hrs**

History and scope of Microbiology, Spontaneous generation - Biogenesis theory - Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Sir Alexander Flemming. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

UNIT 2 MICROSCOPY AND STAINING**9 Hrs**

Microscope- Principles, working mechanism and application - Simple and compound microscope -Dark field -Phase contrast, Fluorescence, SEM and TEM. Types of Staining - Simple, Differential (Gram's, AFB), Special - Capsular and Spore staining. LPCB, KOH mount

UNIT 3. ULTRASTRUCTURE OF BACTERIA**9 Hrs**

Structure and organization of bacterial cell - Gram positive and Gram negative bacterial cell wall. Biosynthesis of bacterial cell wall, cell membrane - Bio-membrane, liposomes - membrane transport - diffusion, active and passive transport and osmoregulation.

UNIT 4. STERILIZATION**9 Hrs**

Sterilization and Disinfection- principles and methods of sterilization- physical methods - Dry heat- Moist heat- Radiation and Filtration. Chemical sterilization- Chemical agents- mode of action- phenol coefficient test- sterility testing.

UNIT 5. MEDIA AND TECHNIQUES**9 Hrs**

Culture and media preparation - solid and liquid. Types of media- Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques - Tube dilution, Pour, Spread, Streak plate. Anaerobic culture technique - Wright's Tube, Roll tube method, Anaerobic Jar.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- C01** - Describe the basic concepts of microbiology.
- C02** - Summarize the principle and working mechanism of simple and compound microscopes.
- C03** - Describe the various staining techniques used in microbiology
- C04** - Explain cellular organization of various microorganisms
- C05** - Discuss various sterilization methods.
- C06** - Execute preparation of various culture media and plating techniques for growing the microorganisms

SBBA1302	INTRODUCTION TO MOLECULAR BIOLOGY & GENETICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course provides you with further knowledge associated with molecular biology and inheritance at the molecular, cellular and phenotypic levels.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction and History of Microbial Genetics. DNA as a Genetic material. Physical structure and Chemical composition of DNA – RNA and its types RNA as a Genetic material. DNA Replication – Types and Experimental proof of replication – Enzymes involved in DNA replication

UNIT 2 CENTRAL DOGMA

9 Hrs.

Prokaryotic Transcription, Translation. Genetic code – Regulation of gene expression in prokaryotes – lac Operon. Gene transfer mechanisms – Transformation, conjugation and Transduction. Plasmid – Characteristics and types.

UNIT 3 MENDELIAN GENETICS

9 Hrs.

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

UNIT 4 INHERITANCE

9 Hrs.

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex-linked inheritance. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

UNIT 5 MUTATION

9 Hrs.

Mutation – types of mutation – Molecular basis of mutation – Mutagenesis, Detection of mutants – Ames test, DNA repair mechanisms. Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Study the detail of genetic material of our living system-DNA replication, transcription and translation and explain how they relate to each other.

CO2 - Understand the Basic of DNA replication in prokaryotes and eukaryotes.

CO3 - Study the details of gene organization and mechanisms of control the gene expression in various organisms.

CO4 - Understand the applications of molecular biology in the modern world.

CO5 - Through this course the students are exposed to importance of biological macromolecules

CO6 - Understanding the molecular aspects of the biology.

SBBA1303	CONCEPTS IN BIOTECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

This course aims at making the students understand the basics of biotechnology and its various fields

UNIT 1 BIOTECHNOLOGY: AN OVERVIEW**9 Hrs.**

What is Biotechnology? – an interdisciplinary pursuit, old Vs new biotechnology, scope and importance, commercial potential, public perception of Biotechnology, Biotechnology in India and Global. Branches of biotechnology.

UNIT 2 ANIMAL & PLANT BIOTECHNOLOGY**9 Hrs.**

Biotechnology methods of crop improvement- plant tissue culture. Transgenic plants, applications of transgenic plants, transgenesis, transgenic animals,

UNIT 3 INDUSTRIAL BIOTECHNOLOGY**9 Hrs.**

Isolation and screening of micro-organisms, Bioreactors, food and beverage fermentation, production of antibiotics (β -lactum antibiotic), vitamin B12, Enzyme- amylase, protease, Biotransformation, SCP and its economical implications.

UNIT 4 MEDICAL BIOTECHNOLOGY**9 Hrs.**

Conventional vaccines, recombinant vaccines, DNA vaccines, monoclonal antibodies and their applications, interferons, drug designing, gene therapy, forensic medicine applications in human genetic research.

UNIT 5 ENVIRONMENTAL BIOTECHNOLOGY AND BIOETHICS**9 Hrs.**

Novel and better bioinsecticides. Biofertilizers, Biodegradation of Xenobiotic compounds. Legal aspects genetically manipulated organisms and environment, biosafety, Social, moral and Ethical Considerations, IPR.

COURSE OBJECTIVES**Max. 45 Hours**

On completion of the course, the students will be able to

CO1 - Explain the current scenario about biotechnology

CO2 - Describes the biotechnological methods in crop development and transgenic animal production

CO3 - Highlighting the application of industrial biotechnology

CO4 - Demonstrate the healthcare application of biotechnology

CO5 - Implementation of biotechnology in the protection of environment

CO6 - Discuss the ethical issues of biotechnology

SBBA1304	ANALYTICAL TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding the principle and application of various instruments used in Biotechnology industries.

UNIT1 MICROSCOPY**9 Hrs.**

Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

UNIT 2 LAB EQUIPMENT**9 Hrs.**

Autoclave, Hot air oven, Incubator, Water Bath, Laminar air flow, BOD incubator, Centrifuges – Bench top, High speed, Ultra centrifuge, density gradient centrifugation. pH meter, Conductivity meter, Lyophilizer, McIntosh anaerobic jar, Biosensor, Metabolic shaker.

UNIT 3 CHROMATOGRAPHY AND ELECTROPHORESIS**9 Hrs.**

Principles and applications of Chromatography – Paper, Thin layer, Column, Ion-exchange, Gas and HPLC – Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gelelectrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gelelectrophoresis..

UNIT –IV PHOTOMETRY**9 Hrs.**

Colorimetry, Turbidometry, Spectrometry – UV & Visible spectrophotometer. Flame photometry- Micronutrient analysis.

UNIT BIOCHEMISTRY ANALYSIS**9 Hrs.**

Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality, PPM- Ammonium sulphate precipitation.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1 – Explain in detail about microscopic techniques
- CO2 – Discuss the different analytical instruments used in laboratories
- CO3 – Understand various chromatographic methods
- CO4 – Describe Photometric techniques
- CO5 – Understand various analytic methods in biochemistry
- CO6 – Demonstrate the biochemical calculation used to prepare buffers

SMBA1401	MEDICAL BACTERIOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding important medically important bacteria its mode of infection, pathogenesis prophylaxis and treatment.

UNIT 1 INFECTION

9 Hrs.

Infection-Sources of infection, method of transmission of infection, Factors predisposing to microbial pathogenicity, Types of infectious diseases. Normal Microbial flora of human body. Gram-positive pathogens *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Clostridium*.

UNIT 2 GRAM NEGATIVE PATHOGENS

9 Hrs.

Gram negative pathogens- *Neisseria*, *E.coli*, *Klebsiella*, *Proteus*, *Salmonella*, *Shigella*, *Vibrio*, *Yersinia*.

UNIT 3 ACID FAST BACTERIS

9 Hrs.

Acid fast bacteria-*Mycobacterium tuberculosis* and *M.lepreae*.

UNIT 4 SPIROCHETES

9 Hrs.

Spirochetes-*Leptospira*, *Treponema*.

UNIT 5 OTHER MEDICALLY IMPORTANT ORGANISMS

9 Hrs.

Mycoplasma, *Chlamydia*, *Helicobacter* and *Campylobacter*. Other important anaerobic pathogens.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, the student will be able to

CO1 – Understand the concept of infections and various factors associated to it

CO2 – Describe different Gram negative pathogenic microorganisms

CO3 – Discuss about the acid fast bacilli *Mycobacterium*

CO4 – Describe the different bacterial genus belonging to spirochetes phylum

CO5 – Explain several organisms that have medical significance and diseases caused by them

CO6 - Demonstrate the role of microorganism in causing disease.

SMBA1402	MEDICAL VIROLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding important medically important virus its mode of infection, pathogenesis prophylaxis and treatment.

UNIT 1 GENERAL CONCEPTS

9 Hrs.

General Concepts: Virus history, Diversity, shapes, sizes and components of genomes. Isolation and purification of viruses and components.

UNIT2 INFECTION

9 Hrs.

Consequences of virus infection to animals and human. Viral infection: affect on host macromolecules. Viral infection: establishment of the antiviral state. Viruses counter attack mechanisms.

UNIT3 CLASSIFICATION

9 Hrs.

Classification of viruses and nomenclatures.

Positive strand RNA viruses- Picornaviruses. Flaviviruses- West Nile virus and Dengue virus. Coronaviruses- SARS pathogenesis Negative strand RNA viruses Paramyxoviruses. Orthomyxoviruses: Influenza pathogenesis and Bird flu. Rhabdoviruses: Rabies pathogenesis.

UNIT 4 RNA VIRUS

9 Hrs.

dsRNA viruses- Reoviruses. Retroviruses: structure, classification, life cycle; reverse transcription. Retroviruses: HIV, viral pathogenesis and AIDS.

UNIT 5 DNA VIRUS

9 Hrs.

Small DNA viruses: parvo- and polyomaviruses. Large DNA viruses: Herpes-ado-, and poxviruses. Miscellaneous viruses.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 – Explain the basic concepts of virology
- CO2 – Understand the viral infections and factors associated to it
- CO3 – Outlie the classification of viruses
- CO4 – Discuss in detail about the RNA viruses
- CO5 – Understand DNA viruses
- CO6 – Demonstrate various viruses and disease caused by it.

SMBA1403	MEDICAL MYCOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding important medically important fungi its mode of infection, pathogenesis prophylaxis and treatment.

UNIT 1 CLASSIFICATION

9 Hrs.

General characteristics and classification of fungi - Morphology & reproduction of fungi – Pathogenesis of fungal infections
Isolation & identification of fungi

UNIT 2 YEAST

9 Hrs.

Yeasts and yeast like fungi of medical importance including *Candida*. - *Cryptococcus*, *Malassezia*, *Trichosporon*, *Geotrichum*, *Saccharomyces* etc. Mycelial fungi of medical importance including *Aspergillus*, *Zygomycetes*, *Pseudoallescheria*, *Fusarium*, *Piedra*, other dematiaceous hyphomycetes and other hyalohyphomycetes etc.

UNIT 3 DIMORPHIC FUNGI 9 Hrs.

Dimorphic fungi including *Histoplasma*, *Blastomyces*, *Coccidioides*, *Paracoccidioides*, *Sporothrix*, *Penicillium marneffei* etc. - Dermatophytes

UNIT 4 FUNGI DISEASES

9 Hrs.

Fungi causing mycetoma, keratomycosis & otomycosis. - *Pneumocystis jirovecii* infection - *Rhinosporidium seeberi* & *Loboa loboi* - Actinomycetes & *Nocardia*.

UNIT 5 COMMON LAB CONTAMINANTS

9 Hrs.

Common laboratory fungal contaminants- Mycetism & mycotoxicosis - Antifungal agents & in vitro antifungal susceptibility tests. - Hypersensitivity to fungi

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 – Understand the fungal classification and infections caused by them
- CO2 – Explain Yeasts and their medical importance
- CO3 – Explain the concept of fungal dimorphism and organisms that exhibit it
- CO4 – Describe various fungal diseases and the organisms responsible for that
- CO5 – Discuss about the fungal contaminants that are seen in laboratories
- CO6 – Demonstrate the use of various antifungal agents

SMBA1404	PHYCOLOGY AND MEDICAL PARASITOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

This course aims at understanding important medically important parasite its mode of infection, pathogenesis prophylaxis and treatment. To understand the Algal diversity.

UNIT 1 CLASSIFICATION

9 Hrs.

Algae in diversified habitats (terrestrial, fresh water, marine) thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual) criteria for classification of algae: pigments, reserve food, flagella, modern classification.

UNIT 2 CLASSIFICATIONS & APPLICATIONS

9 Hrs.

Salient features of protochlorophyta, chlorophyta, charophyta, xanthophyta, Bacillariophyta, phaeophyta and Rhodophyta with special reference to Microcystis, Hydrodictyon, Chara, Draparnaldiopsis, Sargassum, Dictyota, Batrachospermum. Algal blooms, algal biofertilizers; algae as food, feed and use in industry.

UNIT 3 PARASITOLOGY

9 Hrs.

Parasitology – General Concepts – Introduction to Parasitology, Classification – Host parasite relationship. Laboratory techniques in parasitology – Blood – Thick and thin smear, Faeces – Examination for ova and cyst.

UNIT 4 PROTOZOOLOGY

9 Hrs.

Protozoology: Pathogenic mechanisms, Disease transmissions, their life cycles and Lab Diagnosis of the following- *Entamoebahistolitica*, *Plasmodium vivax*, *Plasmodium falciparum*, *Leishmaniadonovani*, *Giardia lamblia*, *Trichomonasvaginalis*, *Balantidium coli*, *Toxoplasma gondii* and *Cryptosporidium parvum*.

UNIT 5 HELMINTHOLOGY

9 Hrs.

Helminthology: Classification, Cestodes – *Taeniasolium*, *T. saginata*, *T. echinococcus*, trematodes – *Schistosoma haematobium*, *Fasciola hepatica*, Nematodes – *Ascaris*, *Anchylostoma*, *Trichuris*, *Enterobius* and *Wuchereria*- their life cycle, Transmission, pathogenicity and Lab Diagnosis.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 – Classify different algae in variety of habitats
- CO2 – Understand the applications of algae and harmful algal blooms
- CO3 – Understand the basic concepts of parasitology
- CO4 – Classify protozoans and the diseases caused by them
- CO5 – Discuss helminths, their classification and infections caused by them
- CO6 – Demonstrate the life cycle of various parasites

SBBA4002	MEDICAL LABORATORY TECHNIQUES	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

COURSE OBJECTIVES

The main purpose of the program is to provide the students with the good knowledge of the basic techniques used in the laboratory.

UNIT 1 DISEASES AND ITS AGENTS

9

Hrs.

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

UNIT 2 CLINICAL TRIALS

9

Hrs.

Collection of clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

UNIT 3 STAINING TECHNIQUES

9

Hrs.

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

UNIT 4 ASSAYS

9

Hrs.

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes

UNIT 5 DISEASE PREDICTION

9

Hrs.

Typhoid, Dengue and HIV, Swine flu Testing for Antibiotic Sensitivity in Bacteria Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

Max. 45 hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 – Describe the various techniques used in medical laboratories.
- CO2 – Understand the application of laboratory techniques in disease diagnosis
- CO3 – Explore various infectious agents and the diseases caused by it
- CO4 – Explain the protocols for disease diagnosis
- CO5 – Demonstrate each technique and inference of test results
- CO6 – Gain knowledge on infectious diseases.

B.Sc. Biochemistry			
1	SBC1101	Biomolecules	76
2.	SBCA1301	Molecular Biology 1	77
3.	SBCA1302	Enzymes	78
4.	SBCA1303	Biophysical Chemistry	79
5.	SBCA3001	Nutritional Biochemistry	80
6.	SBCA1402	Intermediary Metabolism I	81
7.	SBCA1401	Molecular Biology II	82
8.	SBCA1403	Basic Immunology	83
9.	SBBA4002	Medical Laboratory techniques	84

SBCB1101	BIOMOLECULES	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

COURSE OBJECTIVES

- To learn about the structure, properties, functions and importance of biomolecules

UNIT 1 CARBOHYDRATES**9 Hrs**

Carbohydrates – Definition and classification. Structure, Chemical properties and role of monosaccharide. Structure, and biological functions of oligosaccharides (Disaccharides and Trisaccharides). Chemistry and biological importance of polysaccharides (Homopolysaccharide and Heteropolysaccharide).

UNIT 2 LIPIDS**9 Hrs**

Lipids – Definition and classification of lipids, simple, compound and derived. Simple lipids-Physical and chemical properties of fats. Characterization of fat – Saponification number, Acid number, Iodine number and Reichert Meisel number. Compound lipids – Structure and functions of Phospholipids, sphingolipids, glycolipids and lipoproteins. Derived lipids - Fatty acids-Nomenclature of fatty acidssaturated and unsaturated. Essential fatty acids. Steroids -Structure and function of cholesterol.

UNIT 3. AMINO ACIDS**9 Hrs**

Amino acids – Structure, classification and chemical properties. Isoelectric pH, pKa and titration curve of amino acids. Peptides and peptide bond. Proteins – classification and biological importance. Denaturation and precipitation of proteins by salts.

UNIT 4. NUCLEIC ACIDS**9 Hrs**

Nucleic acids – purines and pyrimidines. Nucleosides and nucleotides. Polynucleotides: DNA and RNA, biological significance. Structure, forms of DNA and types of RNA. Denaturation and Renaturation

UNIT 5. VITAMINS AND MINERALS**9 Hrs**

Vitamins – Source, biological function, daily requirement and deficiency symptoms of fat soluble vitamins (A, D, E and K) and water soluble vitamins (Ascorbic acid, thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, lipoic acid, biotin, folic acid and vitamin B12). Minerals: Mineral requirement, sources and functions of essential macro minerals and essential micro minerals.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- C01 - Have exhaustive knowledge about the structure, chemistry and function of carbohydrates
- C02 - Know In depth knowledge about the significance of the complex lipids
- C03 - Understand about the importance of proteins and peptides
- C04 - Categorize the salient structure, chemistry and features of nucleic acids
- C05 - Understand the importance of vitamins and minerals.
- C06 - Evaluate the role of vitamins and minerals in human body.

SBCA1301	MOLECULAR BIOLOGY I	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Molecular Biology I is an introductory course deals with the fundamental principles of DNA structure, organization and its function in both prokaryotes and eukaryotes.

UNIT 1 BASIC CONCEPTS IN MOLECULAR BIOLOGY**9 Hrs**

History of significant discoveries in Molecular Biology. Central dogma – DNA as genetic material. Evidence to prove DNA as genetic material- Griffith's transforming principle; Avery, McLeod and McCarty's experiment; Hershey and Chase experiment. Chargaff's law. Watson and Crick model of DNA (B form). Other different forms of DNA- A, Z. Physical Properties of DNA- Denaturation, Renaturation, hyper and hypochromic effect, Cot curve significance.

UNIT 2 DNA REPLICATION**9 HRS.**

Meselson-Stahl's experiment to prove semi-conservative model of replication. DNA replication in prokaryotes and eukaryotes. Types of DNA polymerases, enzymes and proteins associated with DNA replication. Mechanism of replication- Initiation, Elongation and Termination. Other modes of replication: rolling circle replication, D-loop mechanism.

UNIT 3 GENETIC CODE AND TRANSCRIPTION**9 HRS.**

Genetic code properties; initiation and termination codon; Wobble hypothesis. Transcription in prokaryotes and eukaryotes. RNA polymerases; mechanism of transcription- initiation, elongation and termination. Types of RNA – rRNA, mRNA, tRNA, snRNA. Post transcriptional modifications; 5' capping and poly A tailing. RNA splicing- Splicing pathways and Spliceosome. Concept of Alternate Splicing.

UNIT 4 PROTEIN SYNTHESIS**9 HRS.**

Translation in prokaryotes and eukaryotes. Mechanism of translation; initiation, elongation and termination. Co and post translational modifications of proteins. Import into nucleus.

UNIT 5 GENE REGULATION**9 HRS.**

Regulation of gene expression- regulatory proteins, promoters, enhancers. Operon concept- negative and positive regulation- Lac, Trp, Ara operon- structure and function.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 - Study the detail of genetic material of our living system-DNA replication, transcription and translation and explain how they relate to each other.

CO2 - Understand the Basic of DNA replication in prokaryotes and eukaryotes.

CO3 - Study the details of gene organization and mechanisms of control the gene expression in various organisms.

CO4 - Understand the applications of molecular biology in the modern world.

CO5 - Through this course the students are exposed to importance of biological macromolecules

CO6 - Understanding the molecular aspects of the biology.

SBCA1302	ENZYMES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

➤ The objective of the course is to provide a deeper insight into the fundamentals, classification, structure, function and kinetics of enzymes. Also know about current applications and future potential of enzymes.

UNIT 1 INTRODUCTION TO ENZYMES**9 Hrs.**

Historical perspective, Nomenclature and Classification of Enzymes – Properties of Enzymes, Enzyme Activity and Units, Specific Activity, Catalytic Power and Specificity, Lock and Key Theory, Induced Fit Model, Transition State and Strain Theory of Enzyme Action.

UNIT 2 ENZYME KINETICS AND INHIBITION**9 Hrs.**

Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant, monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee, Hanes-Woolf, and Cornish-Bowden Plots – K_m and V_{max} , K_{cat} and turnover number, Effect of pH, temperature and metal ions on the activity of enzyme, Bi-substrate Reactions, Enzyme Inhibition, Irreversible, Reversible, Competitive, Uncompetitive – Mixed and Non-Competitive inhibition, graphical analysis.

UNIT 3 ENZYMATIC CATALYSIS & COENZYMES**9 Hrs.**

Acid-Base Catalysis, Covalent Catalysis, Metal ion Catalysis, Electrostatic Catalysis, Catalysis through Proximity and Orientation effects, Catalysis by Transition State Binding. Catalysis in Model Enzymes – Ribonuclease A – Chymotrypsin, Carbonic anhydrase – Carboxypeptidase A, Lysozyme. Coenzymes – NAD(P)⁺, FMN & FAD, CoA-SH, TPP, PLP, Biotin, THF, Methylcobalamin, Structure & Function.

UNIT 4 ENZYME REGULATION AND PURIFICATION**9 Hrs.**

Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

Enzyme isolation and purification, Preliminary and Advanced techniques.

UNIT 5 APPLICATIONS OF ENZYMES**9 Hrs.**

Immobilized enzymes, methods and applications in industry, medicine, Isoenzymes, properties and physiological significance (lactate dehydrogenase). Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase).

COURSE OUTCOMES**Max. 45 Hours**

On completion of the course, student will be able to

CO1- Students will learn basics of enzymology and will be familiar with important terms of enzymology

CO2- Study the theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards modern application.

CO3-Familiar with overview and scope of enzymes in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.

CO4- Ideas on Processing, Production and Purification of enzymes at an industrial scale

CO5- It helps the students to learn the significant features of the biochemical catalysts.

CO6- understand the methodology involved in assessing the enzyme activity and mechanism of enzyme action.

SBICA1303	BIOPHYSICAL CHEMISTRY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Developing of general understanding how physical laws govern biological processes.
- Acquire basic knowledge about how physical methods can be applied to understand biological processes.

UNIT 1 WATER**9 Hrs.**

Structure and interactions, water as solvent, proton mobility, acid-base reactions, pH and buffers, isoelectric pH. Importance of buffers in biological systems (cytosol and blood).

UNIT 2 THERMODYNAMICS**9 Hrs.**

First law of thermodynamics, basic concepts of entropy and second law of thermodynamics, free energy changes, standard free energy change and its relation to equilibrium constant. Oxidation – reduction reactions in biological systems.

UNIT 3 CELL MEMBRANE AND TRANSPORT MECHANISMS**9 Hrs.**

Structure, principles of membrane organization, membrane models, membrane protein types and its functions, Transport through cell membrane, active and passive transport systems, Ping - pong mechanism for transport of diffusion, Macromolecules across the Plasma Membrane, Role of Intercellular spaces in transport process, Homocellular, Transcellular, Intracellular transport, Irreversible thermodynamic treatment of membrane transport.

UNIT 4 BIOMOLECULAR INTERACTIONS**9 Hrs.**

Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction, Multiple equilibria and various types of binding processes in biological system. Hydrogen ion titration curve, Thermodynamics of biopolymers, Vant's Hoff's law of osmotic pressure, Theory of osmotic pressure and semipermeability, Behaviour of cells and molecular weight determination from osmotic pressure measurements, Significance of osmosis in biology..

UNIT 5 TECHNIQUES FOR THE STUDY OF MACROMOLECULAR STRUCTURE**9 Hrs.**

Analytical Ultracentrifugation : Sedimentation velocity and equilibrium, determination of molecular weights, Micro calorimetry (DSC and ITC) and its application. Circular Dichroism spectroscopy, UV, visible and Fluorescence spectroscopy, X-ray Diffraction, Nuclear Magnetic Resonance (NMR), Mass Spectrometry.

COURSE OUTCOMES**Max. 45 Hours**

On completion of the course, student will be able to

CO 1: Understand the fundamental principles and thermodynamics that drive biomolecules.

CO:2: Emphasize profound knowledge on cell structure, function and dynamics of inter-intra cellular processes.

CO 3: Explore various basic and advanced sophisticated biochemical and biophysical techniques for analyzing macromolecules

CO 4: Comprehend clear understanding on various cellular metabolic pathway mechanism and its applications in biological system.

CO 5. The application of mathematical tools to calculate thermodynamic.

CO 6: The students familiar about the inorganic halogen compounds, coordination compounds and transition elements.

SBICA3001	NUTRITIONAL BIOCHEMISTRY	L	T	P	CREDITS	TOTAL MARK
		3	0	0	3	100

COURSE OBJECTIVES

This course provides introduction to biochemistry of macro- and micronutrients with a brief focus on medical aspects of nutrient deficiencies and metabolism

UNIT 1 CONCEPTS OF FOOD AND NUTRITION**9 Hrs.**

Basic food groups- energy yielding, body building and functional foods. Units of energy. Calorific and nutritive value of foods. Measurement of calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA- definition and determination.

UNIT 2 ELEMENTS OF NUTRITION**9 Hrs.**

Physiological role and nutritional significance of carbohydrates, lipids and proteins, Evaluation of proteins by nitrogen balance method - Biological value of proteins – Digestibility Coefficient, Biological Value, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition- Kwashiorkor and Marasmus. Clinical manifestations and management. Obesity (elementary details)

UNIT 3 VITAMINS**9 Hrs.**

Balanced diet, example of a low and high cost balanced diet – for infants, children, adolescents, adults and elderly people. Role of dietary fiber. Vitamins- definition and types of vitamins. Sources, requirement, biological functions, deficiency symptoms of thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, folic acid, biotin, cyanocobalamin, vitamins C, A, D, E and K. Hypervitaminosis.

UNIT 4 MINERALS**9 Hrs.**

Minerals- sources, requirement, physiological functions, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, chromium, cobalt, copper, manganese, molybdenum, selenium, iodine and zinc.

UNIT 5 HUMAN RIGHTS**9 Hrs.**

Introduction- definition, scope and need for study of human rights and relations. Categories- civil and political rights, economic relations and social relations. Institutions : International and National- United Nations Human Rights Commission, State Human Rights Commission. International Convention on civil and political rights. International, convention on economic and social rights. National Human Rights Act- National Commission for minorities, SC/ST and Women, Students activity- assignment, case study, term paper.

COURSE OUTCOMES**MAX. 45 HOURS**

On completion of the course, student will be able to

CO1 – Familiarize with various nutritional sources

CO2 – Understand the important role each nutrients in metabolism

CO3 – Identify various types of micro and macro nutrients

CO4 – Discuss importance of nutrients and its role in disease

CO5 – Explain different types of minerals

CO6 – Apply the nutritional requirements and its importance in human rights

SBCE1402	INTERMEDIARY METABOLISM I	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

➤ This course aims at understanding the essential metabolic functions of the organism as well as consumption and storage of energy intermediary metabolism of main biomolecules and its regulatory mechanisms.

UNIT 1 THERMODYNAMIC PRINCIPLES**9 Hrs.**

Laws of Thermodynamics, Enthalpy, enthalpy free energy, forward and reverse reaction equilibrium state, oxidation and reduction, redox reactions, redox potential. Anabolism – catabolism. High energy compounds.

UNIT 2 METABOLIC PRINCIPLES**9 Hrs.**

Structure, Functions, and Properties of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

UNIT 3 PHOTOSYNTHESIS**9 Hrs.**

Photophosphorylation: Cyclic and Non-cyclic photophosphorylation. Central photochemical event. Light-driven electron flow, ATP synthesis by photophosphorylation

UNIT 4 CARBOHYDRATE METABOLISM**9 Hrs.**

Glycolysis and oxidation of pyruvate, Pentose phosphate pathway, Glycogen metabolism: Glycogenesis and glycogenolysis, glyoxalate shunt, fatty acid synthesis and oxidation, gluconeogenesis - illustrations, regulation, and energetics.

UNIT 5 ENERGY PRODUCTION**9 Hrs.**

Tricarboxylic acid cycle, the convergence of all metabolic pathways into TCA, Respiratory chain in mitochondria, chemiosmotic theory, oxidative phosphorylation, uncouplers, transport systems in inner mitochondrial membrane, calculation of ATP yield during oxidation of glucose and fatty acids

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

CO1 – develop knowledge on how biomolecules perform complex metabolic functions.

CO2 – evaluate the energy metabolism and its regulatory mechanism

CO3 – analyze complex biochemical pathways of energy production

CO4 – will be able to illustrate important metabolic pathways of organisms

CO5 – have a strong understanding of the structure and essential functions of biomolecules

CO6 – outline the concepts of immunity and its significance in fighting a disease

SBCA1401	MOLECULAR BIOLOGY II	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

➤ To provide sound knowledge on the gene organisation, structure, function and important molecular functions of prokaryotic and eukaryotic cells.

UNIT 1 ORGANIZATION OF DNA IN PROKARYOTES AND EUKARYOTIC CHROMOSOME. 9 Hrs.

Prokaryotic Genomes - Physical organization of bacterial genomes .Structure of the bacterial nucleoid. Eukaryotic genome organization- DNA binding histones, nucleosome, solenoid, chromatin. Eukaryotic genomes contain both non repetitive and repetitive DNA sequences- satellite DNA. Human genome has fewer genes than expected. Mitochondrial DNA organization.

UNIT 2 MUTATION AND REPAIR 9 Hrs.

Mutagenesis, Mutations, and Mutants- Terminology, Types of Mutations and their Notation, Biochemical Basis of Mutants, Mutagenesis, Mutational Hot Spots, Reversion. Errors in DNA replication and it's repair. Direct reversal of DNA damage. Base excision repair and nucleotide excision repair. Repair by homologous recombination.

UNIT 3 GENETIC RECOMBINATION 9 Hrs.

Genetic Recombination Between Homologous DNA Sequences: Recombination in bacterial transformation. Types of Recombination- Site-specific & illegitimate recombination. Breakage and Rejoining and Heteroduplexes, Branch migration. Mismatch Base Pairs and Their Resolution. Models for Homologous Recombination- Holliday junctions, RecA, RecBCD, RuvAB functions

UNIT 4 TRANSPOSABLE ELEMENTS 9 Hrs.

Transposable Elements: An Overview of Transposition, Insertion sequences, Types of bacterial Transposons, Transposition, Replication of a transposon during transposition between two plasmids, The Cointegrate as an Intermediate in transposition of Tn3, Deletions and Inversions Caused by Transposons, Role of IS elements in Hfr Formation. Transposable Elements in Eukaryotes- Retroposons, retrotransposons .Limitation of Transposition.

UNIT 5 MOLECULAR BIOLOGY OF CANCER 9 Hrs.

Cell cycle regulation and cancer. Activation of oncogenes, Inactivation of tumor suppressor genes, Inappropriate expression of micro RNAs in cancer, Chromosomal rearrangements and cancer, Viruses and cancer, Chemical carcinogenesis

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

CO1 – compare and contrast the general principles of gene organization in both prokaryotic and eukaryotic organisms.

CO2 – have an understanding of molecular pathways involved in DNA mutation and repair

CO3 – explain the underlying mechanism of DNA recombination

CO4 – analyze the consequences of DNA transposition

CO5 – will predict how a mutation to the anticodon sequence of a tRNA or a promoter sequence would alter its function.

CO6 – relate the properties of cancerous cells to mutational changes in gene function

SBCA1403	BASIC IMMUNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

➤ To know the fundamentals of innate and acquired immunity. To understand how the immune system fights and combats infection and diseases. To get an insight into the principle mechanism of immunity.

UNIT 1 HISTORY OF IMMUNOLOGY**9 Hrs.**

History of Immunology – Host-parasite relationship – Immunity – Innate and acquired immunity – Humoral and Cell-mediated immunity.

UNIT 2 PROPERTIES OF IMMUNE CELLS**9 Hrs.**

Structure, Functions, and Properties of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

UNIT 3 ANTIGENS AND ANTIBODIES**9 Hrs.**

Differentiation and classification of T-cells and B-cells, antigen processing and presentation, Antigens – Types, properties – Immunoglobulins – Structure, types and Functions, Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Complement – Classical and alternative pathways

UNIT 4 MONOCLONAL ANTIBODIES**9 Hrs.**

Monoclonal antibodies, Antigen- Antibody reactions: Agglutination – Precipitation – Complement fixation – Immunofluorescence – ELISA, RIA.

UNIT 5 CELL MEDIATED IMMUNITY**9 Hrs.**

Autoimmunity: Hypersensitivity reactions – Antibody-mediated – Type I, Type II and Type III – cell-mediated - Type IV; Transplantation immunology; Tumor immunology

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, the student will be able to

CO1 – develop knowledge on *how human immune cells combat an infection*

CO2 – evaluate the role of different immune cells

CO3 – *analyze how human immune cells combat an infection.*

CO4 – apply the methods to detect an immune reaction.

CO5 – *have a strong understanding of the mechanism behind allergy and hypersensitivity*

CO6 – outline the concepts of immunity and its significance in fighting a disease

SBBA4002	MEDICAL LABORATORY TECHNIQUES	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

COURSE OBJECTIVES

The main purpose of the program is to provide the students with the good knowledge of the basic techniques used in the laboratory.

UNIT 1 DISEASES AND ITS AGENTS**9 Hrs.**

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

UNIT 2 CLINICAL TRIALS**9 Hrs.**

Collection of clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

UNIT 3 STAINING TECHNIQUES**9 Hrs.**

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

UNIT 4 ASSAYS**9 Hrs.**

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes

UNIT 5 DISEASE PREDICTION**9 Hrs.**

Typhoid, Dengue and HIV, Swine flu Testing for Antibiotic Sensitivity in Bacteria Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

Max hours 45 hours**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1 – Describe the various techniques used in medical laboratories.

CO2 – Understand the application of laboratory techniques in disease diagnosis

CO3 – Explore various infectious agents and the diseases caused by it

CO4 – Explain the protocols for disease diagnosis

CO5 – Demonstrate each technique and inference of test results

CO6 – Gain knowledge on infectious diseases.