Name of School: Sciences
Name of Program: B.Sc. Biotechnology

Program Objectives:

The program educational objectives of B.Sc. Biotechnology are to produce engineering professionals and researchers with following qualities:

1**.** Apply basic knowledge of Cell Biology, Microbiology, Biotechnology, Genomics, Recombinant DNA Technology, Biostatistics and Research Methodology, and interdisciplinary engineering concepts to solve problems related to field of Biotechnology.
2. Demonstrate the application of biotechnology practices and engineering principles through development of innovative products that are of beneficial for the human welfare and the nation.
3**.** Exhibit strong, independent learning, analytical and problem solving skills with special emphasis on design, communication, and ability to work in teams.
4**.** Pursue higher education and research in reputed institute at national and international level.

Program Outcomes:

The graduates of B.Sc. Biotechnology will have aptitude of:

1. Graduates will gain and apply knowledge of Biotechnology and Science concepts to solve problems related to field of Biotechnology.
2. Graduates will be able to design and develop solution to Biotechnology problems by applying appropriate tools while keeping in mind safety factor for environmental & society.
3. Graduates will be able design, perform experiments, analyze and interpret data for investigating complex problems in biotechnology and related fields.
4. Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological practices
5. Graduates will be able to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

PROGRAMME CORE

First Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BSC-101	CELL BIOLOGY	3	0	2	4	CBL/PBL
BSC-102	BIOCHEMISTRY-I	3	0	2	4	CBL/PBL
BSC-103	INTRODUCTORY PARASITOLOGY	3	0	2	4	CBL/PBL
ENG-104	COMMUNICATION SKILLS & PERSONALITY DEVELOPMENT-I	3	1	2	5	CBL
BSC-104	BIOMATHEMATICS-I	3	0	0	3	CBL
BIOT-101	INTRODUCTION TO MICROBIOLOGY	3	0	2	4	CBL/PBL
Total		18	1	10	24	

Second Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BSC-201	INTRODUCTION TO C-PROGRAMMING & DIGITAL LOGIC	3	0	2	4	CBL/ PBL
BSC-202	BIOPHYSICS	3	0	0	3	CBL
BSC-203	GENETICS	3	0	2	4	CBL/PBL
BSC-204	ENVIRONMENTAL STUDIES	2	0	0	2	CBL
BSC-205	BIOCHEMISTRY-II	3	0	2	4	CBL/PBL
BIOT-201	PRINCIPLES OF IMMUNOLOGY	3	0	2	4	CBL/PBL
		17		8	21	

**CBL/PBL/RBL: Course Based Learning/ Practical Based Learning/ Research Based Learning*

Third Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BIOT-131	FUNDAMENTALS TO BIOTECHNOLOGY	3	0	0	3	CBL
BIOT-132	MOLECULAR BIOLOGY	3	0	2	4	CBL/PBL
BIOT-133	MEDICAL BIOTECHNOLOGY	3	1	0	3	CBL
BIOT-134	INDUSTRAIL BIOTECHNOLOGY	3	0	0	3	CBL
BIOT-135	ANIMAL BIOTECHNOLOGY	3	0	2	4	CBL/PBL
	Total	15	1	4	17	

Fourth Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BIOT-141	RECOMBINANT DNA TECHNOLOGY	3	0	2	4	CBL/RBL
BIOT-142	GENOMIC ANALYSIS	3	0	0	3	CBL
BIOT-143	PLANT BIOTECHNOLOGY	3	0	2	4	CBL/RBL
BIOT-144	PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3	CBL
BIOT-145	MICROSCOPY	3	0	0	3	CBL
	Total	15		4	17	

Fifth Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BIOT-151	GENOMICS & PROTEOMICS	3	0	0	3	CBL
BIOT-152	INSTRUMENTATION AND TECHNOLOGY	3	0	2	4	CBL/PBL
BIOT-153	INTRODUCTION TO BIOSTATISTICS	3	0	0	3	CBL
BIOT-154	Minor Project	-		-	6	RBL
	Total	9		2	16	

Sixth Semester

Course Code	***Course Title***	***Lecture Hours Per Week***	***Tutorial Hours Per Week***	***Practical Hours Per Week***	***Total Credits***	***CBL/ PBL/ RBL****
BIOT-161	DNA FINGERPRINTING	3	-	-	3	CBL
BIOT-162	FOOD BIOTECHNOLOGY	3	1	-	4	CBL
BIOT-163	CYTOGENETICS	3	-	2	4	CBL/PBL
BIOT-164	ENVIRONMENTAL BIOTECHNOLOGY	3	0	2	4	CBL/PBL
	Total	12	1	4	15	

First-Semester

BIOT-111	CELL BIOLOGY	L	T	P	C
Date of Approval		3	0	2	4
Pre-requisites					
Co-requisites					

Course Objective: The given course has been formulated with an objective to make the student aware about the basics of biology. It includes the study of cells, study of the human anatomy and physiology, aspect of Genetics. These modules have been worked out with an aim to introduce the students to the fundamental functioning of the human body and the basic of the chemical changes that are important for Forensic biology. The students will learn about the laws of genetics, organization of chromosomes, cell division, various types of mutations and various genetic disorders.

Course Outcome: This course would help even the Non-Bio students to understand the basic concepts of Biology. They would be able to identify the various stages of cell division. They would be able to describe the various systems of Human Anatomy. They would be able to describe the structure, properties and functions of the human Biochemistry.

UNIT I Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III

Cell; Tissues; Cell theory, Prokaryotic and eukaryotic cells, Cell components (structure and functions): Plasma membrane, cell wall, endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, plastids, nucleus, ribosomes, chromosomes, cytoskeleton, centrioles, cilia and flagella.

UNIT IV

Cell cycle, Mitosis: general events of interphase, prophase, metaphase, anaphase, telophase, cytokinesis, significance of mitosis, Meiosis: kinds of meiosis, process of meiosis, Meiosis I, Meiosis II, significance of meiosis;Comparison of mitosis and meiosis, Reproduction: asexual and sexual. Cancer: Carcinogenesis, agents promoting carcinogenesis

Required Books and Materials:

1. *Molecular Biology of the cell* , Albert Etal , Fourth Edition., Garland Science (Iaylar and Francis) New York Group , 2002.
2. *Plant Molecular Biology2*, Herrmann, R.G., Larkins, B.A. Plenum Press, New York, 1991.

3. *Cell and Molecular Biology*, Rastogi, S.C. New Age International (P) Ltd. N. Delhi, 2005.
4. *Molecular Cell Biology*, LodishEtal , Fifth Edition, W H Freeman and company, New York, 2004
5. *Cell Biology, Rastogi*, S.C. New Age International (P) Ltd. N. Delhi, 2008.
6. *Cell Physiology*, Giese Arthur, Fifth Edition, Toppan company Ltd., Tokyo, Japan, 1979

Cell biology- PRACTICALS

1. Study of plant cell.
2. Study of animal cell.
3. Study of blood cell.
4. Study of mitosis and meiosis with the help of permanent slides.
5. Study of polytene and lampbrush chromosomes with the help of permanent slides.
6. Blood smear preparation
7. Study of structure of any Prokaryotic and Eukaryotic cell.
8. Cell division in onion root tip
9. LS and TS of monocot and dicot root and shoot
10. Study of plasmolysis and de-plasmolysis.
11. Study of prepared slides of histology

Mode of Evaluation

Quiz, Assignment	20
Minors	20
Practical examination	50
End term Examination	60
Total	150

Academic Council Approval date:

BIOT-112	**BIOCHEMISTRY-I**	**L**	**T**	**P**	**C**
Date of Approval:		3	0	2	4
Pre-requisites					
Co-requisites					

Course Objectives: The course has been designed **to** help student to identify the structural elements of proteins, the basic features of enzyme catalysis and regulation, describe the basic structural features of nucleic acids, the mechanisms by which DNA is transcribed, replicated, and repaired, understanding of the metabolic processes by which energy is produced in cells and amino acids, lipids, purines and pyrimidines, and carbohydrates are synthesized.

Course outcomes: After completion of course, the Students will be able to:

- Demonstrate a thorough knowledge of the intersection between the disciplines of Biology and Chemistry.
- Demonstrate a proficiency in developing relevant biochemical questions, carrying out laboratory investigations to answer those questions, and critically analyzing, interpreting, and presenting in oral and written form the results of their experiments.

Course detail:

UNIT I: **Introduction to Biochemistry**: Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Unit –II **Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

UNIT III **Lipids**: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

UNIT IV **Enzymes**: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories

UNIT V **Carbohydrates Metabolism**: Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

PRACTICALS

1. To study activity of any enzyme under optimum conditions.

2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.

3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.

4. Estimation of blood glucose by glucose oxidase method.

5. Principles of Colorimetry**: (i)** Verification of Beer's law, estimation of protein. (**ii)** To study relation between absorbance and % transmission.

6. Preparation of buffers.

7. Separation of Amino acids by paper chromatography.

8. Qualitative tests for Carbohydrates, lipids and proteins

RECOMMENDED BOOKS:

1. Outlines of Biochemistry- Conn EE, Stumff, P.K Bruening G and Doi RH, John Wiley and Sons , Inc,New York and Toronto.

2. Biochemistry for medical students-AVSS Rama Rao and Suryalaxmi, UBS Publishers Distributors Pvt. Ltd., New Dehli, India

3. An introduction to practical biochemistry by-DJ Plummer, Tata Mc Graw Hill Publishing Company Ltd. New Dehli.

PRACTICALS

1. To study activity of any enzyme under optimum conditions.

2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.

3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.

4. Estimation of blood glucose by glucose oxidase method.

5. Principles of Colorimetry**: (i)** Verification of Beer's law, estimation of protein. (**ii)** To study relation between absorbance and % transmission.

6. Preparation of buffers.

7. Separation of Amino acids by paper chromatography.

8. Qualitative tests for Carbohydrates, lipids and proteins

Mode of Evaluation

Quiz, Assignment	20
Minors	20
Practical examination	50
End term Examination	60
Total	150

Academic Council Approval date:

BIOT-113	**INTRODUCTORY PARISITOLOGY**	**L**	**T**	**P**	**C**
Date of Approval:		3	0	2	4
Pre-requisites					
Co-requisites					

Course objective:

- To provide students with knowledge concerning biological, epidemiological and ecological aspects of parasites causing diseases to humans.
- To enable students to reach diagnosis and know the general outline of treatment, prevention and control of parasitic infections.

Course Outcomes: By the end of the courses, students should be able to:

- Describe the common parasitic diseases and life-threatening conditions caused by some pathogens as regards etiology and life cycle of parasites of medical importance
- Describe the common diseases caused by helminthes and protozoa as regards pathogenesis, clinical features, differential diagnosis

Course detail:

Unit-I Introduction about parasites, types, hosts, types of hosts, schematic steps in parasitological analysis.

Unit-II Habit, habitat, life cycle, pathogenicity, diagnosis, treatment and prophylaxis of *Leishmania donovani* and *Giardia intestinalis* and *Trypanosoma gambiense*.

Unit-III Habit, habitat, life cycle, pathogenicity, diagnosis, treatment and prophylaxis of *Fasciola hepatica*, *Diphyllobothrium latum*, *Paragonimus westermanii* and *Hymenolepis nana* and *Taenia solium*.

Unit-IV Habit, habitat, life cycle, pathogenicity, diagnosis, treatment and prophylaxis of *Ancylostoma dodenale*, *Dracunculus mediansis* and *Wuchereria bancrofti* and *Ascaris lumbricoides*.

Practical:

- Study of museum specimens of Platyhelminthes and Aschelminthes.
- Study of morphology of parasites by means of charts.

Mode of Evaluation

Quiz, Assignment	20
Minors	20
Practical examination	50
End term Examination	60
Total	150

Academic Council Approval date:

BIOT-114	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT	L	T	P	C
Date of Approval:		3	0	0	3
Pre-requisites					
Co-requisites					

Course Objective: The core objective of the course is to improve the language proficiency of the learners. The focus will be on understanding the concept of communication skills while adopting the proper spoken skills with the knowledge of grammar. The motive of the course is to enable students to express themselves fluently and appropriately in social and professional context.

UNIT I: Introduction to Communication: Definition and Purpose of Communication, Nature of communication, Process of Communication, Types of Communication; verbal and non-verbal communication. Different mediums of Communication, Barriers to Communication – Physical Barriers, Psychological Barriers, Organizational Barriers.

UNIT II: Basic Grammar: Use of Articles, Prepositions, Syntax, Tenses, Voices (Active & Passive), Narration (Direct & Indirect speech).

UNIT III: Essentials of Grammar: Sentence Structure, Parts of Speech, Punctuation Marks, Use of Dictionary, Spotting the Sentence Errors.

UNIT IV: Social Communication Skills: Individualized Pronunciation Practice, Conversational English, Small Talks, Building relationships through Communication.

UNIT V: Non-verbal Communication & Kinesics: Forms of non-verbal communication, Interpreting body language, Kinesics, Proxemics, Chronemics.

Text Books:

1. Functional Aspects of Communication Skills by P. Prasad, published by S. K. Kataria, 2011.
2. Communication Skills by Leena Sen, published by PHI, 2007.
3. English Grammar & Composition by Wren & Martin published by S. Chand & Company Ltd., New Delhi, 2010.

Reference Books:

1. Business Communication by Virender Kumar, published by Kalyani Publishers.
2. Communication skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning private limited, 2010.
3. An Approach to Communication Skills by Bhattacharya Indrajit, published by Dhanpatrai Co., (Pvt.) Ltd., New Delhi, 2010.

4. Handbook of Practical Communication Skills by Wright, Chrissie, published by Jaico Publishing House. Mumbai.

Mode of Evaluation

Quiz, Assignment	20
Minors	20
End term Examination	60
Total	100

Academic Council Approval date:

BIOT-115	**BIOMATHEMATICS**	**L**	**T**	**P**	**C**
Date of Approval:		3	0	0	3
Pre-requisites					
Co-requisites					

Course description: The primary objective of this course is to provide knowledge of matrices and determinants, differential Calculus, integral calculus and analytical geometry. The emphasis in this course is to understand and evaluate derivatives for complexly constructed elementary functions, evaluate definite and indefinite integrals. This course also emphasis to understand the applications of matrices and determinants & basics of straight line and circle.

Course content: Upon successful completion of biomathematics, students will be able to:

- Express their interest in mathematics, and
- Write precisely about mathematics.
- Describe several diverse examples of mathematics not in secondary school mathematics,
- Solve problems using mathematics in unfamiliar settings, and
- Explain why mathematical thinking is valuable in daily life.
- Demonstrate algebraic facility with topics like limit and continuity, trigonometric functions, equation of line and distance formula

Unit-A

- Algebra of matrices.
- Minor and Cofactor of Determinant, Determinant of a square matrix, Properties of determinants, singular and non-singular matrices.
- Applications of Determinants in the solution of simultaneous linear algebraic equations by Cramer's rule and area of Triangles.

- Adjoint and inverse of matrices in solving simultaneous equations in two or three variables, Matrix Method.

Unit-B

- Basic concept of limit and continuity.
- Derivative. Rules of differentiation, theorem relating to the derivatives of the sum, difference, product and quotient of functions.
- Derivative of Trigonometric functions, inverse trigonometric functions, logarithmic and exponential functions, Differentiation of Implicit functions, Chain Rule, derivative of functions expressed in parametric form.

Unit-C

- Integration as the inverse of differentiation, indefinite integral or antiderivative.
- Fundamental integrals involving algebraic, trigonometric, exponential and Logarithmic functions, integration by parts (statement only), substitution and partial fractions.
- Important properties of definite integrals.

Unit-D

- Distance Formula.
- Straight Line: General form of the equation to a straight line. Slope of the line, slope-point form, Condition for two lines to be parallel and perpendicular and angle between two lines.
- Circle: General equation of a circle, finding center and radius of the circle, diameter form of a circle.

Text Book:

1. NCERT. Mathematics Text Book for class XI & XII.
2. Mathematics Text Book for class XI & XII, R.D Sharma, DhanpatRai Publications.
3. Mathematics Text Book for class XI, V.K. Bhandari & O. P. Arora, Dinesh Publications.

Reference Book:

1. Differential Calculus by Shantinarayan, S. Chand & Co., Delhi.
   Advanced Engineering Mathematics by Grewal, Khanna Publications, Delhi

Mode of Evaluation

Quiz, Assignment	20
Minors	20
End term Examination	60
Total	100

Academic Council Approval date:

BIOT-116	INTRODUCTION TO MICROBIOLOGY	L	T	P	C
Date of Approval:		3	0	2	4
Pre-requisites					
Co-requisites					

Course Description: This course will educate the students in a variety of important microbiological disciplines, as well as to promote and develop skills and competencies that have enduring value beyond the classroom, familiarize growth, evolution and classification, description of metabolic processes and diversity of microorganisms in order to understand how microorganisms live. The students will be trained in such a way that they develop critical thinking and problem solving as related to the microbiology.

Course Outcomes: The students will be able to:

- Acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others
- Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/ studies etc

Course Content:

Unit-A: Introduction History of Microbiology, Germ theory, Disciplines of Microbiology, Structure of Microbes (bacteria, archaea, algae, fungi and viruses), Microbial taxonomy including modern approaches of taxonomy such as DNA taxonomy and Numerical taxonomy, different groups of bacteria

Unit-B: Methods in Microbiology: Principles of microbial nutrition, culture media, theory and practice of sterilization, pure culture techniques, methods of isolation, Purification and preservation.

Unit-C: Metabolic diversity among Microorganisms: Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Unit-D: Basic concepts of Virology - General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Capsids,

complex (Bacteriophage, and Virion size, enveloped (Herpes), helical (TMV) and icosahedral (Polyoma), Capsids.

List of Practical:

- To study different parts of compound microscope.
- Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization.
- Isolation of microorganisms from air, water and soil samples.
- Dilution and pour plating techniques.
- Enumeration of microorganisms total vs viable counts.
- Identification of isolated bacteria.
- Gram staining, other staining methods, metabolic characterisation (IMVIC) Tests.
- Growth curve of microorganisms.
- Testing of water quality.
- Use of haemocytometer
- Observation of morphology - shape and arrangement of cells.
- Microscopic measurements, micrometer (ocular and stage)
- Methods of inoculation of different microbes in selective media.

Required Books and Materials:

- Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
- Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
- Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
- Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
- Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Mode of Evaluation

Quiz, Assignment	20
Minors	20
Practical examination	50
End term Examination	60
Total	150

Academic Council Approval date:

SEMESTER-II

BIOT-121	Introduction to Computers and C Programming	L	T	P	C
Date of Approval:		2	0	2	3
Pre-requisites					
Co-requisites					

Course Objectives: The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Course Outcomes:

- Demonstrate a basic understanding of computer hardware and software
- Develop proficiency in writing small to medium sized programs in a procedural programming language.
- Apply problem-solving skills and knowledge of computing fundamentals to a wide variety of engineering, science and technology problems
- Expose, diagnose, and fix errors in a program, using systematic testing and debugging techniques
- Have developed interest in the field of computers to be able to adjust to the demands of current trends and technology

Course Description: The course fully covers the basics of programming in the "C" programming language and demonstrates fundamental programming techniques, customs and vocabulary including the most common library functions and the usage of the preprocessor.

Course contents:

Unit 1: Introduction to Computers –Computer Languages, Creating and running programs, Role of Compiler and Interpreter, algorithms and flowcharts. Introduction to C Language – Background, Header Files, Compiling and Execution of C programs, Tokens in C.

Operators and Functions:-Arithmetic, relational, logical and bitwise Operators in C, Expressions, Precedence and Associativity. Designing Structured Programs, Functions, user defined

functions, inter function communication, Standard functions, Scope of Variables, recursion- recursive functions, Limitations of recursion

Unit 2: Statements- If and ElseIf statements in C, Nested if and switch-case statements, Repetition statements -while, for, do-while statements, other statements– break, continue, goto.
Arrays – Concepts, declaration, definition, accessing elements, storing elements, one and two – dimensional arrays, multidimensional arrays, Working with 2-D arrays.

Unit 3: String Handling and Structures – Concepts, C Strings, String Library functions, String Input / Output functions, arrays of strings, string manipulation functions, working with structures. Structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields

Unit 4: Pointers – concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays.
File Handling in C– Function Calls, Call by Value and Call by Reference, Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling), Positioning functions (fseek ,rewind and ftell).

TEXT BOOKS

1: Fundamentals of Computer Programming in C, S.K.Jha, Katson Books.
2: Introduction to C Programming, Reema Thareja, Oxford University Press.
3: Computer Fundamentals and Programming in C, Pradip Dey & Manas Ghosh, Oxford University Press.
4: Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.

REFERENCES

1. Spoken Tutorials for C and CPP from IIT Bombay at https://spoken-tutorial.org.
2. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
3. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
4. Programming in C - Stephen G. Kochan, III Edition, Pearson Eductaion.
5. Data Structures and Program Design in C, R.Kruse, C.L. Tondo, BP Leung, Shashi M, Second Edition, Pearson Education.

List of Practicals:
Program 1. Write a program to print your name.

Program 2. Write a program to print "Welcome to the World of C". See what happens if \n is not included in the print statement.

Program 3. Write a program that identifies several tokens and datatypes used C.

Program 4. Write a program in C for getting the sum of predefined two variables, using function.

Program 5. Write a program in C which identifies the global and local scope of variables.

Program 6. Write a program in C using if else statements to display the range of sum of two user defined integers.

Program 7. Write a program in C which describes the difference of post and pre increment/decrement operators.

Program 8. Write a program in C which demonstrates the operations of Arithmetic Operators.

Program 9. WAP in C to demonstrate the use of several Relational Operators.

Program 10. WAP in C using logical AND and OR operators which displays the functioning of Logical Operators.

Program 11. WAP in C using do-while loop to display the sum of positive integers.

Program 12. WAP in C using single dimensional array to calculate the sum of its elements.

Program 13. WAP in C using arrays to get the sum of two multidimensional arrays.

Program 14. WAP in C using String libraries to illustrate the usage of strings.

Program 15. WAP in C which compares two entered strings.

Program 16. WAP in C which copies the content of a string.

Program 17. WAP in C which determines the length of the content of a string.

Program 18. WAP in C using a structure to obtain the total marks of a student.

Program 19. WAP in C which identifies the different set of pointers used in C.

Program 20. WAP in C which swaps the values using CALL By Reference function.

Program 21. WAP in C which evaluates the cube of a number by using the CALL by Value property of a function.

Program 22. WAP in C which writes the output into a different program illustrating the concept of FILE HANDLING in C.

Mode of Evaluation

Quiz, Assignment	20
Minors	20
Practical examination	50
End term Examination	60
Total	150

Academic Council Approval date:

BIOT-122	**BIOPHYSICS**	L	T	P	C
Date of Approval:		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Objective: The students will learn about the fundamentals of Physics including Newton's Law of Motion, elasticity, and fluid dynamics. They will also study about Kinetic Energy, work and Rotation, waves and sound characteristics of laser and fiber Optics.

Course Outcome: The students will be able to gain knowledge about the fundamentals of Physics including Newton's Law of Motion, elasticity, and fluid dynamics. They would be able to describe the characteristics of Laser and fiber Optics. The knowledge about Radio Activity, Kinetic Energy, Work and Rotation will help the student in understanding the various aspects of Forensic Physics and Ballistics.

Unit I: Newton's Law Of Motion, Elasticity & Fluid Dynamics Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimension;
Interpretation and applications of Newton's laws of motion, Pseudo forces, elastic properties of matter, elastic constants and their interrelations
Fluid dynamics, equation of continuity, Bernoulli's equation, stream line and turbulent flow, lines of flow in air foil, Poiseuille's equation

Unit II: Kinetic Energy and Work, and Rotation Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy.
Rotation: The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation

Unit III: Study of Waves and Sound
Types of waves, transverse and longitudinal waves, wavelength and frequency, speed of travelling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves.
Velocity of sound, noise and sound intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient, acoustics of buildings and factors affecting acoustics of buildings.
Sound distribution in an auditorium, introduction to ultrasonic, production of ultrasonic waves, applications of ultrasonics.

Unit IV: Laser and Fiber Optics
Laser Characteristics, Einstein's co-efficient, Population Inversion and Pumping; types of Laser (Ruby laser, He-Ne, dye laser, semi-conductor lasers), Application of lasers: Industrial & Medical, Holography: construction and reconstruction of images.
Optical fibers, Propagation of light through optical fiber, Angle of acceptance and numerical aperture, losses, Solar cells.

Unit V: Radio Activity
Review of nuclear composition, nuclear properties and half life, Radioactive decay Schemes, Applications of Radio Isotopes, Radiometric dating.

Text & References books:

1. Halliday, Resnick and Walker, **Fundamentals of Physics**, John Wiley & Sons Publication, sixth edition, 2004.
2. R. K. Gaur and S. L. Gupta, **Engineering Physics**, DhanpatRai Publication, 8th Edition, 2010.
3. Feynman, Leighton and Sands, **The Feynman Lectures on Physics -Volume 1**, Narosa Publishing house, 13th edition, 2008.
4. A.P. French, **Vibrations and waves,** CBS Publishers and Distributors, Inc., first Indian edition 1987.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-123	**GENETICS**	L	T	P	C
Dateof Approval:		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Description: It embodies our belief that a good course in genetics should maintain the right balance between two important aspects of the science. The first aspect is that genetics is a body of knowledge pertaining to genetic transmission, function, and mutation. This constitutes the Principles. The second aspect is that genetics is an experimental approach, or a kit of "tools," for the study of biological processes such as development or behavior. This is Analysis. The overall aim of Course: Principles and Analysis, is to provide a clear, comprehensive, rigorous, and balanced introduction to genetics at the college level.

Course outcome:

(a) To Utilize the knowledge in understanding how particular genetic disease transfer from parents to offspring
(b) After learning this course one will understand how closely genes resides on chromosomes
(c) Learning of basic understanding of concept of gene.

UNIT I- Introduction to model organisms and Mendelism: Model organisms: *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Caenorhabditis elegans* and *Arabidopsis thaliana*,

Basic principles of heredity. Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.

UNIT II -Extensions of Mendelism: Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy gene interaction - epistatic and non-epistatic interaction between gene(s) and environment. Penetrance and expressivity.

UNIT III -Genetic definition of a gene: Complementation test, limitations of *cis-trans* test, intragenic complementation, rII locus of phage T4 and concept of cistron.
Mechanism of genetic exchange - conjugation, transformation and transduction.

UNIT IV - Linkage, crossing over and mapping techniques: Linkage and crossing over, genetic mapping in eukaryotes, centromere mapping with ordered tetrads, detection of linked loci by pedigree analysis in humans and somatic cell hybridization Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis.

PRACTICALS-Genetics

1. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
2. Induction of polyploidy in onion roots by colchicine treatment
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
4. Monohybrid crosses in *Drosophila* for studying autosomal and sex linked inheritance.
5. PTC testing in a population and calculation of allele and genotype frequencies.
7. Conjugation in bacteria
8. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
9. Permanent and temporary mount of mitosis.
10. Permanent and temporary mount of meiosis.
11. Demonstration of Law of segregation and Independent assortment
12. Detection of Blood groups (A B O & Rh factors)

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

BSC-204	ENVIRONMENTAL STUDIES	L	T	P	C
Date of Approval:		2	0	0	2
Pre-requisites					
Co-requisites					

Course Objective:

a) To study and understand the impact of development on the environment as well as look at remedies to reduce such adverse impact, so as to make the world a sustainable place to live in.
b) To understand the natural environment and its relationships with human activities to Integrate facts.
c) To learn the concepts and methods from multiple disciplines and apply to environmental problems.
d) To learn types of pollution- Air, water.
e) To learn methods of environmental protection, biological indicators, biosensors.
f) To understand Climate change- Reasons, Greenhouse effect, Global warming.

Course outcomes: The students will be able to:

- Understand various aspects of ecosystem and resources
- Have knowledge about creation of environmental pollution and its effect
- Knowledge about the role of various organizations ion minimization of pollution

Course Contents

Unit I

Environment - Definition, Eco system -- Balanced ecosystem, Human activities - Food, Shelter, Economic and Social Security; Effects of human activities on environment - Agriculture, Housing, Industry, Mining, and Transportation activities, Environmental Impact Assessment. Sustainable Development.

Unit II

Natural Resources - Water resources - Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material Cycles - Carbon, Nitrogen and Sulphur Cycles; Energy - Different types of energy, Electro-magnetic radiation. Conventional and Non - Conventional sources - Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy.

Unit III

Environmental pollution-such as air water, social & noise pollution. Their global, regional & local aspects. Air pollution, Water pollution, Noise pollution, Soil pollution –Their sources, effects on humans, plants & animals and their control.Climate change and Global warming - Effects, Urbanization, Automobile pollution

Unit IV

Acid Rain, Ozone layer depletion, Animal Husbandry; Environmental Protection - Role of Government, Legal aspects, Initiatives by Non - Governmental Organizations (NGO), Environmental Education, Women

Education.

Text Books:

1. Environmental Studies - Benny Joseph - Tata McGrawHill-2005.
2. Environmental Studies - Dr. D.L Manjunath, Pearson Education – 2006
3. Environmental Studies – 2005 by R. Rajagopalan, Oxford Publishers.

Reference Books:

1. Principles of Environmental Science and Engineering - P. Venugopala Rao, Prentice Hall of India.
2. Environmental Science and Engineering - Meenakshi, Prentice Hall India.
3. Gilbert M. Masters, (2004),***Introduction to Environmental Engineering and Science***, 2nd Ed., Pearson
4. Hans-Joachin Joerdening and Josef Winter., (20 05)), ***Environmental Biotechnology***; Concepts and Applications, Willy-VCH Verlag

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-125	**BIOCHEMISTRY-II**	**L**	**T**	**P**	**C**
Date of Approval:		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Objective: To provide comprehensive information on fundamentals of Biochemistry and to provide an in-depth understanding on the origin and history of biochemistry.

It also provides a perspective of research methodology and familiarizes the student with the varied branches of biochemistry, bioinformatics and biostatistics

Course Outcome:

a. Provide basic understanding of carbohydrates, lipids, and proteins and their roles in normal biological processes.

b. Metabolic pathways of carbohydrates along with their roles in providing energy will be discussed in detail.
c. Knowledge about the structural units of proteins, amino acids, and their metabolism will be given.
d. Information about fatty acids and its metabolism and the structural units of genetic code will be provided.
e. Cellular processes involved in the generation of energy will be discussed in detail.

Course contents:

UNIT - II: CARBOHYDRATE METABOLISM

Glycolysis, kreb's cycle. Pentose phosphate pathway, glyoxylate cycle, glyconeogenesis and glycogenesis, glucogenolysis. Anaerobic respiration and basics of fermentation.

UNIT - III LIPID METABOLISM

Biosynthesis of odd and even carbon saturated and Unsaturated Fatty acids, formation of ketone bodies, biosynthesis of triacylglycerole, membrane phospholipids, cholesterol .

UNIT - IV PROTEIN METABOLISM

Metabolic fate of amino group (transamination and deamination), decarboxylation and oxidative degradation of amino acid, Nitrogen excretion and urea cycle.

UNIT - V NUCLEIC ACID METABOLISM

Biosynthesis and break down of purine & pyrimidine nucleotide by De novo and salvage pathway.

Text & References:

1. Principles of biochemistry - Lehniger 3rd ed. McMilklan
2. Biochemistry - G. Zubay
3. Biochemistry - Stryer 5th ed. 2001 W. H. Freeman
4. Biochemistry - Garret and Grasim Pub. Somders college.

Practical:

- Identification of different types of carbohydrates
- Difference between reducing & non-reducing sugar
- Preparation of Buffer solution
- Ninhydrin & Biuret test of protein
- Separation of protein & amino acids
- Enzymatic activity of salivery amylase on carbohydrates
- Identification of different types of vitamins

- Measurement of optical density of biomolecules.
- To determine the acid value of given oil.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

BIOT-126	**PRINCIPLES OF IMMUNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval:		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course description: This course is a foundation course designed to introduce to and to extends basic and fundamental knowledge of Immunology to understand how the immune system functions in health and disease and how immunological therapies can be devised. The evolution of the immune system has been shaped by its need to protect the host from infection and the majority of multicellular organisms have some form of organized immune system that increases in complexity in line with the organism. The course considers the cells and organs of the immune system, their differentiation and how they function to provide innate and adaptive immunity. Antibody structure and function, Antigen-antibody interactions, Immunoassays, hybridoma technology, B and T cell, immunoassay, mono and polyclonal sera are covered in detail.

Course outcomes: On the completion of course, the students will:

• Communicate effectively in oral and written formats using appropriate vocabulary regarding the immunological response, mechanisms of this response, its regulation and the genetic basis.

• Apply scientific principles in the interpretation of immunological responses and data.

• Apply an understanding of the roles of immunology in protection against disease and autoimmune disorders to choices in their daily lives.

Course Content:

Unit-A: Introduction Types of immunity-innate and adaptive; features of immune response-memory, Specificity and recognition of self and non-self; terminology and approaches to the study of immune system; immunity to viruses, bacteria, fungi and tumors; Vaccines

Unit-B: **Cells and organs of the Immune System** Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells; Monocytes, Polymorphs, Primary and Secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphatic traffic

Unit-C: Humoral Immunity and Cell mediated Immunity Antigen-antibody interactions; affinity and avidity; high and low affinity antibodies, immunoglobulins, classes and structure, molecular mechanism of generation of antibody diversity, complement fixing antibodies and complement cascade Polyclonal sera Monoclonal antibodies, Hybridoma technology

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of T-cell antigen receptors

Unit-D: Immunodiagnostic Procedures Various types of immuno-diffusion and immuno-electrophoretic procedures, Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, Haemagglutination and Haemagglutination inhibition

TEXT BOOKS:

- Kuby Immunology, Godsby, R.A. et al. 2000. W.H. Freeman and Company.
- Fundamental Immunology, Robert M. coleman, Mary F. Lanbard and Raymond E.S. Card. 1992. Wm. C. Brown Publishers.
- Immunology, Roitt, I.M., Brostoff. J. and Male, D.K. 1985. Churchil Livingstone.

REFERENCE BOOKS:

- Immune Regulation, Ruben, L.N. and Gershwin, M.E. 1982.
- Comparative Immunology, Cooper, E.L. 1976. Prentice Hall.
- Immunology, Burnet, F.M. W.H. Freeman and Company.
- Immunology – A short course, Benjamini, et al. 2000. Wiley Liss.
- Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
- Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

List of Practicals:

- Differential Leucocytes Count
- Total leucocytes count
- Total RBC count
- Haemagglutination Assay
- Haemagglutination inhibition Assay
- Double immuno-diffusion test using specific antibody and antigen
- Latex agglutination test
- Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods

- Direct and Indirect ELISA
- Antigen-Antibody reactions – Immuno-electrophoresis, Rocket immuno-electrophoresis

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

Third Semester

BIOT-131	**FUNDAMENTALS TO BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course objectives: To gain the basic understanding of subject biotechnology. To recognize the foundations of modern biotechnology and explain the principles that forms the basis for bioremediation, biotechnological tools and animal biotechnology.Use of microorganisms in recovery of minerals of commercial interest is also an interesting area.

Course outcomes

1. Describe the structure of animal genes and genomes.
2. Describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
3. Describe gene transfer technologies for animals and animal cell lines.
4. Describe techniques and problems both technical and ethical in animal and plant cloning.

Unit I

Definition & scope of Biotechnology; Historical developments in biotechnology; need for biotechnology, current uses of biotechnology

UNIT-II

Introduction of genetic engineering; plant and animal tissue culture; fermentation technology; immobilized enzymes; Introduction to gene and genomes, Proteins and proteome; History of genetic manipulations; recombinant DNA technology, DNA fingerprinting and forensic analysis.

Unit III

Genetic modification in animals – animal cloning, cloning method; Producing Genetically modified organisms

Application of biotechnology in agriculture; animal and veterinary sciences, pharmaceutical industry, food industry and chemical industry.

UNIT-IV

Bioremediation and waste treatment biotechnology.

Biotechnology research in India. Biotechnology in context of developing world.

UNIT-V

Brief account of safety guidelines and risk assessment in biotechnology. Ethics in Biotechnology, Intellectual property rights.

REFERENCE BOOKS

1. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
2. Biotechnology -By H.J. Rehm and G. Reed. VIH Publications, Germany
3. Biotechnology - By K. Trehan
5. Industrial Microbiology - By L.E. Casida 6. Food Microbiology - By M.R. Adams and M.O. Moss
7. Introduction to Biotechnology - By P.K. Gupta
8. Bioprocess Engineering - By Shuler (Pearson Education)

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-132	MOLECULAR BIOLOGY	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To understand the structure of nucleic acids & proteins and their interactions.
b. To understand the mechanisms of central dogma of life.
c. To study the molecular mechanisms of gene regulation in prokaryotes and eukaryotes.

Course Outcomes:

a. Exhibit a knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
b. Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology.

c. Exhibit clear and concise communication of scientific data.
d. Engage in review of scientific literature in the areas of biomedical sciences.
e. Critique and professionally present primary literature articles in the general molecular biology field.

Details of Course:

UNIT – I DNA AND RNA STRUCTURE

Nucleic acids and their structure, nucleic acid as genetic material, types of DNA, RNA structure and function

UNIT – II DNA REPLICATION AND REPAIR

DNA replication in prokaryotes and eukaryotes, model of DNA replication, DNA repair: types and mechanism DNA repair in prokaryotes and eukaryotes.

UNIT – III ORGANIZATION OF GENETIC MATERIAL

Packaging of DNA as nucleosides in chromosome, repetitive and unique DNA sequences, split genes, overlapping genes and pseudo genes.

UNIT – IV TRANSCRIPTION IN PROKARYOTES AND EUKARYOTES

Central dogma concept, transcription in prokaryotes: initiation, elongation and termination.

Transcription in eukaryotes: RNA polymerase, transcription factors and initiation RNA synthesis, elongation and termination of RNA synthesis. RNA Splicing

UNIT – V TRANSLATION IN PROKARYOTES AND EUKARYOTES

Initiation and elongation of polypeptide, formation of peptide bond, termination of polypeptide, modification, protein sorting or protein trafficking, protein folding.

UNIT – VI REGULATION OF GENE EXPRESSION

Regulation of gene expression in bacteria- operon concept, inducible and repressible operons (lac and trp), Control of gene expression in eukaryotes.

BOOKS RECOMMENDED:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Practical: Molecular Biology

1. Preparation of solutions for Molecular Biology experiments.

2. Isolation of chromosomal DNA from bacterial cells.

3. Isolation of Plasmid DNA by alkaline lysis method

4. Agarose gel electrophoresis of genomic DNA & plasmid DNA

5. Preparation of restriction enzyme digests of DNA samples

6. Demonstration of AMES test or reverse mutation for carcinogenicity

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

BIOT-133	**MEDICAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Objectives:

a. To understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market.
b. To understand the novel formulation approaches for better delivery of biotechnology derived drugs, such as reverse micelles, liposomes, microemulsions and microencapsulation will be addressed.

Course Outcomes:

a. Demonstrate a systematic knowledge of medical biotechnology at the forefront of research.
b. Have a critical awareness of applications to biomedical science, disease and diagnosis.
c. Demonstrate a comprehensive understanding of the practical, professional and/or research skills necessary for working as a Biotechnologist with the medical sphere.

Unit-I
Methods for diagnosis of human diseases
Karyotyping of human chromosomes
Chromosome banding – G-banding and R-banding technique
Unit-II
Inheritance patterns in Man – Pedigree analysis
Prenatal diagnosis - Invasive techniques – Amniocentesis, Chorionic Villi Sampling (CVS);
Non-invasive techniques – Ultrasonography
Unit-III
Diagnosis using monoclonal antibodies - ELISA
DNA/RNA based diagnosis – HBV, HIV

Unit-IV
Inherited disorders
Chromosomal disorders caused due to structural chromosomal abnormalities (Deletions, duplications, Translocations)
Chromosomal disorders caused due to numerical chromosomal abnormalities (autosomal and allosomal)
Monogenic disorders (autosomal and X-linked diseases)
Therapeutic approaches for human diseases
Unit-V
Gene therapy – ex vivo and in vivo gene therapy; somatic and germline gene therapy
Strategies of gene therapy: Cystic Fibrosis & Familial hyper cholesterolemia
Stem cells – potency definitions; embryonic and adult stem cells; applications of stem cells – cell based therapies and regenerative medicine

REFERENCE BOOKS
1. Medical Biotechnology-PratibhaNallari, V.Venugopal Rao-Oxford Press
2. Introduction to Human Molecular Genetics – J.J Pasternak, John Wiley Publishers.
3. Human Molecular Genetics –Tom Strachen and A P Read, Bios Scxientific Publishers
4. Human Genetics Molecular Evolution, McConkey
5. Principles and Practice of Medical Genetics, I, II, III Volumes by AEH Edts. Emery

Mode of Evaluation	
Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-134	**INDUSTRAIL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. Describe the main steps and processes used to products in industry.
b. Discover new useful microorganisms and store them reliably.
c. Understand ethical and commercial issues such as record keeping.

Course outcomes

1. Describe the main steps and processes used to produce biological products in industry.

2. Evaluate which molecular techniques are applicable to improve production (including transfer of useful genes to microorganisms that are more amenable to large-scale production and the use of molecular techniques to block and enhance specific metabolism).
3. Understand ethical and commercial issues such as record keeping, confidentiality, patenting, and licensing.

Course Detail
UNIT - I

Production of Industrial Food Grade Products: Bakers Yeast, Single cell proteins, Amino acids, Vitamins, Enzymes, Beer, Wine, Acetic acid (Vinegar), Citric acid, Lactic acid.

Production of industrial Biochemicals and Biofuels: Ethanol, Acetone and Butanol.

UNIT - II : Types of Fermentation:

(1) Submerged fermenter systems: Stirred tank fermenter, Air lift fermenter, Fluidized Bed fermenter, Microcarrier bioreactor, Membrane bioreactor, Photobioreactor, Innovative and Special fermenters;

(2) Solid-State Fermenter Systems: Laboratory and Industrial Scale SSF Fermenter.

Configurations: Range and Component parts of fermentation processes.

UNIT – III Stages in Industrial Fermentation Process:

(1) Upstream Processing: design preparation, substrates, and sterilization of fermentation media; Optimization of fermentation media and inoculation.

(2) Fermentation process: Modes of operation- Batch fermentation, Continuous fermentation process, Fed Batch fermentation; Inoculum preservation, Growth of the inoculum, Fermenter preculture, Production fermenter-fermenter size, temperature, aeration, agitation and pressure; Process monitoring and control.

UNIT- IV

Downstream processing: Removal of insolubles, product isolation, product purification, product polishing.

Scale Up of fermentation processes

Asepsis in fermentation processes

Unit V:

Quality Control, Process Economics and GLP: Sterility testing. Toxicity testing. Good Laboratory Practices.

RECOMMENDED BOOKS:

1. Casida L.E (1991) - Industrial Microbiology, Wiley Eastern, New Delhi.
2. Crueger W and Crueger A (2000) - Biotechnology: A Textbook of Industrial Microbiology, 2nd Edi. Panima Publishing Corporation, New Delhi.
3. Patel A.H. (2004) - Industrial Microbiology, Macmillan India Ltd.,New Delhi.

4. Peppler H.J and Perlman D (2006) - Microbial Technology,Vol I and II,Academic Press, New York.
5. Stanbury P.F., Whitaker A. and Hall S.J (1997) - Principles of Fermentation Technology

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-135	**ANIMAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To recognize the foundations of modern biotechnology and explain the principles that forms the basis for bioremediation, biotechnological tools and animal biotechnology.
b. The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology.
c. Use of microorganisms in recovery of minerals of commercial interest is also an interesting area.

Course outcomes

5. Describe the formulate proposals to convert ideas of engineering solutions and Present scientific papers in environmental biotechnology.
6. Describe the structure of animal genes and genomes.
7. Describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
8. Describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
9. Describe gene transfer technologies for animals and animal cell lines.
10. Describe techniques and problems both technical and ethical in animal cloning.

Course contents

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, *Coccidiosis*, *Trypanosomiasis*, *Theileriosis*.

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

RECOMMENDED BOOKS

1. Animal Cell Culture Techniques-Martin Clynes
2. Culture of Animal Cells- R.Ian Froshney
3. Animal Cell Culture- Practical Approach-John R.W.Misters.
4. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.

Practical:

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization

2. Sources of contamination and decontamination measures.

3. Preparation of Hanks Balanced salt solution

4. Preparation of Minimal Essential Growth medium

5. Isolation of lymphocytes for culturing

6. DNA isolation from animal tissue

7. Quantification of isolated DNA.

8. Resolving DNA on Agarose Gel.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

FORTH SEMESTER

BIOT-141	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
Date of Approval		3	0	2	4
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques in genetic engineering.
b. Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes.
c. Apply research based knowledge and biotechnological methods to investigate complex biological problems.
d. To apply Recombinant DNA Technology for the human welfare.

Course Learning Outcomes:

a. Learn about the vectors and their ideal characteristics.
b. Understand different methods of recombinant DNA techniques like labeling DNA, PCR and gene sequencing.
c. Gain knowledge about prokaryotic and mammalian expression vectors and cloning in plants.
d. Learn about preparation of genomic and cDNA libraries, mutagenesis, and cloning techniques for altering gene expression.

Details of Courses:

UNIT – I

Gene cloning and need to clone a gene; Isolation and purification of plasmid, chromosomal and genomic DNA from bacterial, plant and animal cells.

UNIT – II

Different cloning vectors like plasmids, cosmids, phagemids, shuttle vectors, and other vectors for plant and animals; enzymes used in recombinant DNA technology like restriction endonucleases, ligases, polymerases, kinases and phosphatases.

UNIT – III

Generation of genomic and cDNA libraries in plasmid**;** Expression of recombinant proteins using bacterial, animal and plant vectors.

Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice,

UNIT – IV

A brief introduction to the followings: phage display system, Yeast two hybrid system; DNA sequencing methods

UNIT – V

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants

Applications of recombinant DNA technology in the fields of Medicine, Agriculture, Forensic and Environment.

PRACTICAL

- Digestion of plasmid DNA by restriction endonuclease;
- Isolation of chromosomal DNA from plant cells
- Isolation of chromosomal DNA from *E.coli*
- Ligation assay;
- Making competent cells
- Demonstration of PCR

SUGGESTED READING

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington

4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.

5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

6.Watson, J. (5th ed.) : Molecular Biology of the Gene, Benjamin, Cummings, Pearson education, Schweiz AG, Germany, 2004.

7.Alberts, B. *et al* . : Molecular Biology of Cell, Garland Publishers Inc.,London,1994.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

BIOT-142	GENOMIC ANALYSIS	L	T	P	C
Date of Approval		3	0	0	3
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. Genome analysis entails the prediction of genes in uncharacterized genomic sequences.

b. The objective is to be able to take a newly sequenced uncharacterized genome and break it up into introns, exons, repetitive DNA sequences, transposons etc. and other elements.

Course outcomes

1. Explain genomic medicine.
2. To review early triumphs, and potential limitations of Genetic diseases.
3. Impart the knowledge for genomic medicine, Guiding treatment, Risk assessment, Early detection/prevention, Diagnostics.
4. Analysis and designing of new Gene.
5. Apply the genetics for the production of Genetically Modified Crops.

Course Details:

UNIT - I STRUCTURE OF PROKARYOTIC AND EUKARYOTIC GENOME

Basic structure of prokaryotic and eukaryotic genome.Chromatin model, concept of gene, linkage and crossing linkage analysis in *Drosophila* and *Neurospora*.

UNIT - II GENETIC MAPPING

Pedigree analysis in human. Genetic mapping and its genetic mapping of complex character. Multigene families in human genome and repetitive DNA valve paradox and complexity of genome.

UNIT - III PHYSICAL MAPPING OF GENOME

Physical mapping genome- chromosome walking. Chromosome painting, FISH, GISH ZOO BLOT, DOT BLOT , VNTR, RFLP, RAPD, SNPs, QTLS, EST, CpG island identification.

UNIT - IV EXON TRAPPING AND SEQUENCE ANALYSIS

Exon trapping and sequence analysis. Rice genome project and its applicability.

UNIT – V HUMAN GENOME PROJECT

Human genome project and its application to future of man.

RECOMMENDED BOOKS:

1. Genetics:Griffith and Suzuki
2. Principles of Genetics:Gardner 8th Ed.2002 Oxford University
3. Genes VIII: Benzamin Lewin Ist Edition, 2003, Oxford University.
4. Genome: T.A. Brown 19999 John Wiley & sons

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-143	**PLANT BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To comprehend the concepts of plant tissue culture techniques

b. To learn the In vitro study of plant secondary metabolites.

c. To understand the technology of plant transformation

d. To study of conventional and molecular marker breeding techniques.

Course Outcomes:

a. Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components,
b. Explain the various steps taken to establish and optimise media for particular purposes in particular species, without the aid of texts.
c. Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.
d. Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.
e. Investigate and define a protocol to establish an unknown species and test its response.

Course detail:

UNIT- I PLANT TISSUE CULTURE LABORATORY AND MEDIA

Introduction to plant cell and tissue culture, historical perspectives, laboratory organization, tissue culture media- composition and preparation.

UNIT – II CELL CULTURE, ORGANOGENESIS, EMBRYOGENESIS AND PRODUCTION OF HAPLOID

Callus formation, organogenesis, protoplast isolation, culture and fusion; selection of hybrid cells and production of somatic hybrid, somatic embryogenesis; somaclonal variation, and application in crop improvement. Production of haploid and homozygous diploid lines through embryo culture, anther and pollen culture.

UNIT - III REGENERATION, PRODUCTION, PRESERVATION AND SELECTION OF PLANT CELLS

Plant regeneration, production of "synthetic seeds. Cryopreservation for germplasm conservation, clonal and micropropogation. Production of pathogen free plant. Production of plant cell line and its applications.

UNIT – IV GENETIC ENGINEERING IN PLANT

Gene constructs and vector for the production of transgenetic plant. Techniques for plant transformation: *Agrobacterium* mediated transformation, physical methods of gene transfer, production of human protein in plant cell (planti bodies) and pharmaceutically useful proteins in plants. Biosafety regulations relating to transgenic plants.

UNIT – V PRODUCTION OF TRANSGENETIC PLANT

The genetic manipulation of herbicide tolerance, insect resistance, weedicides resistance plant Genetic modification of plant for biotic and abiotic resistance. Improvement, yield and quality in crop plant.

PRACTICALS

- Selection, preparation and sterilization of explant and laboratory wares.
- Aseptic culture techniques for establishment and maintenance of cultures.
- Preparation of stock solutions of MS (Murashige and Skoog) basal medium and plant growth regulator stocks.
- Production Callus from different tissues of plant.
- Isolation and culture of protoplasts.
- Plant regeneration by embryo/ anther /pollen culture.
- Performance of *Agrobacterium* mediated gene transformation in plant.
- Performance of gene transfer by physical delivery method.
- Isolation of plant genomic DNA by modified CTAB method.

SUGGESTED READING

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.

2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.

3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.

4. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date:

BIOT-144	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To be able to describe basic energy concepts, account for conventional and renewable energy technologies.
b. To be able to demonstrate the energy balance and cost reduction in transport and process industries and general energy use pattern and its impact on environment.
c. To understand the physical concept of energy and learn to identify it in the world around.

Course outcomes

1. Recall the history and process in drug discovery with respect to specific drug types.
2. Understand drug design, development and its evaluation through various stages of preclinical steps.
3. Demonstrate the process of drug design, development and its evaluation through various stages of clinical trials
4. Describe the processes involved in clinical data management and practices referring to the regulatory mechanisms involved.
5. Appraise the guidelines for GCP and Drug regulatory affairs.

Course Detail:

UNIT - I PHARMACOKINETICS

Pharmacokinetics. Physiologically based Pharmacokinetics (PB-PK). Pharmacokinetics / Pharmacodynamics (PK/PD) modeling. Application of pharmacometric in Drug development. Clinical trial, design and simulation. Biostatistical methodologies.

UNIT - II PROJECT PLANNING AND MANAGEMENT

Project planning and management. Matrix management. Decision making. Cross functional team communications. Resource allocation. Time management.

UNIT - III CLINICAL DEVELOPMENT PROCESS AND PHASES

Laws, regulation, guidelines, polices and proceeding. Clinical development, process and phases. Phase- IV commitments. Labeled driven drug development. Interaction with regulatory agencies: Do's and Don'ts.

UNIT - IV CLINICAL TRIALS

Clinical Trials: First time in humans. First entry. Multiple dose time. AME/Radiolabeled studies. Food effects studies. Drug-drug interaction studies. Accelerating the clinical trial process.

UNIT - V ENZYME IMMOBILIZATION

Enzyme immobilization. Techniques employed for enzymes immobilization and its application in industry. Factors affecting enzyme Kinetics. Immoblization of microbial and plant cells. Study of hyaluronidase, penicillinase, streptokinase amylases and proteases. Biosensors.

RECOMMENDED BOOKS

1. Goodman Gillman's The Pharmacological Basis of Therapeutics (2001) Ed. Hardfman JG, Limbird LE (10 edition) McGraw Hill Press, New York.
2. Applied Biopharmaceutics and Pharmacokinetics (1999) Ed. Sargel L; (4 edition), prentice Hall International, London.
3. Fundamentals of Experimental Pharmacology. (1984) Ed. Ghosh MN. Scientific book Agency, Kolkata.
4. Textbook of Receptor Pharmacology, Eds. Forman JC, Johansen TJ, CRC Press, New York, 1996.
5. Drug Discovery & Evaluation – Pharmacological Assays. (1997) Ed. Vogel HG & Vogel WH. Springer New York.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-145	MICROSCOPY	L	T	P	C
Date of Approval		3	0	0	3
Pre-requisites					
Co-requisites					

Course Objective:

To impart knowledge regarding the various types of Microscopes used in analyzing samples obtained in the Forensic Science Laboratory and the different principles governing it

Course Outcome:
On completion of this course, students would learn about the various types of microscopes like Simple microscope, Compound microscope, Comparison microscope, Stereo microscope, SEM and Fluorescence microscope and their important parts, functions and their application in Forensic Science.

Course Contents:

UNIT I: Introduction: Definition of microscopy, different types of microscopes its important parts and their functions, Scope of microscopy in Forensic Science, elementary theory of microscope: light and lenses

UNIT II: Microscopes – 1 Simple microscope: Components, performance criteria and uses Compound microscope: Components, performance criteria and uses

UNIT III: Microscopes – 2 Comparison microscope: Components, performance criteria and uses Stereomicroscope: Components, performance criteria and uses

UNIT IV: Microscopes – 3 SEMmicroscope: Components, performance criteria and uses TEM microscope: Components, performance criteria and uses

UNIT V: Microscopes – 4 Polarizing Microscope, components, performance criteria and uses Fluorescence microscope: Components, performance criteria and uses Phase-contrast Microscope: Components, performance criteria and uses

Text & References:

- Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001.
- Saferstein, R., Forensic Science Handbook, Prentice Hall, New Jersey, 1982.
- Nicholas, Microscopy for criminalist Chemist and conservation
- John R. Vacca, Computer Forensics : Computer Crime Scene Investigation, 2003
- Edward M Robinson, Crime Scene Photography
- Herbert L Blitzer, Forensic Digital Imaging and Photography,

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

Fifth Semester

BIOT-151	GENOMICS & PROTEOMICS	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. Understand organization and structure of prokaryotic, eukaryotic and organellar genomes.
b. Study molecular markers, DNA sequencing and bioinformatic tools for genome analysis.
c. Analyse gene expression
d. Comprehend the techniques of protein separation, sequencing, identification and protein-protein interactions.
e. Understand the clinical and biomedical applications of proteomics.

Course Outcomes:

a. Recall and relate the role of genes, genetic code, recombinant methods in rDNA technology.
b. Describe the role of various enzymes in genetic manipulation.
c. Make use of the techniques involved in isolation, purification and separation of nucleic acids.
d. Apply rDNA technology in various fields using suitable methodology.
e. Appraise the use of genetic engineering principles for gene therapies

Course detail:

UNIT I Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam and Gilbert and Sangers method. Chain termination method, Pyrosequencing, Genome Sequencing methods: Shotgun &

Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organismal Genomes and Databases.

UNIT III Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT IV Introduction to Proteomics, The proteome. Analysis of proteomes. 2DPAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

SUGGESTED READING

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.

2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.

3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.

5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.

6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.

7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

8. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-152	INSTRUMENTATION AND TECHNIQUES	L	T	P	C
Date of Approval		3	0	2	4
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To introduce students to the use of basic biological research instrumentation
b. To develop the laboratory skills and techniques required to design experimental protocols and test hypotheses utilizing basic laboratory research equipment
c. To develop and improve scientific writing and oral communications skills based upon laboratory experiences and ability to think critically.

Course Outcome:

1. Explain the basic principles of analyses and detection systems involved in photometric, fluorometric and luminescence -based methods.
2. Explain principles of electrophoresis and chromatography and discuss how these techniques can be used in molecular medicine.
3. Explain basic principles for chromatographic separation techniques.

Course details

UNIT I Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

PRACTICAL-**Instrumentation and techniques**

2. Study of different parts of simple and compound microscopes
3. Preparation of Solutions and buffers
4. Study of different parts of centrifuge and types of rotors
5. Study of electrophorectic apparatus
6. TLC separation of Amino acids /sugars
7. Determination of Iodine number of a fat
8. Verification of Beer's Law Spectrophotometrically.

BIOT-153	**INTRODUCTION TO BIOSTATISTICS**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. Describe the roles biostatistics serves in public health and biomedical research.
b. Assess data sources and data quality for the purpose of selecting appropriate data for specific research questions.
c. Translate research objectives into clear, testable statistical hypotheses.

Course outcomes:

1. Demonstrate knowledge of the important ecological principles operating at different levels of organization.
2. Critically analyse research methodologies identified in existing literature.
3. Propose and distinguish appropriate research designs and methodologies to apply to a specific research project.
4. Use basic and modern statistical software to analyse the biological and clinical data.
5. Develop a comprehensive methodology for a research question.
6. Apply the understanding of feasibility and practicality of Statistical methods.

UNIT I INTRODUCTIO OF BIOSTATISTICS

Definition of statistics, scope of statistics, Definition of Biostatistics, Collection of data, Multiplication theorem on probability, Function of statistics.

UNIT II MEASUREMENT OF CENTRAL TENDENCY

Type of averages, Arithmetic mean, Median, Mod, Binomial distribution, Poisson distribution, Normal distribution, Cumulative distribution, (Distribution Function) Expectation of the random, variable, Variance and standard deviation, Frequencies distribution.

UNIT III TESTING OF SIGNIFICANCE

Student ‘t’ distribution, Properties of ‘t’ distribution, critical values of ‘t’, student ‘t’ test, sample and sampling, Chi-square and F test, type of hypothesis

UNIT IV MEASURES OF VARIATION

Characteristics of a good measure of dispersion, Different measures of dispersion, Range standard deviation, Mean deviation, coefficient of variation, Relation between measures of dispersion.

UNIT V CORRELATION AND REGRESSION

Types of correlation, Positive correlation, Negative correlation, Scatter Diagram, Regression co-efficient, Properties of Regression co-efficient, Properties of Regression Line, Difference between Correlation and Regression

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA

2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA

3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.

4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

Course Code	Course Name	L	T	P	C
BIOT-154	**Minor Project**	**0**	**0**	**0**	**6**

Course Objective: A term (or research) paper is primarily a record of intelligent articulation through several sources on a particular topic of a given subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned/chosen. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned/chosen. The evaluation will be done by Board of examiners comprising of the faculties.

Course Outcome: A term paper will help to orient the students to research ideas. It will give them an idea how different research works are done. Also how they can formulate their own research ideas and draft them.

The procedure for writing a term paper may consist of the following steps:

1. Choosing a topic
2. Finding sources of material
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

Term papers should be composed of the following sections:

1) Title page
2) Abstract
3) Introduction
4) Review of the Literature
5) Discussion&Conclusion
6) References
7) Appendix

The Layout Guidelines for the Term Paper:

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Assessment Scheme:

Continuous Evaluation: 30%
(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)

Final Evaluation: 70%
(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)

SIXTH SEMESTER

BIOT-161	**DNA Fingerprinting**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**

Pre-requisites	
Co-requisites	

Course Objective: To understand the genetic basis of DNA Fingerprinting, types and techniques of DNA Fingerprinting, Polymerase Chain Reaction technique and the practical applications and forensic importance of DNA Fingerprinting. To know the types of evidences that are collected for conducting DNA Fingerprinting.

Course Outcome: On completion of this course, the students would understand the genetic basis of DNA Fingerprinting, types and techniques of DNA Fingerprinting, Polymerase Chain Reaction technique and the practical applications and forensic importance of DNA Fingerprinting. They would also know the types of evidences that need to be given importance for conducting DNA Fingerprinting.

Course Contents:

UNIT I: Introduction : Definition, importance in Forensic Science; collection and types of evidences for DNA fingerprinting, Genetic basis of DNA Fingerprinting**,** Chromosomes, DNA, Nuclear DNA and Mitochondrial DNA

UNIT II: Techniques of DNA Fingerprinting
Isolation, southern blots, radioactive probe, Hybridization reaction, visualization, FTA cards for isolation of DNA

UNIT III: Types of DNA Fingerprinting:
Single locus DNA fingerprinting, multi – locus DNA Fingerprinting, Mini satellite, micro-satellite, VNTR, HLA-DQα, STRs, RFLP

UNIT IV: Polymerase Chain Reaction
Instrumentation, principle, significance in forensic case samples.Denaturation,annealing and extension, Detection of PCR products.

UNIT V: Practical application of DNA Fingerprinting
Paternity and maternity testing, personal identification, criminal identification and Forensic importance; DNA databank, limitations of DNA Fingerprinting, legality of DNA Fingerprinting in India

Text & References:

- Norah Rudin and Keith Inman, (2^{nd} Ed): An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002.
- Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3^{rd}Edn) Universal Law Publishing
- Co. Ltd. New Delhi, 2001.
- John M. Butler, Forensic DNA Typing

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.: 20 Marks

Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-162	**FOOD BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To train students about Quality Control and Food Safety, Nutrition and Food Science.

b. To ensure the quality of training for students, to link training with research and practical application.

c. To integrate fundamental and applied research across dairy, seafood, wine, beer, fruit, and vegetable categories to provide value-added solutions to current and future problems encountered by food and beverage processing industry.

Course Learning Outcomes:

a. Understanding the various causes of food deterioration and food poisoning. Identification of appropriate processing, preservation, and packaging method.
b. Analyze product quality and effect of processing technique on it.
c. Identify important species of pathogenic microbes and describe factors that affect their growth in various types of food.
d. Analysis of food related hazards and Hazard Analysis Critical Control Point (HACCP) method.

Details of Courses:

UNIT – I INTRODUCTION

Historical highlights, important genera of food borne microorganisms, factors affecting the growth and survival of microorganisms in food.

UNIT – II MICROBIOLOGICAL EXAMINATION OF FOOD

Direct examination, culture techniques, MPN count, dye reduction assay, immunological methods and advance techniques.

UNIT – III FOOD PRESERVATION

Principles of food preservation, asepsis, anaerobic conditions, removal of microorganisms, low temperature, high temperature, radiation, drying, chemical preservatives and miscellaneous methods, canning.

UNIT – IV FOOD SPOILAGE

Microbial spoilage of food, common food borne diseases, bacterial agents of food borne illness, non-bacterial agents of food borne illness.

UNIT – V FERMENTED FOODS

Fermented milk, cheese, sauerkraut, fermented meat, beer, vinegar, fish products, products of baking, oriental foods. Role of enzymes in different food products (bakery, cheese, beverage production and cereal products) and industries, utilization of food waste for production of valuables.

UNIT – VI QUALITY CONTROL USING MICROBIOLOGICAL CRITERIA [6Hrs]

Cleaning and disinfection code for good manufacturing practices, microbial and chemical safety of food products, indicator organisms, ISO, hazard analysis and critical control points, sterility testing.

BOOKS RECOMMENDED:

- Modern Food Microbiology by James M. J., CBS Publishers and Publishers.
- Food Microbiology by Freiser.
- Willis Biotechnology, Challenges for the flavour and food industries by Lidsay, Elsevier Applied Science.
- Food Biotechnology by Roger A., Gordan B., and John T.
- Basic Food Microbiology by George J. B., CBS Publishers and Distributors.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-163	**CYTOGENETICS**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**0**	**3**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. Describe the molecular methods for identifying balanced genomic rearrangements
b. Contrast the clinical utility and limitations of current and evolving technologies for balanced genom ic rearrangement detection
c. Differentiate how evolving technologies will answer clinical questions historically answed by conv entional cytogenetics
d. Learn about future applications and techniques in cytogenetics

Course outcomes

a. Understand cell division, cell cycle and signal transduction.
b. Understand the structure, functiona and types of chromosomes.
c. Apply rDNA technology in various fields using suitable methodology.

Course details:

UNIT-I CHROMOSOME STRUCTURE: Chromosomal theory of inheritance, Interphase nucleus, Nuclear matrix and other structures, Molecular organization of prokaryotic and eukaryotic chromosomes, Nucleosome structure, Chromosomal protein, DNA scaffolds and loops, Chromomere, Kinetochores, Cenromeres & Telomeres, Heterochromatin & Euchromatin.

UNIT-II CELL DIVISION: Mitotic and meiotic transmission of chromosomes, Lampbrush chromosomes: Types, occurrence, organization and biological significance. Polytene chromosomes: Occurrence, structural organization and their functional role.

UNIT -III CHROMOSOME MUTATIONS: Changes in chromosome structure, Origins of changes in chromosome structure. Deletions, duplications, inversions and translocations. Genetic significance of non-Robertsonian chromosome changes.

UNIT -IV CHANGES IN CHROMOSOME NUMBER: Anueuploidy: Causes and consequences. Polyploidy: Occurrence, types and genetic significance, Overview of chromosome dynamics during cell division. Mechanisms of chromosome inheritance.

PRACTICALS

1. Karyotyping of normal & abnormal human chromosome sets
2. Human pedigree analysis
3. ABO blood grouping and Rh typing.
4. RBC counting using a haemocytometer.
5. Permanent slide analysis for chromosomal abrasions.

Suggested Readings & References

- Hamerton, J. L., 1984. Human Cytogenetics. Vols. I &II. Academic Press, N.Y.
- White, M.J.D., 1973. Animal Cytology and Evolution, Cambridge University Press.

- Gardner, Simmons, & Snustad, 1997. Principles of Genetics 8th Ed., John Wiley and Sons.
- Lewin, B., 1996. Genes VI, John Wiley and Sons.
- Sambamurthy, A.V.S., 1999. Genetics, Narosa Publishing House, New Delhi.

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Major:	60 Marks
Total:	**100 Marks**

Academic Council Approval date:

BIOT-164	**ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Date of Approval		**3**	**0**	**2**	**4**
Pre-requisites					
Co-requisites					

Course Learning Objectives:

a. To explain the importance of microbial diversity in environmental systems, processes and biotechnology.
b. To describe existing and emerging technologies that are important in the area of environmental biotechnology.
c. To describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling.
d. To analyse case-studies representative of key areas of environmental biotechnology.
e. To understand the practical approaches relevant to environmental microbiology and biotechnology and record.

Course Outcomes:

a. Evaluate the significance and the main technologies used in environmental biotechnoogy.
b. Describe methods used to detect and identify microorganisms in the environment.
c. Describe and solve problems relating to basic concepts in biological nutrient removal.
d. Use of various approaches to anaerobic digestion of wastes and solve related problems**.**

UNIT I

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT III Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT IV Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

PRACTICALS

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.

SUGGESTED READING

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter 4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
5. Agricultural Biotechnology, S.S. Purohit
6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters

Mode of Evaluation

Quiz, Assignment, Seminar and Attendance etc.:	20 Marks
Minors:	20 Marks
Practical	50 Marks
Major:	60 Marks
Total:	**150 Marks**

Academic Council Approval date: