PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

HOLY CROSS COLLEGE (AUTONOMOUS)

Affiliated to Bharathidasan University
Nationally Accredited (4th Cycle) with 'A++' Grade(3.75 /4) by NAAC
College with Potential for Excellence.
Tiruchirapalli - 620002.

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc. Biotechnology

PO No.	**Programme Outcomes** ***Upon completion of the B.Sc. Degree Programme, the graduate will be able to***
PO-1	Obtain hands-on experience in state of art laboratory techniques.
PO-2	Acquire basic and specific skills to full fill the manpower need of biotechnological industries.
PO-3	Gain knowledge in the scientific development and problems involved with the national and international community.
PO-4	Acquire self-confidence and determination to become entrepreneur and startup.
PO-5	List opportunities in reputed companies, research institutions for higher education towards teaching and research.

PSO No.	**Programme Specific Outcomes** ***Upon completion of the courses the student would be able to***
PSO-1	Gain knowledge on basic tools and techniques learnt for designing and performing new experiments.

PSO-2	Decide and apply suitable tools and techniques in biotechnological manipulation (data analysis, soft skill, biotechnological manipulation, team work, laboratory documentation).
PSO-3	Understand and acquire knowledge on ethical legal issues, innovations in environment, health sector and agriculture; and there by implementation for finding sustainable solution to issues pertaining to environment upliftment.
PSO-4	Learn and identify the existing needs and narrow down their specific field of interest.
PSO-5	Able to equip her reading, presenting, oral, verbal and written scientific communication skills in focusing higher education.

(For The Candidates Admitted From 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI – 2

COURSE CONTENT AND SCHEME OF EXAMINATIONS

SCHOOL OF LIFE SCIENCES

DEPARTMENT OF BIOTECHNOLOGY- CHOICE BASED CREDIT SYSTEM

UG COURSE PATTERN B.Sc. BIOTECHNOLOGY

Semester	Part	Course	Title of the Paper	Code	Hrs/ Week	Credit	Marks
I	I	Language	Tamil paper I/ Hindi paper I / French paper 1	U20TL1TAM01/ U20HN1HIN01/ U20FR1FRE01	3	3	100
	II	English	English Paper 1	U20EL1GEN01	3	3	100
	III	Major Core -1	Cell Biology	U20BT1MCT01	4	3	100
		Major Core -2	Microbial Technology	U20BT1MCT02	4	4	100
		Major -Core Practical - 1	Main Practical I- Cell Biology+ Microbial Technology	U20BT1MCT03	5	4	100
		Allied-1	Biomolecular Chemistry	U20BC1ALT01	4	2	100
		Allied-2	Biochemistry-Practical	U20BC1ALP01	4	2	100
	IV	Environmental studies	Environmental studies	U20RE1EST01	2	1	100
		Value Education	Bible/Catechism/Ethics	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1		-
		Extra credit	Internship/Field Work/Field Project- 30 hours. Extra Credit	U20SP1ECC01	-	2	100

		Service Oriented Course			1		
				Total	**30**	**24**	**900**
Semester	**Part**	**Course**	**Title of the Paper**	**Code**	**Hrs/ Week**	**Credit**	**Marks**
II	I	Language	Tamil paper II/ Hindi paper II / French paper II	U20TL2TAM02/ U20HN2HIN02/ U20FR2FRE02	3	3	100
	II	English	English Paper II	U20EL2GEN02	3	3	100
	III	Major Core 3	Human Molecular Genetics (Theory cum Lab)	U20BT2MCT04	4	4	100
		Major Core 4	Biostatistics & SPSS(Theory cum Lab)	U20BT2MCT05	5	4	100
		Major Elective 1	Botany/Biochemistry/Zoology/Chemistry/Computer Science	-	4	3	100
		Allied 3	Biochemistry-II	U20BC2ALT03	4	2	100
	IV	Major Skill based Elec- 1	Dairy Microbiology (Lab)/ Computer Literacy for Biotechnology	U20BT1MST01/ U20BT1MST02	2	1	100
		Skill Based Course-1	Soft Skill Development	U20BT1SBT02	2	1	100
		Skill Based Course-2	Rural Enrichment and Sustainable Development	U20BT1SBT03	2	1	100
		Value Education	Bible Studies /Catechism / Ethics	U20VE2LVE01/ U20VE2LVB01/ U20VE2LVC01	1	1	100
		Summer Internship/Field Work/Field Project 30 hours- Extra Credit		U20SP2ECC02	-	2	100
		Service Oriented Course		-	-	-	-
				Total	**30**	**25**	**1100**

LIST OF ALLIED COURSES OFFERED BY THE DEPARTMENT

S.No.	Semester	Part	Component	Title	Code	Hours	Credits	Marks
1	I	III	Allied 1	Basics of Bioinformatics (for Biochemistry students)	U20BT1ALT01	4	2	100
2	II	III	Allied 1	Biostatistics (For BioChemistry students)	U20BT1ALT03	4	2	100

LIST OF MAJOR ELECTIVE COURSES OFFERED BY THE DEPARTMENT

S.No.	Semester	Part	Component	Title	Code	Hours	Credits	Marks
1	I	III	Major Elective	Nanoscience and Nanotechnology for Chemical Science	U20BT2MET01	4	3	100

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HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – I

Course Title	**Major Core 1 – Cell Biology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U20BT1MCT01**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

Student learns the ultrastructural details and functions of cellular organelles such as cell membrane, lysosomes, mitochondria, ribosome, endoplasmic reticulum, Golgi complex, centrosome, nucleus and chromosomes. They also learn the cell division – mitosis and meiosis. Student also learns the structure and replications of DNA, transcription, post transcriptional modification, structure and functions of RNAs, translation and post translational modification.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO1	Identify the basic structure and functions of a living cell and differentiate between prokaryotic and eukaryotic cells.

CO2	Comprehend the ultrastructure and functional roles of all the cellular organelles.
CO3	Outline the role of autonomous and semi-autonomous organelles in the cell.
CO4	Demonstrate the organization, ultrastructure and chemistry of specialized types of chromosomes.
CO5	Explain the basic mechanics of cell division and cell cycle control.

UNIT I **12hrs**

Discovery of Cell and Cell theory:

Cell as basic unit of life: Viral, bacterial, fungal, plant and animal cells. **Ultra structure cell:** Prokaryotic & eukaryotic cell

Extra Reading (Key words): *Stem Cell*

UNIT-II **12hrs**

Plasma Membrane: Ultrastructure -Unit membrane and Fluid mosaic models; Modifications; Permeability Functions- Passive, Facilitated, Active, Exo and Endocytosis; Introduction to signal transduction. **Ribosomes:** Structure – Composition and Assembly - Functions.

Endoplasmic Reticulum: Ultra structure - Types – Protein trafficking- Other functions. **Golgi Complex**: Ultra structure - Role in cell secretion

Extra Reading (Key words): *Vesicular traffic in secretion*

UNIT III **12hrs**

Nucleus: Ultrastructural Organization – Functions**. Semi- autonomous Organelles:** **Mitochondria** -Ultra structure – chemistry and functions & Chloroplast - Endosymbiotic theory. **Lysosome**: Polymorphic forms, Cytochemistry – Functions.

Extra Reading (Key words): *Red hot mitochondria*

UNIT IV **12hrs**

Chromosomes: Prokaryotic & eukaryotic -Organization - Chemistry- Functions. **Centrosome**: Ultra structure and Functions. **Structure of specialized chromosomes**: Polytene and Lamp Brush– Organization and functions.

Cytoskeleton-Microfilaments and Intermediate Filaments, Microtubules, Role of cytoskeleton in motility.

Extra Reading (Key words): *Free chromosomal region*

UNIT V **12hrs**

Cell division: **Mitosis -** Stages- Spindle mechanics- mitotic inhibitors, **Meiosis** – Stages – Significance.

Cell Cycle control. Programmed Cell Death.

Extra Reading (Key words): *Check points of cell cycle*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Differentiate between structural and functional details of prokaryotic and eukaryotic cells.	PSO-3	An
CO-2	Illustrate the detailed structural aspects of cell organelles.	PSO-1	R
CO-3	Exemplify the basic signal transduction and protein trafficking mechanism.	PSO-3	U
CO-4	Explain the ultrastructure and functions of the nucleus, mitochondria and chloroplast.	PSO-2	U
CO-5	Categorize chromosomes based on their structural organization and specialized functions.	PSO-3	Ap
CO-6	Relate to the different stages of mitosis and meiosis.	PSO-4	E
CO-7	Explore the basis of cell cycle control mechanism and programmed cell death.	PSO-4,5	Ap

The learner will be able to cultivate laboratory skills to enhance understanding of cell structure and function while participating in a group environment.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

Text Book

1. Agarwal**,** V.K., (Latest Edition). Molecular Biology, S. Chand and Company Ltd., New Delhi
2. Verma P.S. & Agarwal V.K. (Latest Edition). Cell Biology, S.Chand and Company Ltd, New Delhi.

Reference Books

1. Geoffrey M.Cooper/Robert E.Hausman- Sinauer Associates, Inc 6th Edition, The Cell- A Molecular Approach.
2. Freifelder, D. (Latest Edition), Essentials of molecular Biology, fourth edition, Jones and Bartlett Publications Inc.
3. De Robertis DP (2012) Cell and Molecular Biology, 8th Edition, Lippincott Williams and Williams.
4. Gerald Karp, (2013), Cell Biology, VII edition Internationl Student Version, Wiley publication.
5. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Matthew P. Scott, (2018), Molecular Cell Biology, VII edition, W.H. Freeman and Company, New York.
6. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, (2002), Molecular Biology of the Cell, IV edition, Garland Publishing, New York.
7. Stephen R.Bolsover et al – John Wiley& Sons - Cell Biology, A Short Course.

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc. Biotechnology

First Year - Semester – I

Course Title	**Major Core 2- Microbial Technology**
Total Hours	**60**
Hours/Week	**4Hrs Wk**
Code	**U20BT4MCT02**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

The student gains basic knowledge of the structure of enzymes and amino acids that build active sites of enzymes, enzyme kinetics, the parameters of the enzymatic reaction, mechanisms of action of enzymes and inhibitors, industrial applications of enzyme technology.

Course Objectives:

After completion the student will be able to

CO No.	**Course Objectives**
CO1	Distinguish and differentiate the characteristic features of various microbial classes and explain the architecture of different viruses.
CO2	Classify bacteria and virus based on different characteristics and elucidate the phenomenon of viral host and gene transfer.

CO3	Formulate the methods of estimating population density of animals and plants and designate the importance of microbes on biodegradation.
CO4	Assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches.
CO5	Demonstrate how microbes were identified and isolated practically

UNIT I **12hrs**

Introduction

Whittaker's classification and characteristic features of Micro organisms - Virus, bacteria, algae, fungi and protozoa – Microbial association.Scope of microbiology.

Methods in microbial culture – sterilization, inoculation and incubation; preparation of pure culture and maintenance. Nutritional requirements, types of culture media, culture and growth characteristics. Current methods of microbial identification

UNIT II **12hrs**

Bacteria - Classification of bacteria based on morphology (shape and flagella), staining, nutrition and extreme environment - Bergey's manual of classification. Bacterial respiration, bacterial photosynthesis and reproduction. Bacterial taxonomy.

Gene transfer mechanism- conjugation, transformation and transduction.

UNIT III **12hrs**

Viruses – Classification of virus based on their - Genetic material – RNA & DNA; Viral host – Plant viruses-CMV and TMV, Animal viruses – HIV, Hepatitis virus, Human papilloma virus, Bacterial viruses – Bacteriophage, M13. ICTV classification of viruses.

Algae – N2 fixation, cyanobacteria; Fungi – Mushrooms, Superficial mycosis, spirullina, Candida – oral and vaginal.

UNIT IV **12hrs**

Medical microbiology

Study of common bacterial and viral diseases in man: causative organisms, mode of transmission, pathogenicity, symptoms and preventive measures.

Diseases of Gastro-enteric system: Cholera, Typhoid and Viral hepatitis.Respiratory system: Influenza, Pneumonia and Tuberculosis.Nervous system: Meningitis, Leprosy, Tetanus, Polio, Rabies and Herpes. Genital system: Gonorrhea, Syphilis and Candidiasis.Rheumatic fever and AIDS.

UNIT V **12hrs**

Environmental and Industrial microbiology

Common air and soil microbes. Food microbiology: Microbial food spoilage, food poisoning, physic-chemical methods in food preservation. Water microbiology: Common pathogenic microbes in water. Basic design of fermenter, industrial fermentation of ethanol, penicillin and enzymes. Dairy microbiology: Pasteurization, fermented milk products (Curd and Cheese).

Note: Texts given in the Extra reading/Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the concept of microbial taxa, species and strains.	PSO 1	U
CO-2	Classify viruses based on their genetic material and host.	PSO 2	R
CO-3	Organize different bacterial strains based on classical and modern taxonomical16S r RNA sequencing methods.	PSO 2	E
CO-4	Demonstrate the methods of measuring bacterial growth and gene transfer mechanisms in bacteria.	PSO 3	R
CO-5	Distinguish antimicrobial agents based on their characteristics and mode of action and investigate drug resistance.	PSO 4	An
CO-6	Experiment with the existing applications of microbes and devise novel applications.	PSO 4	E
CO-7	Experiment on the isolation, identification and examination of food microbes.	PSO 5	Ap

The learners will be able to nurture employability skill in hospitals, laboratories as skilled person, biotechnology industries or as R&D scientist in the companies after taking up their research career.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

Text Books:

1. Prescott LM., Harley JP., Klein DA., (2006). Microbiology sixth edition. McGraw –Hill, New York.
2. Jeffry.C.Pommerville Jones and Bartlett, (2006) Fundamentals of Microbiology, Seventh Edition
3. Brenner, D.J., Krieg, N.R., Staley, J.T., (2005), Bergey's manual of systematic bacteriology. Vol. II edition, New York: Springer.

Books For Reference:

4. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, (2015). Microbiology: An Introduction, XII edition, Pearson Education.
5. Jacquelyn G.Black, (2008), Microbiology Principles and Explorations, seventh edition.
6. Glazer and Nikaido, (2007), Microbial Biotechnology, II edition, Cambridge University Press.
7. Gerard J. Tortora, Berdell R. Funke, Christian L.Case, (2006), Microbiology: An Introduction, nineth edition, Benjamin Cummings Publications
8. Adams, Martin.R.Moss, Maurice.O, (2004), Food Microbiology, Third edition, Royal Society of Chemistry Cambridge.
9. John L Ingraham and Catherine A Ingraham (2004). Introduction to Micobiology – A case History Approach, Thomson Asia Pvt. Ltd.
10. Ronald M. Atlas, Richard Bartha.R., (2004), Microbial Ecology - Fundamentals and applications, Pearson education Limited.
11. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGrawHill Publishing Company Ltd, New Delhi, India.
12. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
13. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India. 8. Lund BM, Baird Parker AC, and Gould GW.

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – I

Course Title	**Major Core 3-Practical - I – Cell Biology+ Microbial technology**
Total Hours	**65**
Hours/Week	**5 Hrs Wk**
Code	**U20BT1MCP03**
Course Type	**Practical**
Credits	**4**
Marks	**100**

Objectives

Student learns the skills of performing experiments, analyzing the results and discussing the observations pertaining to courses studied.

Cell Biology

1. Identification of plant, fungi, bacteria and animal cells.
2. Identification of different types of human cells.
3. Preparation of polytene chromosomes in salivary gland of Chironomous larva/ Drosophila larva
4. Study of mitotic stage in onion root tip.
5. Study of mitosis and meiosis from permanent slides.
6. Preparation of buccal cells.
7. Study of meiosis in Grasshopper testis.
8. Identification, maintenance and culturing of Drosophila stock.
   Epistasis and codominance, 2 point test cross, gene mapping

Practical

1. Isolation of microorganism using spread plate, pour plate and streak plate methods
2. Colony counting
3. Identification of microbe – Microscopic, color and morphology.
4. Identification of bacteria – Simple & Gram's staining.
5. Identification of products of metabolic pathways (IMViC)
6. Starch plate assay.
7. Test for motility in micro-organism.
8. Single colony isolation and measurement of growth rate.
9. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
10. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
11. Preparation of Yogurt and Dahi.
12. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

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PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biochemistry

First Year - Semester – I

Course Title	**Allied -I Basics of Bioinformatics**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U20BT1ALT01**
Course Type	**Theory**
Credits	**2**
Marks	**100**

General Objective

The paper enables the students to familiar with all the available databases and their related software to analyze and compare the sequence and structure of the biomolecules. The students can predict the genes responsible for the defect using gene prediction method

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Understand the overview of bioinformatics and the set of databases utilized for data retrieval, analysis and manipulation.
CO-2	Compute the significant relationship between two or more biological sequences using bioinformatics tools.
CO-3	Study the different types of protein secondary structures and its associated structure prediction tools in bioinformatics.

CO-4	Study the different types of protein secondary structures and its associated structure prediction tools in bioinformatics.
CO-5	Understand the set of databases utilized for data retrieval, analysis and manipulation and able to apply the tools in analysis.

UNIT -I **12hrs**

Overview of Bioinformatics – Scope-Application-History. Human Genome Project -

Bioinformatics in India – Future of Bioinformatics.

Resources – NCBI –EBI, ExPasy- Introduction to Biological Database. Types of Biological databases. Nucleotide Sequence Databases- Genbank, DDBJ, EMBL. Protein Sequence Databases- Swissprot, TrEMBL. Protein Structure Database- PDB. Derived Databases- Prosite, Pfam. Literature Databases- Pubmed, OMIM. Chemical databases- pubchem.

Extra Reading (Key words): *Newly developed databases*

Unit – II **12hrs**

Introduction to Genomics-Types of Genomics-Functional Genomics, Structural and Copmarative Genomics- Map Viewer-Genome database-GOLD Database-Metabolic Pathway Database- KEGG.

Sequence analysis – Sequence alignment methods- Pairwise sequence alignments – BLAST ,

FASTA ,multiple sequence alignment,Clustal X, phylogenetic analysis.

Extra Reading (Key words): *Statistical methods and scoring functions*

UNIT- III **12hrs**

Protein Secondary structure prediction – Use of sequence pattern, leucine zipper, coiled

coil,

transmembrane, signal peptide, cleavage site Chou-Fasman, Garnier-Osguthorpe-Robson

(GOR)

methods ***Extra Reading (Key words):*** *Protein-protein interaction networks and patterns*

UNIT- IV **12hrs**

Protein Structure Prediction

Prediction of 3D structures by comparative modeling-Homology modeling, fold recognition by threading,ab-initio prediction. Protein Visualisation Tools-Rasmol and SwisspdbViewer.

Extra Reading (Key words): *Tools and software packages used in homology modeling*

UNIT- V (PRACTICAL) **12hrs**

Computer-aided Drug Design: Concepts and Principles in CADD.

Molecular docking – principle – Types of docking

Ligand design – structure based ligand design – 3D database searching and de nova ligand design

Virtual Screening - Molecular Dynamics - Pharmacophore generation

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Understand the history and basic concepts in bioinformatics.	PSO 1	U
CO-2	Knowledge on the informative databases available for all the biological macromolecules.	PSO1	U
CO-3	The global and local sequence alignment tools and their importance were conceptualized.	PSO 2, 3	An
CO-4	Study of various protein structure prediction methods through computational approaches.	PSO 3	R
CO-5	Understanding the significance of gene prediction methods.	PSO 1	U
CO-6	Apply the tools and software in the analysis of nucleic acid and protein.	PSO 2	E

The learners will be able to nurture employability skill in laboratories as skilled person, research analyst in biotechnology industries or as R&D scientist in the companies after taking up their research career, apply the software as bioinformatics tools in biomedical sciences.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

TEXT BOOK:

1. Attwood. T.K and Parry Smith D.J,(2004), Introduction to Bioinformatics, 1st Edition, Pearson Education Ltd, NewDelhi.

REFERENCE BOOKS

1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.

2. Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience, Hoboken, NJ, 2005.

3. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press, New Delhi, 2000.

4. David W. Mount.Bioinformatics Sequence and Genome Analysis. 2001. Cold Spring Harbor Laboratory Press.

5. Jeffrey et al. 2000. Structural genomics and its importance for gene function analysis. *Nature Biotechnology*. 18:283 – 287

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PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – II

Course Title	**Major Core 4– Human Molecular Genetics**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U20BT2MCT04**
Course Type	**Theory cum Lab**
Credits	**4**
Marks	**100**

General Objective:

The student will learn the basic concepts of Genetics, mechanism of sex determination and inheritance of genes, metabolic disorder and its management, types of mutation, bacterial and cancer genetics.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO1	Understand the outline of genetics and hereditary relationship among different genus and species.
CO2	Describe the fundamental molecular principles of genetics and testing of defect genes in various diseases.
CO3	Understand the relationship and molecular diagnosis of cancer genes in humans.
CO4	Discuss about the molecular fingerprinting screening methods implemented to social and legal aspects.
CO5	Experience the fundamentals of genetics via hands on lab experiments.

UNIT I **12hrs**

Overview of Mendelian genetics – Human chromosomes: Structure and chemical nature – Linkage and crossing over – Chromosomal aberrations and abnormalities – Heterochromatin and euchromatin – Cell Division: Mitosis and Meiosis - Karyotyping and chromosomal banding–molecular cytogenetics: FISH, Fiber FISH and m–FISH.

Extra Reading/Key words: *Epigenome*

UNIT II **12 hrs**

Genetic testing: Detection of genetic defects – Gene polymorphism: candidate genes approach – Metabolic and genetic disorders: cardiac disorders – DNA analysis in Duchene Muscular Dystrophy – Molecular diagnosis - Sickle cell anemia and β-Thalassemia, retinoblastoma, cystic fibrosis, Alzheimer's – Genetics of human syndromes – X–linked CGD: molecular aspects.

Extra Reading/Key words: *Duchenne muscular dystrophy*

UNIT III **12 hrs**

Cancer genes – Types of oncogenes – Molecular diagnostics of cancer markers – Stability of the genome - Tumor imaging and staging–Tumor suppression: mode of action and mutation in p53– Gene therapy for cancers – cell cycle control - BRCA genes–Telomeres in Cancers and aging.

Molecular pathology: from genes to disease and from disease to genes – Epigenetics - Comparative genomics for human disease gene identification – Proteomic tools in human disease diagnosis..

Extra Reading/Key words: *Inherited biological traits*

UNIT IV **12 hrs**

Genetic Testing – Materials for testing: DNA, RNA or protein – Mutational screening: Loss of function and gain of function.

Molecular Forensics: Contributions of Alec Jeffrys – DNA as evidence – DNA fingerprinting – Paternity dispute– Personal identification and identity of descent by molecular methods – National laboratories – CDFD – Prenatal molecular diagnosis: CVS and amniocentesis – preimplantation test –Medico, legal, social, ethical and legal aspects of molecular diagnostics.

Extra Reading/Key words: *LINES, SINES*

UNIT V **12 hrs**

1. Karyotyping of normal and abnormal chromosome sets.
2. Identification of inactivated X chromosome as Barr body
3. Preparation of mitotic & meiotic chromosomes
4. Preparation of Pedigree chart of some common phenotypic characters of human.
5. Studies of a Model organism: Identification of normal and mutant flies (Drosophila melanogaster)
6. Preparation of Drosophila polytene chromosomes.
7. Estimation of Hb

Extra Reading/Key words: *Pseudogenes*

Note: Texts given in the Extra reading/Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identifies the different types of inheritance patterns observed in the individuals raised from one generation to another	PSO4	An
CO-2	Deal with the testing and detection of various genetic disorders.	PSO3,4	Ap
CO-3	Understand the association and function of genes in cancer.	PSO1	E
CO-4	Outline the molecular patterns in forensics and their role in , ethical and legal aspects.	PSO2	U
CO-5	Depict the pattern of inheritance from the pedigree analysis of the family history carrying a particular trait	PSO3	E

The students will be able to cultivate their skill in molecular genetics as employer in laboratories or scientific research institutions.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

Text Book

1. Ajoy Paul., 2011. Text Book of Genetics- from Genes to Genomes- Books and Allied (P) Ltd, Kolkata. Third Edition.
2. Alice Marcus (2009) Genetics, MJP Publishers, Chennai.
3. Verma,P.S. and Agarwal, V.K. (1988) Genetics. S.Chand & Company Ltd, New Delhi.

References Books

1. E.J.Gardener, M.J.Simmons and D.P.Snustad, Principles of Genetics – John Wiley & Sons Publications.
2. Strickberger, M.W., (Latest Edition). Fourth Edition.Genetics –Printice Hall, ,
3. Principles of Genetics by Gardner, Simmons, Snustad, 8th edition – John Wiley and Sons, Inc., 2003.
4. Alberts., 2002. Molecular Biology of the Cell –. Garland publication, Fourth Edition.
5. Benjamini E, Coico R and G. Sunskise (2000) Immunology a short course. IV edn. (Chapters 1–13) Wiley – Liss publication, NY.
6. Biomedical Methods Hand Book– John M. Walkser, Ralph Raplay. Humana Press, 2005.
7. Carl A.Burtis, Edward R. Ashwood, David E. Bruns. Saunders (1999) – Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – 4th Ed. Elsevier.
8. Goldsby R.A. Kindt T.I and Osborne B.A (2000) Kuby Immunology IV edn. S WH Freeman andCo, NY.
9. Jack J. Pasternak, Wiley–Liss and Sons Inc., (2005) An introduction to Human Molecular Genetics Mechanisms of Inherited Diseases. IInd Ed.. N J, USA.
10. Julian Little, Muin J. Khoury, Wylie Burke (2003). Human Genome Epidemiology: A Scientific Foundation for Using Genetic Information to Improve Health and Prevent Disease, Oxford University Press.
11. Kuby, J (2005) immunology, III edn, WH Freeman andCo, NY.
12. L.R. Haaheim., J.R. Pattison. R.J.Whitley. John Wiley andSons (1994). A Practical Guide to Clinical Virology. 2nd Ed.
13. Michael L. Bishop, Edward P. Fody, Larry Scoeff – Lipincott Williams and Wilkins (2005). Clinical chemistry– Principles, Procedures and correlations 5th edn/.
14. Muller, Young – Churchill Livingstone (2002). Elements of Medical Genetics. II edition
15. Strachan, T. and A.P. Read. (2004). Human Molecular Genetics. 3rd Edition. Garland Science, UK.

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – II

Course Title	**Major Core 5– Biostatistics & SPSS**
Total Hours	**75**
Hours/Week	**5 Hrs Wk**
Code	**U20BT2MCT05**
Course Type	**Theory cum Lab**
Credits	**4**
Marks	**100**

General Objectives:

This paper enables the students to describe the fundamental concepts, procedures, applications of statistics; the main principles of probability, statistical theory and the mathematical foundation which can be applied to other fields such as Actuarial Science and Computer Science. The students learn to use statistical package for social sciences (SPSS) to enter and edit data and apply different tests to derive conclusions and to apply the knowledge in their future research.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Estimate the measures of central tendency and describe the different indications of the central value in the distribution.
CO-2	Critically appraise the association between two variables and more than two variables using correlation and regression analysis.

CO-3	Observe and utilize the various methods of hypothesis testing and assess the functions of different elements of probability.
CO-4	Apply the concept of matrices algebra and vector algebra in Bioinformatics algorithms.
CO-5	Examine the Basic differentiation of algebraic and trigonometric functions.

UNIT – I **15 hrs**

Basics of Statistics - Nature of biological and clinical experiments – collection of experimental data - Measures of central tendency of a set of observations - Purpose of statistical investigations - arithmetic mean - mean of grouped data - median – mode - range, mean deviation, variants and standard deviation.

Statistical Package for Social Sciences (SPSS) - Introduction to SPSS for windows - data entry on SPSS - Variable naming- Analysis of data - Formulation of frequency tables. Applications of SPSS.

Extra Reading/Key words: *Statistics in Bioinformatics.*

UNIT – II **15hrs**

Correlation and Regression - Scatter diagram – Karl Pearson's Coefficient of Correlation - Correlation Coefficient for a bivariate frequency distribution – Rank correlation - Linear regression - Principles of least squares – Student's't' test for mean, difference of means – paired't' test for difference of means – test for correlation and regression coefficients – Chi-square test for goodness of fit and independence of attributes - Simple problems based on biochemical data.

Extra Reading/Key words: *Statistics module, rating scales*

UNIT – III **15hrs**

Basic Concepts of Probability - Sample space and events - The use of counting methods in probability - Addition law - Conditional probability - Simple problems involving the estimation of probabilities - Normal Distribution and Binomial distribution – Z-score, P-value and E-value.

Extra Reading/Key words: *Probability in Bioinformatics*

UNIT – IV **15hrs**

Matrices: Matrix algebra – Types of matrices – determinant – inverse, rank of matrix – solution of simultaneous equations.

Vectors: Vector algebra - addition and subtraction of vectors – product of vectors, dot & cross products - scalar triple product – vector calculus – gradient, divergence, curl of a vector & identities – applications.

Extra Reading/Key words: *Matlab,Minitab*

UNIT – V **15hrs**

Differentiation and Integration

Basic differentiation of algebraic and trigonometric functions – Maxima and Minima - Integration of simple functions - Definite and non-definite integrals – Table of integrals – applications.

Extra Reading/Key words: *Dataport, Datamining*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Study on data collection, analysis, interpretation and documentation.	PSO 1	U
CO-2	Investigate the SPSS software packages in data analysis and evaluations.	PSO 2	R
CO-3	Familiarize in the concepts of measures of central tendencies.	PSO 2	Ap
CO-4	Analysis of correlation and regression between two variables and perform hypothesis testing.	PSO 1	R
CO-5	Study the basic concepts and laws in probability distribution.	PSO 4	An
CO-6	Apply statistical hypothesis testing including Chi-square, F‟ test, ANOVA in identification of significant relationship between two or multiple variables.	PSO 4	U

The students gain knowledge on the basics of research that pay way in finding their careers involving teaching, research, and data analyst in the scientific data for public health, life sciences, and survey research.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap –Apply; An – Analyse; E- Evaluate; C – Create

T**ext Books:**

1. Jerold. H. Zar. 2010. Biostatistical analysis (Fifth Edition). Prentice Hall.

REFERENCE BOOKS:

STATISTICS

1. Bailey, N.T J. (1959). Statistical methods in biology. The English language book society and English university press Ltd.
2. Ipsen, J./ and Feigl, P. (1970). Bancroft's Introduction to Biostatistics. Haper and Row Publishers New York, London.
3. Snedecor, G.W & William, G. (1975). Statistical Methods. Havard University, Oxford & IBH Publications Co., Calcuta. Bombay, new Delhi.
4. Sokal, R and James F.R. (1973). Introduction to Biostatistics, W.H. Freeman & company, Toppan company, Ltd., Tokyo, Japan.
5. Robert L. Miler John Maltby & co., (2002). SPSS for Social Scientists. Palcrave Macmillan, New York.

SPSS

1. Millie R.L., Ciaran A., Fullerton D.A., and Maltby., (2002) SPSS for Social Scientists.(Version 9, 10, 11). Consultant Editior - Jo. Campling, Publiushers Palcrave Macmillan, (UK, USA) Printed in China.
2. Einspruch E.L. (2004) Next steps in SPSS Sage Publications, International Education and Professional Publishers, Thousand Oaks, London, New Delhi.

Note: Testing for this paper will be done in the lab by external examiner. Students

will work out problems using SPSS package.

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – II

Course Title	**Major Skill Based Elective-1 – Dairy Microbiology**
Total Hours	**30**
Hours/Week	**2 Hrs Wk**
Code	**U20BT2MST01**
Course Type	**Theory cum lab**
Credits	**1**
Marks	**100**

General Objectives

Students will learn the composition and processing of dairy products. In addition, they will learn the significance of different food microorganisms, their control and other related aspects.

Course Objectives:

After completion the student will be able to

CO No.	**Course Objectives**
CO-1	Summaries the physic chemical properties of milk
CO-2	Describe different dairy products and classification
CO-3	Comprehend the microbes that spoil dairy foods
CO-4	Demonstrate the role of beneficial microbes in dairy industries
CO-5	Hands on training to survey, detect contamination and adulteration in milk

UNIT I **9hrs**

Composition of Milk: Composition of milk, factors affecting composition of milk Properties Physical and Chemical properties- Physical state of milk, Flavor Color, Freezing point, Specific gravity, Effect of heat, Acid, Alkali, and Enzymes on milk.

Extra Reading (Key words: *Starter culture*

UNIT II **9hrs**

Dairy products: Technology of Butter, Ice cream, Skim & Whole milk powder, Cheese – Classification, Cottage Cheddar Cheese, Fermented Milk - Butter milk, yoghurt, Acidophilus milk.

Extra Reading (Key words: *Bio preservation of food*

UNIT III **9hrs**

Dairy spoilage: microbial flora of milk, sources of milk contamination.

Extra Reading (Key words: *Vacuum Packaging*

UNIT IV **9hrs**

Microbiology of dairy products: Microbiology of cream, butter, ice-cream and indigenous dairy products such as khoa, peda, yoghurth, acidophilus milk, dahi, kefir, koumiss, shrikhand, cultured butter milk, cheese and other fermented milk products; use of rennet and microbial rennet substitutes in cheese making.

Extra Reading (Key words: *Intermediate moisture foods (IMF)*

UNIT V (PRACTICAL) (Report will be submitted) **9hrs**

1. Visit to diary testing lab /or any agency of food standards
2. Market survey of milk and milk products
3. Detection microbes in milk
4. Detection of Adulterants in Milk
    - Detection of Cane Sugar
    - Detection of Starch in Milk
    - Detection of Cellulose in Milk
    - Test for Presence of Skimmed milk Powder in Natural milk (Cow, buffalo, goat, sheep)

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Analyze the properties of milk and the effect of heat and alkali on milk production.	PSO 1	An
CO-2	Identify different dairy products and their Industrial applications	PSO 2	An

CO-3	Find the microbes that spoil the dairy products and their source of contamination	PSO 2	Ap
CO-4	Formulate the dairy products with the help of beneficial microbes	PSO 3	Ap
CO-5	Evaluate the quality of dairy products	PSO 3s	U

TEXT BOOKS

1. Dairy Microbiology, (2015)2nd edition, Agrobios Publishers, Jodhpur, India.
2. Manual of methods of analysis of foods, milk and milk products(2015).Food Safety And Standards Authority Of India Ministry Of Health And Family Welfare Government Of India New Delhi.

REFERENCES BOOKS:

1. Downes, F.P and Ito, K.2001. Compendium methods for the Microbiological Examination of Foods, 4 th edition, APHA, Wahington, DC
2. Doy le, M.P., Beuchat, L.R. and Montville, T.J. 2001. Food Microbiology, Fundamentals and Frontiers, 2nd edition ASM Press Washington DC.
3. Frazier, W.C and Westhoff, D.C.1988. Food Microbiology, 4th edition, Tata McGraw-Hill Publishing Company, New Delhi
4. Marth, E.H and Steele, J.L.2001. Applied Dairy Microbiology, R, Marcel Dekker AG Publishers, Switzerland. 5. Parihar, P and Parihar, L.2006.
5. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
6. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
7. Sridhar, S.2010. Industrial Microbiology, Dominant Publishers, New Delhi.
8. Stanbury, P.E, Whitaker, A. and Hall, S.J. Principles of fermentation technology

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc., Biotechnology

First Year - Semester – II

/ Dairy Microbiology (Lab)

Course Title	**Major Skill Based Elective-1** **– Computer Literacy for Biotechnology**
Total Hours	**30**
Hours/Week	**2 Hrs Wk**
Code	**U20BT2MST02**
Course Type	**Theory**
Credits	**1**
Marks	**100**

General Objective:

The course is designed to aim at imparting a basic level appreciation programme for the common man. After completing the course, the incumbent is able to the use the computer for basic purposes of preparing his personnel/business letters, viewing information on Internet (the web), sending mails, using internet banking services etc. This allows a common man or housewife to be also a part of computer users list by making them digitally literate.

Course Objectives:

The student will be able to

CO 1	Apply the office packages to gain a better understanding of the computer.
CO 2	Understand the functions of smart devices and online transactions
CO 3	Analyse the purpose of social networking and cyber security in the e-world

CO 4	Discuss the need for e-services in banking and finance
CO 5	Assessment of updated government norms in various sectors

Unit I: Office Packages: (6hrs)

MS- Word: Creation of Documents (letters, Bio- data, etc). Creation of Tables, Formatting Tables (Time table, Calendar, etc) Working with Mail Merge (Circular letters).

MS – Excel: Creation of Worksheet (Mark Sheet, Pay Slip, PF Contribution list, etc). Excel Function (Date, Time, Statistical, Mathematical, Financial Functions). Creating charts (Line, Pie, Bar, etc).

MS- Power Point: Creation of Presentations (Duplicate and New slides, Layouts, View, Slide show, etc.,). Working with objects (Movie, Sound, Word, Excel, etc.,) Working with Transition and Animation effects (Text, Object, Pictures)

Extra Reading/Key words: *Units of Data Storage.*

Unit II: Smart Devices and Online Transactions: (6hrs)

Smart phone – Types: Tablet PC, Smart TV, Smart Camera, Smart Watch and Smart Oven.Operating system for Smart phones- Apple iOS, Android, Windows 10, Blackberry, Synbian and Bada. Benefits of Smart Phones.

E-Commerce and M-Commerce: Components of E-Commerce- history, types, and benefits of each (B2B, B2C, C2B, C2C). Business to Government E-Commerce. M-Commerce-History, customers point of view and the provider point of view. Applications of M-Commerce- Mobile ticketing, mobile money transfer, mobile banking, mobile marketing and advertising. Payment methods in M-Commerce- Premium rate telephone numbers, Direct mobile dealing, Macro, Micro payment services and mobile wallets.

Extra Reading/Key words: *Google play for Android Phones.*

Unit III: Social Networking and Cyber Security (6hrs)

Social Networking Sites: Characteristics of Social Networking Website- Examples of Social Networking Services (Facebook, SnapChat, Instagram, Whatsapp, Pinterest, Tumblr, Linkedin, Twitter, Quora and Patreon). Advantages and Disadvantages of Social Network.

Cyber law: Evolution and Historical events in cyber law. Case studies- Article taken from Media. Building blocks of cyber law(Netizens, Cyber space and Technology). Cyber Crime, Electronic and Digital devices, Intellectual Property, Data Protection and Privacy. Merits and Demerits of Cyber crime.

Extra Reading/Key words: *How to stay out of trouble from Social Network.*

Unit IV: **(6hrs)**

Computer Literacy for Banking Scheme and Applications: Why savings are needed, Why save in a bank, Banking products-ATM card, Banking Instruments-Cheque, Demand Draft (DD), Banking Services Delivery Channels, Know Your Customer (KYC), Opening of bank account and documents required, Types of bank accounts, Bank's services including remittances, loan, mobile banking, Overdraft, Pension etc.

Extra Reading/Key words: *Social Security Schemes-Atal Pension Yojana (APY), Pradhan Mantri Suraksha Bima Yojana (PMSBY)*

Unit V: **(6hrs)**

Government, federal, state, city, local and other public datasets- Data APIs, Hubs, Marketplaces, Platforms, Portals, and Search Engines. Enigma, National Government Statistical Web Sites, Open Data Census, Socrata OpenData- provides easy access to government, NGO, and other public domain datasets. Census India, Open Government Data (OGD) Platform, India.

Competitive exams: IIT-JAM, JEST,TIFR GS, JNUEE, NEST, BINC, GATE, CSIR.

Extra Reading/Key words: *Applications of IECT*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Identify various presentation software, Recall principles of multimedia applications	PSO1	An
CO-2	Define digital literacy and recognize principles of computer literacy, how computers are used in society	PSO4	E
CO-3	Recall the inner components and working patterns of smart electronic devices	PSO5	R
CO-4	Differentiate between the various uses of the internet and software for searching, productivity and networking	PSO3	An
CO-5	Recognize the basics of piracy and principles of cyber crimes	PSO2	R

CO-6	Utilization of banking facilities through online with easy conveyance mode for 24×7 services	PSO1	Ap
CO-7	Equip the skills required for protecting and recovering self data from government and public datasets	PSO5	Ap

The learners will be able to develop their employability in computer desirable workplace and may also cultivate entrepreneurship capability.

Books for Reference:

1. Mastering Ms-Office by Bittu Kumar
2. https://www.webopedia.com/DidYouKnow/Hardware_Software/mobile-operating-systems-mobile-os-explained.html
3. https://makeawebsitehub.com/social-media-sites/
4. https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf
5. https://www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf
6. https://www.irjet.net/archives/V4/i6/IRJET-V4I6303.pdf

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc.,

First Year - Semester – II

Course Title	**Allied-3– Biostatistics**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U20BT2MCT05**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objectives:

Student understands the scope of collection and classification of data in biology. They learn the different ways of presenting data. They understand the application of various tools to design an experiment, interpret and make decisions on the data collected.

Course Objectives:

The learner will be able to

CO No.	Course Objectives
CO-1	Estimate the measures of central tendency and describe the different indications of the central value in the distribution.
CO-2	Critically appraise the association between two variables and more than two variables using correlation and regression analysis.
CO-3	Observe and utilize the various methods of hypothesis testing and assess the functions of different elements of probability.

CO-4	Apply the concept of matrices algebra and vector algebra in Bioinformatics algorithms.
CO-5	Examine the Basic differentiation of algebraic and trigonometric functions.

UNIT- I **12hrs**

Definition; Scope of Biostatistics, Variables in biology; Population and sampling, sampling distribution; Difference between parametric and non – parametric statistics; Data Collection, Classification, Tabulation.

Statistical Package for Social Sciences (SPSS) – Introduction to SPSS for windows – data entry on SPSS – Variable naming- Analysis of data – Formulation of frequency tables.

Extra Reading/Key words: *Statistics in Bioinformatics.*

UNIT-II **12hrs**

Measures of central tendency – Mean, Median, and Mode.

Measures of dispersion – Range, Quartile deviation, mean deviation and Standard deviation.

Skewnes and kurtosis.

Diagrammatic representation – Bar and pie chart – histogram – frequency polygon, Frequency Curve – Logarithmic curves –Scatter plot and line graphs.

Extra Reading/Key words: *Matlab,Minitab*

UNIT-III **12hrs**

Correlation – Types; methods – Graphic, mathematical- Pearson's correlation co-efficienl, Rank correlation co-efficient.

Regression – Simple linear regression- regression equation and regression line.

Extra Reading/Key words: *Probability in Bioinformatics*

UNIT-IV **12hrs**

Elements of probability – Probability distribution – Binamial, Poisson, Normal,

Test of significance – hypothesis testing- Type I error, Type II error, level of significance. Student 't' test - One sample't' test, Independent sample and Paired't' test.

Extra Reading/Key words: *Matlab,Minitab*

UNIT – V **12hrs**

Chi – square; Application of chi – square test. Chi – square test for Goodness fit; Test for Independence of Attributes.

F' test – Analysis of Variance (ANOVA) – One way ANOVA – Two way analysis of variance. Introduction to Multrovariate statistics.

Extra Reading/Key words: *Dataport, Datamining*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Study on data collection, analysis, interpretation and documentation.	PSO 1	U
CO-2	Explain the SPSS software packages in data analysis and evaluations.	PSO 2	R
CO-3	Familiarize in the concepts of measures of central tendencies.	PSO 2	Ap
CO-4	Analysis of correlation and regression between two variables and perform hypothesis testing.	PSO 1	R
CO-5	Study the basic concepts and laws in probability distribution.	PSO 4	An
CO-6	Apply statistical hypothesis testing including Chi-square, F‟ test, ANOVA in identification of significant relationship between two or multiple variables.	PSO 4	U

The students gain knowledge on the basics of research that pay way in finding their careers involving teaching, research, and data analyst in the scientific data for public health, life sciences, and survey research.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap –Apply; An – Analyse; E- Evaluate; C – Create

Text Books:

2. Jerold. H. Zar. 2010. Biostatistical analysis (Fifth Edition). Prentice Hall.

Reference Books:

1. D.W. Jordan and P. Smith, Mathematical Techniques, Oxford University Press, New Delhi, 1997.s
2. E. Batschelet, Introduction to Mathematics for Life Scientists, 2nd Edition., Springer International Student Edition., Narosa Publishing House, New Delhi, 1991.
3. L. Forthofer, Introduction to Biostatistics, Academic Press, 1995.
4. Robert R. Sokal and F.J. Rohlf, Introduction to Biostatistics (Biology- Statistics Series), W.H. Freeman & Company, New York, 1987.
5. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical, Statistics, 11^{th} Edition, Sultan Chand & Sons, New Delhi, 2002.

(For Candidates Admitted from 2020 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS)

SCHOOL OF LIFE SCIENCES

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM

Programme: B.Sc

First Year - Semester – II

Course Title	**Major Elective– Nanoscience and Nanotechnology for Chemical Science**
Total Hours	**60**
Hours/Week	**Hrs Wk**
Code	**U20BT2MET01**
Course Type	**Theory cum lab**
Credits	**3**
Marks	**100**

General Objective:

The objective of the course was to equip the students with the concepts related to the basics of nanoscience, preparation, characterization and surface of nanomaterials to develop nano based materials in her future career.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Obtain the knowledge on the basics on nanomaterials and their properties based on size.
CO-2	Make them understand the process of synthesizing nanoparticles with different source/materials.
CO-3	Outline the characterization of the synthesized nanoparticles.
CO-4	Demonstrate the application of nanomaterials in different streams.
CO-5	Practically analyze the process synthesis and characterization of nanoparticles

UNIT I: **15hrs**

Basic Concepts of Nanoscience Scientific Revolution - Feynman's Vision – Nanoscience – Nanotechnology – Nanomaterials definitions - Classification of Nanomaterials - dimensions, confinement - Surface to volume ratio - Energy at bulk and nano scale - Nature Nanophenomena - Size dependent variation in Mechanical, Physical- Chemical- electronics- reaction- catalytic properties.

Extra Reading (Key words):

UNIT II: **15hrs**

Preparation and Types of Nanomaterials Physical- chemical and mechanical methods of preparation – Top down approach- Chemical Vapor Deposition- High-energy balling- Mechano chemical reactions – Mechanical alloying – Nanostructure through Lithography. Bottom up approach: Polyol route – Colloidal precipitation – Sol-Gel process– Chemical precipitation Sonochemical – Microbial routes – Biosynthesis – Electrospining method - Special Nanostructures - Quantum dots – Magnetic NPs – metal nanoparticles- Carbon Nanomaterials – Nanocomposites.

Extra Reading (Key words):

UNIT III: **15hrs**

Characterization Techniques of Nanomaterials

Characterization of electrical- optical- mechanical and magnetic properties of nanomaterials. Electrical conductivity and permittivity- magnetic permeability- Structural characterization: X-ray diffraction- Electron microscopy- FTIR- XPS. Surface characterization: scanning electron microscopy- atomic force microscopy. Characterization of porous structures. Characterization of quasi-static and dynamic elastic properties. Mechanical testing.

Extra Reading (Key words):

UNIT IV: **15hrs**

Applications of Nanomaterials

Nanocomposite materials for therapy and food packaging- Functional graphene- carbon nanotube and polymer composite applications in defence and aerospace. Nanomaterials for solar Cells- Nanoscale catalysts for energy and automobile industries. Rechargeable batteries based on nanomaterials- Nanomaterials for electrodes and wearable electronics- Nano based coating and paints.

Extra Reading (Key words):

UNIT V **15hrs**

1. Synthesis of metal oxide nanoparticles and analysis by UV-Vis spectrophotometer and DLS
2. Synthesis of transition metal oxide nanoparticle by hydrothermal technique and to determine particle size Using UV-Vis spectrometer.
3. Synthesis of semiconducting nano structured materials by co precipitation technique and to calculate the absorption coefficient & optical bandgap using UV-Vis spectrometer
4. Green synthesis of silver & iron nanoparticles
5. Characterization of nanoparticles by UV-visible and IR spectroscopy.
6. Evaluating the stability of nanoparticles
7. Evaluation of Encapsulating and drug releasing capacity of nanoparticles
8. Antibacterial activity against- *E. coli* and *S. aureus* (Disc Diffusion method).

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Explain the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials at nanoscale.	PSO 2	Ap
CO-2	Describe the basics of nanomaterial and in depth knowledge about the concepts of synthesis of nanoparticles.	PSO 3	An
CO-3	Choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties	PSO 4	U
CO-4	Correlate properties of nanostructures with their size, shape and surface characteristics.	PSO 2	An
CO-5	Appreciate enhanced sensitivity of nanomaterial based sensors and their novel applications in industry.	PSO 5	C

The learner will be able to cultivate laboratory skills to enhance understanding of cell structure and function while participating in a group environment.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

REFERENCES

1. Nanomaterials for medical diagnosis and therapy, Challa Kumar, Wiley-VCH, 2007.
2. K.K.Jain, Nano Biotechnology, Horizions Biosciences, 2006
3. Springer Handbook of Nanotechnology, Edited by Bharat Bhushan, Springer-Verlag (2004)
4. Nanostructures & Nanomaterials: Synthesis, Properties &Applications, G. Cao, Imperial College Press, 2004.
5. Fundamentals of Nanotechnology, Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep, CRC Press, 2009.
6. Edelstein A S and Cammarata R C, "Nanomaterials: Synthesis, Properties and Applictions",Taylor and Francis, 2012

HOLY CROSS COLLEGE (AUTONOMOUS)

Affiliated to Bharathidasan University
Nationally Accredited (4th Cycle) with 'A++' Grade(3.75 /4) by NAAC

College with Potential for Excellence.
Tiruchirapalli - 620002.

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc. Biotechnology

PO No.	**Programme Outcomes** ***Upon completion of the B.Sc. Degree Programme, the graduate will be able to***
PO-1	Obtain hands-on experience in state of art laboratory techniques.
PO-2	Acquire basic and specific skills to full fill the manpower need of biotechnological industries.
PO-3	Gain knowledge in the scientific development and problems involved with the national and international community.
PO-4	Acquire self-confidence and determination to become entrepreneur and startup.
PO-5	List opportunities in reputed companies, research institutions for higher education towards teaching and research.

PSO No.	**Programme Specific Outcomes** ***Upon completion of the courses the student would be able to***
PSO-1	Gain knowledge on basic tools and techniques learnt for designing and performing new experiments.

PSO-2	Decide and apply suitable tools and techniques in biotechnological manipulation (data analysis, soft skill, biotechnological manipulation, team work, laboratory documentation).
PSO-3	Understand and acquire knowledge on ethical legal issues, innovations in environment, health sector and agriculture; and there by implementation for finding sustainable solution to issues pertaining to environment upliftment.
PSO-4	Learn and identify the existing needs and narrow down their specific field of interest.
PSO-5	Able to equip her reading, presenting, oral, verbal and written scientific communication skills in focusing higher education.

(For The Candidates Admitted From 2018 Onwards)

HOLY CROSS COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI – 2

COURSE CONTENT AND SCHEME OF EXAMINATIONS

DEPARTMENT OF BIOTECHNOLOGY- CHOICE BASED CREDIT SYSTEM

UG COURSE PATTERN B.Sc. BIOTECHNOLOGY

Semester	Part	Course	Title of the Paper	Code	Hrs/ Week	Credit	Marks
I	I	Language	Tamil paper I/ Hindi paper I / French paper 1	U19TL1GEN01/ U18HN1HIN01/ U16FR1FRE01	6	3	100
	II	English	English Paper 1	U15EL1GEN01	6	3	100
	III	Major Core 1	Cell Biology	U18BT1MCT01	4	3	100
	III	Major Core 2	Practical I-Cell Biology	U18BT1MCP02	3	2	100
	III	Allied-1(Optinal)	Chemistry for Biology/Plant science and Phytochemical Techniques	U18BT1AOT01/ U18BT1AOT02	4	4	100
	III	Allied-2 (Optional)	Allied Practical I-Chemistry for Biology/ Plant science and phytochemical techniques	U18BT1 AOP03/ U18BT1 AOP04/	4	3	100
	IV	Environmental studies	Environmental studies	U18RE1EST01	2	1	100
	IV	Value Education	Bible/Catechism/Ethics	U15VE2LVE01/ U15VE2LVB01/ U15VE2LVC01	1	-	-
	VI	Extra credit	Internship/Field Work/Field Project - 30 hours. Extra Credit	U18SP1ECC01	-	2	100
		Service Oriented Course			1		
				Total	**30**	**20**	**700**

Semester	Part	Course	Title of the Paper	Code	Hrs/ Week	Credit	Marks
II	I	Language	Tamil paper II/ Hindi paper II / French paper II	U19TL2GEN02/ U18HN2HIN02/ U16FR2FRE02	5	3	100
	II	English	English Paper II	U15EL2GEN02	6	3	100
	III	Major Core 3	Biochemistry	U18BT2MCT03	3	3	100
	III	Major Core 4	Biological Techniques	U18BT2MCT04	3	3	100
	III	Major Core 5	Practical-II (Biochemistry & Biological Techniques)	U18BT2MCP05	4	3	100
	III	Allied-3 (Optinal)	Bioinformatics/Biostatistics & SPSS(Theory cum Lab)	U18BT2AOT05/ U18BT2AOT06	4	3	100
	IV	Skill Based Elective-1	Soft Skill Development	U15RE2SBT01	2	2	100
	IV	Skill Based Elective-2	Sustainable rural Development and Students Social Responsibility	U18RE2SBT02	1	1	100
		Service Orient Course			-	-	
	IV	Value Education	Bible Studies /Catechism / Ethics	U15VE2LVB01/ U15VE2LVC01/ U15VE2LVE01	1	1	100
	IV	Industrial Relation	Industrial Relation - Industrial Management and Entrepreneurship	U19BT3IRT01	1	1	100
	VI	Summer Internship/Field Work/Field Project 30 hours- Extra Credit		U18SP2ECC02	-	2	100
				Total	**30**	**23**	**1000**

Semester	Part	Course	Title of the Paper	Code	Hrs/ Week	Credit	Marks
III	I	Language	Tamil paper III/ Hindi paper III/ French paper III	U15TL3TAM03/ U15HN3HIN03/ U16FR3FRE03	6	3	100
	II	English	English Paper III	U15EL3GEN03	6	3	100
	III	Major Core 6	Genetics	U18BT3MCT06	3	3	100
	III	Major Core 7	Developmental Biology	U18BT3MCT07	4	4	100
	III	Major Core 8	Practical-III (Genetics & Developmental Biology)	U18BT3MCP08	3	3	100
	III	Allied-4 (Compulsory)	Biology of Invertebrates and Chordates	U18BT3ACT07	4	3	100
	IV	Skill Based Elective-3	Computer Literacy for Biotechnology	U19BT3SBT03/	2	2	100
	IV	Gender Studies	Gender Studies	U15WS3GST01	1	1	100
	IV	Value Education	Bible Studies II/Catechism II/ Ethics II	U15VE4LVB02/ U15VE4LVC02/ U15VE4LVE02/	1		
	IV	Internship/Field Work/Field Project - 30 hours. Extra Credit		U18SP3ECC03/ U18SP3ECC03	-	2	100
	VI	Service Oriented Course			-	-	-
				Total	**30**	**22**	**800**

Semester	Part	Course	Title of the Paper	Code	Hrs/ Week	Credit	Marks

IV	I	Language	Tamil paper IV/ Hindi paper IV/ French paper IV	U15TL4TAM04/ U15HN4HIN04/ U16FR4FRE04	5	3	100
	II	English	English Paper IV	U15EL4GEN04	6	3	100
	III	Major Core-9	Animal Physiology	U18BT4MCT09	4	4	100
	III	Major Core-10	Practical IV-Animal Physiology, Enzymology	U18BT4MCP10	3	3	100
	III	Major Elective- 1	Enzymology/Microbial Technology	U18BT4MET01/ U18BT4MET02	3	3	100
	III	Allied-5 (Compulsory)	Biophysics	U18BT4ACT08	4	4	100
	III	Allied-6 (Compulsory)	Allied Practical II-Biophysics	U18BT4ACT09	4	3	100
	IV	Value Education	Bible II/Catechism II/ Ethics II	U15VE4LVB02/ U15VE4LVC02/ U15VE4LVE02	1	1	100
	VI	Extension Activity outside the class hours from Semester I –IV		Any one activity based on the Student's choice (15Activities)	-	1	100
	Internship/Field Work/Field Project 30 hours- Extra Credit			U18SP4ECC04/ U18SP4ECC02	-	2	100
				Total	**30**	**25**	**1000**

Semester	**Part**	**Course**	**Title of the Paper**	**Code**	**Hrs/ Week**	**Credit**	**Marks**
	III	Major Core-11	Molecular Biology	U18BT5MCT11	4	3	100
	III	Major Core-12	R- DNA Technology	U18BT5MCT12	4	3	100
	III	Major Core-13	Genomics & Proteomics	U18BT5MCT13	4	3	100

V	III	Major Core-14	Immunology	U18BT5MCT14	4	3	100
	III	Major Core 15	Practical-V Molecular Biology, Recombinant DNA Technology & Immunology	U18BT5MCP15	3	3	100
	III	Major Core 16	Practical-VI Genomics & Proteomics, Drug Biology & Nanotechnology	U18BT5MCP16	3	3	100
	III	Major Elective-2	Drug Biology and Nanotechnology/Cheminformatics	U18BT5MET03/ U18BT5MET04	3	3	100
	III	Non-Major Elective -1	Nutrition: A lifespan approach	U18BT5NMT01	2	2	100
	IV	Skill Based Elective-4	Online Course	U19OC4SBT04	2	2	100
	IV	Value Education	Bible III/Catechism III/Ethics III	U15VE6LVB03/ U15VE6LVC03/ U15VE6LVE03	1	-	100
	IV	Internship/Field Work/Field Project - 30 hours. Extra Credit		U18SP5ECC05/ U18SP5ECC02	-	2	100
				Total	**30**	**25**	**1000**

Semester	**Part**	**Course**	**Title of the Paper**	**Code**	**Hrs/ Week**	**Credit**	**Marks**
	III	Major Core-17	Animal Biotechnology	U18BT6MCT17	4	4	100
	III	Major Core-18	Plant Biotechnology	U18BT6MCT18	4	4	100
	III	Major Core-19	Microbial & Bioprocess Technology	U18BT6MCT19	4	4	100
	III	Major Core-20	Practical-VII Animal Biotechnology & Plant Biotechnology	U18BT6MCP20	4	3	100

VI	III	Major Core-21	Practical-VIII Microbial & Bioprocess Technology and Bioinformatics & computational Biology	U18BT6MCP21	4	3	100
	III	Major Elective-3	Bioinformatics & computational Biology/ Medical Informatics	U18BT6MET05/ U18BT6MET06	3	3	100
	IV	Non Major Elective-2	Women and health	U18BT6NMT02	2	2	100
	IV	Skill Based Elective-5	Food Toxicology (Theory cum Lab)/ Dairy Microbiology (Theory cum Lab)	U18BT6SBP05/ U18BT6SBT05	2	2	100
	IV	Skill Based Elective-6	Research Methodology (Theory Cum Project)	U15DS6SBT06	2	2	100
	IV	Value Education	Bible III/Catechism III/Ethics III	U15VE6LVB03/ U15VE6LVC03/ U15VE6LVE03	1		100
	V		RESCAPES- Impact study		1		
		Internship/Field Work/Field Project 30 hours -Extra Credit		U18SP6ECC06/ U18SP6ECC02	-	2	100
				Total	**30**	**27**	**1100**
				Grand Total	**180**	**142**	**5600**

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 11 – Molecular Biology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT5MCT11**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective

To develop an exhaustive acquaintance with the structural, functional and molecular aspects of the genetic material and their mechanisms relating to their research applications.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Demonstrate the structure and cellular functions of DNA & chromosome.
CO-2	Outline and examine the mechanism of DNA replication and the function of chromosomes in replication.
CO-3	Criticize and relate to the concept of processing of prokaryotic & eukaryotic RNA synthesis.
CO-4	Comprehend the mechanism of protein synthesis.
CO-5	Critically assess and predict the mechanism of gene regulation and recombination.

UNIT I **12hrs**

Chromosome: Structure, functions, structural and numerical alterations. DNA modification in specialized chromosomes. Chromatin, heterochromatin and Euchromatin.

DNA Structure: DNA – double helix – Watson and Crick model. Central dogma of molecular biology. Mitochondrial and Chloroplast DNA.

Extra Reading (Key words)*:* Gene free chromosomal region

UNIT II **12hrs**

Replication-Types of DNA replication. Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons. DNA damage, DNA repair mechanisms. DNA mutations – types and detection of mutations -. RNA binding proteins, Ribonucleoproteins, RNA-protein recognition and interactions.

Extra Reading (Key words)*:* Mutation Fog

UNIT – III **12hrs**

RNA synthesis and processing: - Prokaryotic and eukaryotic - Regulatory signal elements: promoter, motifs. Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport. **RNA types and functions**- Non-coding RNAs: structure and function - si RNA and miRNAs. Catalytic RNA.

Extra Reading (Key words)*:* Overlapping genes

UNIT – IV **12hrs**

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification and inhibitors of protein synthesis.

Extra Reading (Key words)*:* Cell-free protein synthesis in protein therapeutics

UNIT – V **12hrs**

Gene Regulation-Types, Operon concept - Lac, Trp and Ara operons - Insertional elements and Transposons - Plant, Bacterial and Animal, Structure- organization and transposition. Homologous recombination and non-homologous recombination of genes - Holiday junction - Rec A and other recombinases.

Extra Reading (Key words): Transposable elements in clinical applications.

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Construct a model depicting the structure and function of chromosome.	PSO 2	Ap
CO-2	Describe the mechanism of replication in relation to the structure, function and numerical alterations of chromosomes in prokaryotes and eukaryotes.	PSO 3	An
CO-3	Reason out the mechanism of construction, damage of DNA and interactions.	PSO 4	U
CO-4	Examine in detail the factors affecting the regulation of RNA and protein synthesis and their properties.	PSO 2	An
CO-5	Present an elaborate account on insertional elements and transposons involved in recombination and interpret the mechanism of tumour formation.	PSO 5	C

The learner will be able to cultivate laboratory skills to enhance understanding of cell structure and function while participating in a group environment.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Ajoy Paul. Textbook of Cell and Molecular Biology (2011). Books & Allied Ltd Publishers. ISBN-10: 8187134747.
2. Freifelder, D. (2003), Essentials of molecular Biology, fourth edition, Jones and Bartlett Publications Inc.
3. De Robertis DP (2001) Cell and Molecular Biology, 8th Edition, Lippincott Williams and Williams.

REFERENCE BOOKS:

1. Gerald Karp, (2013), Cell Biology, VII edition Internationl Student Version, Wiley publication.
2. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Matthew P. Scott, (2012), Molecular Cell Biology, VII edition, W.H. Freeman and Company, New York.
3. David P Clark, (2009) Molecular Biology. (Understanding the genetic revolution), Elsevier Academic Press.
4. Geoffrey M. Cooper, Robert E. Hausman (2007), The Cell - A Molecular Approach, Sinauer Associates, Inc.
5. James D Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings (2004). Molecular Biology of the Gene, Fifth Edition
6. Lodish, Harvey, Arnold, Matsudaira, Paul , Kaiser, Chris A., Krieger, Monty Scott, Matthew P., Zipursky, Lawrence , Darnell, James (2004), Molecular Cell Biology, W.H. Freeman and Company.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 12 – Recombinant DNA Technology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT5MCT12**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective

The courtse empowers the students to understand the mechanism of cloning, gene transfer techniques and DNA finger printing and related techniques on gene sequencing, diagnose the genetic defects and produce the curative molecule for the same.

Course Objective (CO):

After completion the student will be able to

CO No.	Course Objectives
CO-1	Experiment with the basic tools and techniques of gene cloning in new innovative strategies.
CO-2	Identify new vectors and make an attempt to design novel artificial vectors.
CO-3	Demonstrate the techniques of gene transfer and screening of cloned genes.
CO-4	Examine the appropriate selection and screening technique for a specific recombined DNA.
CO-5	Describe the applications of rDNA technology.

UNIT-I **12hrs**

Genes: Isolation and synthesis of desired gene. PCR amplification – types and their application.

Gene cloning - Molecular tools – Restriction enzymes - Discovery, Host controlled restriction-modification - DNA ligase, DNA polymerases, Reverse transcriptase, terminal transferases, T_4 polynucleotide kinases, methylases, DNases, Ribonucleases, alkaline phosphatases, S1 nuclease and other enzymes.

Extra Reading (Key words): *Cold active enzymes.*

UNIT-II **12hrs**

Linking of recombinant DNA: Linkers, adapters and homopolymer tails, terminal dinucleotides.

Gene cloning vectors - Plasmids- Isolation, purification, structure and types. Bacteriophage and other phage vectors.

Types of vectors: Animal viruses as vectors – Types, BAC, YAC, M13 vector, Expression Vectors, Replacement vector, shuttle vectors, Insertion vector, Fusion vector. Phagemids, Cosmids - Construction and its use in gene cloning.

Extra Reading (Key words): *Alpha viruses, Flaviviral vectors*

UNIT-III **12hrs**

Expression of Vectors: Expression of cloned gene, Factors influencing cloned gene expression -Expression strategies for heterologous genes – expression in bacteria, yeast, insect cell lines and mammalian cells.

DNA Library: c-DNA and genomic DNA libraries.

Gene transfer techniques- Chemical mediated gene transfer, Microinjection, Electroporation, Particle gun/Particle bombardment, Transformation, Conjugation and Liposome mediated gene transfer or Lipofection.

Extra Reading (Key words): *Next-Generation Genome Engineering in Vegetable Crops*

UNIT –IV **12hrs**

Selection and screening of transformants - insertional inactivation, α- complementation, immunological screening, molecular probes, dot blot, zoo blot, Southern hybridization, colony hybridization and Molecular Beacons. Use of Reporter genes. DNA and RNA labelling by radioactive and non-radioactive methods.

Extra Reading (Key words): *NER gene expression and marker genes.*

UNIT-V **12hrs**

DNA sequencing methods: Methods – conventional and next generation sequencing methods. Capillary gel electrophoresis for DNA sequencing. Mapping of DNA and map construction, chromosomal walking, jumping. Mapping of DNA and map construction, chromosomal walking, jumping.

Applications of rDNA technology – Production of recombinant proteins (Insulin, Somatostatin and Somatotropin), vaccine and pharmaceutical compounds: Nucleic acid sequence as diagnostic tool, plants and animals as bioreactors.

Extra Reading (Key words): *Duck weed and sea grapes in r DNA technology*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Adressed	Cognitive Level
CO-1	Experiment with new molecular tools employed in rDNA technology.	PSO 1	U
CO-2	Differentiate various types of cloning and expression vectors and integrate them in research.	PSO 2	R
CO-3	Implement gene transfer techniques for producing transformants and select appropriate screening strategies.	PSO 2	U
CO-4	Design an experiment to produce recombinant proteins, vaccines and pharmaceutical compounds.	PSO 4	An
CO-5	Construct novel engineered proteins used in medicine and agriculture using transgenic animal models.	PSO 1,5	U

The students will be able to cultivate their skill in molecular genetics as employer in laboratories or scientific research institutions.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Primrose, S.B, Twyman, R.W. (2006), Principles of Gene Manipulation and Genomics, VII edition, Wiley Blackwell.
2. Glick B.R and Pasternak Jack J, (2003), Molecular Biotechnology– Principles and Applications of Recombinant DNA, III edition, American Society for Microbiology.
3. Brown. T.A., (2001), Gene Cloning and DNA Analysis - An Introduction, IV Edition, Wiley Blackwell Scientific Publications.

REFERENCE BOOKS:

1. Bernard R. Glick, Jack J. Pasternak, (2010). Molecular Biotechnology. ASM Press.
2. Terry Brown, (2010). Gene Cloning and DNA Analysis: An Introduction. John Wiley & Sons
3. Sandy B. Primrose, Richard Twyman, (2009). Principles of Gene Manipulation and Genomics. John Wiley & Sons.
4. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan A. Witkowski, (2007), Recombinant DNA: Genes and Genomics: A short course–III edition, W.H.Freeman and Co Ltd.
5. Primrose S. B, (2001), Molecular Biotechnology – Panima Publications, New Delhi.
6. Helen Kreuzer, Adrianne Massey,(1996). Recombinant DNA and Biotechnology:

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 13 – Genomics and Proteomics**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT5MCT13**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective

To course enhances the students in understanding the concept of genes and genomes and obtain skill in the sequencing and structural analysis of genes and gene expression.

Course Objective (CO):

After completion the student will be able to

CO No.	Course Objectives
CO-1	Examine and investigate the structure, organization**,** location, sequences and mutations of various genes.
CO-2	Predict the gene structure and function by utilizing the different types of genomic databases.
CO-3	Assess and appraise the methods of comparison of genomes and their applications in functional genomics
CO-4	Elucidate the various techniques relating to proteome analysis
CO-5	Identify and integrate the techniques involved in functional proteome analysis.

UNIT I **12hrs**

Genomics- Genome- structure and organization of prokaryotic and eukaryotic geome- repetitive sequences, protein coding gene- pseudogene. Genetic and physical mapping. Assembly of contiguous DNA sequence- Clone contig approach – Whole genome shot gun sequencing. Human Genome project – importance and impact. Genomics of *E. coli, Arabidopsis thaliana* and *Mus musculus*

Organization of genome in human: General features of chromosomes. Gene mapping by somatic cell hybridization, top-down approach to molecular mapping, restriction maps and contig construction (bottom-up approach).

Extra Reading (Key words): *genome hitchhiking, optical mapping*

UNIT II **12hrs**

Concept in genomics - Map repositories: Genome database (GDB), NCBI, OMIM , NGI/MGD – Mouse genome initiative database, Mouse genome expression database, Map viewer

Practical uses of genome maps: Locating genomic regions, Target identification, Arrangement of genes, SNP diagnosis, Positional specific clones, to develop probes, Predicting gene function, Identifying regulatory genes.

Gene Annotation - Structural annotation (Locating coding regions and other structural elements of the gene). Various approaches in gene prediction: ORF prediction, Gene prediction in prokaryotes and eukaryotes. Functional annotation: (Prediction of gene function), Employing the similarity in the sequence and gene family, EST comparison.

Extra Reading(Key words): *GeneID, Mobile genetic elements*

UNIT – III **12hrs**

Comparative Genomics- Purpose and Methods of comparison, Comparison at Nucleotide level, gene cluster level, phylogenetic comparison. Tools for genomic comparison including subtractive hybridization. Comparison of the genomes of the pathogenic and non-pathogenic organisms of the same genes. Applications of comparative genomics, predicting regulatory elements, Identifying targets, protein motif and domain analysis for conserved strings.

Functional Genomics- Microarray application in functional genomics, Expression and regulation of entire set of genes and Differential expression of Genes, Disease Vs normal condition – breast cancer.

Extra Reading (Key words): *Exon shuffling, ENCODE project*

UNIT – IV **12hrs**

Proteome analysis- 2D Electrophoresis, Immobilized pH gradient, Sample preparation, First dimension criteria, second dimension criteria, Stabilization, Detecting protein on gel: Electro-blot, Image analysis, Digital imaging, Spot detection and quantification, Gel matching. Data Analysis – Database for 2D gel.

Extra Reading (Key words): *Zymogram, point matching*

UNIT – V **12hrs**

Functional Proteome Analysis- Integrated Proteome Analysis - Phage antibody as tool, Protein expression analysis, High throughput analysis for proteomics; Genetic mapping of protein markers. MALDI-TOF, SELDI-TOF, LC-MS, LC-MS-MS, X ray crystallography and protein micro array.

Extra Reading (Key words): *Ab initio protein modellind, DNA Chips*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Simplify the basic concepts of genomics involving structure and organization of genes in human and appraise the concept of genetic and physical mapping.	PSO 1	U
CO-2	Construct genome maps using genome databases and predict gene functions by structural and functional gene annotations.	PSO 2	R
CO-3	Compare genomes by employing various tools and predict gene regulatory patterns.	PSO 3	U
CO-4	Categorize the applications of functional genomics in determining the differential expression of genes under normal and diseased conditions.	PSO 4	R
CO-5	Experiment with the techniques involved in proteome analysis and Integrate the tools used in protein expression and functional analysis in their research.	PSO 5	An

The learners will be able to nurture employability skill in biotechnology industries or as R&D scientist in the companies after taking up their research career

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Richard Twyman., (2004). Principles of Proteomics. Taylor & Francis.
2. David.W. Mount, (2001), Bioinformatics Sequence and Genome Analysis, Cold pring Harbor Laboratory Press.

REFERENCE BOOKS:

1. **Josip Lovric, (2011). Introducing Proteomics: From concepts to sample separation, mass spectrometry and data analysis. John Wiley & Sons publisher.**
2. **Greg Gibson, Spencer V. Muse., (2009). A Primer of Genome Science, Third Edition. Sinauer Associates, Inc.**
3. Jonathan Pevsner., (2009). Bioinformatics and Functional genomics, 2nd edition. Wiley-Blackwell.
4. Arthur M Lesk., (2007). Introduction to Genomics. Oxford University Press, USA.
5. Andreas D. Baxevanis and B.F. Francis Ouellette, (2006), Bioinformatics A practical guide to the analysis of Genes and Proteins, A. John Wiley and Sons, Inc., Publications.
6. Pennigton. S.R. and M.J.Dunn. (2002), Proteomics,Viva Books Private Limited, New Delhi.
7. Laszlo Patthy, (1999), Protein Evolution, Blackwell Science.
8. Lisa Holm, Chris Sander., (1993). Protein Structure Comparison by alignment of distance matrices. Journal of Molecular Biology - Elsevier

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 14- Immunology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT5MCT14**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective

To comprehend the overall organization, characteristics and working mechanism of the immune system and their applications at the organ, cellular and molecular levels.

Course Objective (CO):

After completion the student will be able to

CO No.	**Course Objectives**
CO-1	Categorize and explain the role of the major components of the immune system at the organ, cellular and molecular levels.
CO-2	Compare and contrast the functions of the various immune components with respect to their role in the two major types of immune responses.
CO-3	Deconstruct and appraise the underlying mechanism of immune suppression and regulation in immune disorders and its importance in transplantation immunology.
CO-4	Illustrate and investigate the different types of immune response to infections and tumors.
CO-5	Develop new diagnostic and therapeutic Immunological techniques for clinical and research applications.

UNIT I **12hrs**

Immune System- Cells of immune system. Lymphoid organs - Primary and secondary - structure and functions.

Types of Immunity – Innate, acquired, passive, active, primary, secondary, humoral and cell mediated.

Antigen – Immunogenicity, Antigenicity, Immunogen, Adjuvant, Epitope, Super antigen, Allergen, Hapten and carrier.

Antibody – Structures, types, distribution and biological functions. Antibody diversity and expression of heavy and light chain gene, Ig-class switching.

Extra Reading (Key words): *CBC (Complete blood count) and T cell cloning.*

UNIT II **12hrs**

Immune response-Cell mediated immune response- Role of T-cells - Phagocytosis, Macrophages and NK-cells-ADCC-influence of cytokines-Mechanism of CMI.

Major HistoCompatibility (MHC) systems – Genetics organization of MHC in mouse, HLA in man. Structure and functions of MHC molecules.

Humoral immune response – Antigen presentation –T-cell receptor-, B cell activation-clonal proliferation-cytokine influence-kinetics of primary and secondary immune response-Regulation of antibody synthesis.

Complements-Mode of activation, classical and alternate pathway-Toll like receptors.

Extra Reading (Key words): *CH50 assay, Protein chip and protein Databases.*

UNIT III **12hrs**

Immunosuppression - Organ transplantation – Types of Graft, allograft rejection (pathology, mechanism and immune suppression) graft versus host reaction.

Tissue typing tests – Lympho-cytotoxicity and MLR.

Extra Reading (Key words): *Antinuclear antibody tests*

UNIT IV **12hrs**

Immune tolerance - Types - natural, acquired (mechanism of T and C cell) tolerance.

Autoimmunity - Theories, mechanism, disorders (organ specific and systemic). **Hypersensitivity** - Types, mechanisms and disorders.

Extra Reading (Key words): Cytokine-controlled immune checkpoint

UNIT V **12hrs**

Antigen - Antibody reactions – Lattice theory – Precipitation – Agarose gel immunodiffusion, counter current immunoelectrophoresis, single radial immune electrophoresis, rocket immunoelectrophoresis. Agglutination – Latex agglutination and hemagglutination.

Immunotechniques - ELISA, ELISPOT, RIA, Immuno blot, Immuno fluorescence, Flow cytometry, FISH and GISH.

Hybridoma technique - Production and applications of monoclonal, Humanized and Engineered antibodies.

Extra Reading (Key words): *HPLC, MS.*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Outline and classify the types and major components involved in immune response at the cellular and molecular levels.	PSO 1	R, U
CO-2	Differentiate the mechanism of cell mediated and humoral immune response and delineate the role of immunosuppression in organ transplantation and the importance of tissue typing tests.	PSO 3, 5	U
CO-3	Outline the basic mechanism of immune tolerance and distinguish between autoimmunity and hypersensitivity reactions.	PSO 3,4	An
CO-4	Associate with the various players involved in immune response to viral, bacterial, parasitic and acquired infectious diseases their immunodiagnostic and therapy.	PSO 3	U, An
CO-5	Formulate new diagnostic and therapeutic techniques by developing a thorough knowledge of antigen –antibody interactions and their applications.	PSO 3,5	Ap

The learners will be able to nurture employability skill in biotechnology industries or as R&D scientist in the companies after taking up their research career

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Kuby, J. (2007) Immunology. W.H. Freeman and Company, New York.
2. Roitt, I., (2002), Essential Immunology, VI edition, Elsevier Science Publishing Company, New York.
3. Tizard, I.R. (1995) Immunology-An introduction IV Ed. Saunders College Publications, Philadelphia.
4. Richard M. Hyde (1995). Immunology. Williams & Wilkins, Pennsylvania State University

REFERENCE BOOKS:

5. William E. Paul, (2012). Fundamental Immunology, VII edition, Lippincott Williams & Wilkins publisher.
6. Murphy K, (2011). Janeway′s Immunobiology, 8th ed. Garland Science.
7. William E. Paul.,(2008). Fundamental Immunology. Lippincott Williams & Wilkins.
8. Abul K. Abbas, Andrew H. Lichtman, Shiv Pallai., (2007). Cellular and Molecular Immunology 6th ed. Elsevier/ Saunders.
9. David Male, Jonathan Brostoff, David B.Roth, Ivan Roitt., (2006). Immunology 7th ed. Elsevier/ Mosby.
10. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt, (2006), XI edition, Roitt's Essential Immunology Wiley – Blackwell
11. Lydyard, PM, Whelan A, Fanger MV. (2000). Instant Notes in Immunology.
12. *Abbas*, AK, AH Lightman, JS Pober. (1997) Cellular and Molecular Immunology. The WB Saunders Co., Philadelphia, Pa.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	Major Core 15 – Molecular Biology, Recombinant DNA Technology &Immunology
Total Hours	60
Hours/Week	3 Hrs Wk
Code	U18BT5MCP15
Course Type	Practical
Credits	3
Marks	100

General Objectives:

This practical makes the students to learn about various techniques involved in the Rdna technology by implementing molecular tools and immunological assays.

A.Molecular Biology

1. Estimation of DNA (DPA method).
2. Estimation of RNA (Orcinol method).
3. Isolation, separation and quality checking of the following Genomic DNA
    a. **Human (Buccal cells),**
    b. **Plant (cauliflower),**
    c. Bacterium (*E. coli*)
4. Separation of DNA by AGE
5. Separation of proteins- Native PAGE.
6. Molecular weight determination of proteins - SDS-PAGE
7. Operon model in *E.coli* using virtual class study.

B. Recombinant DNA Technology

1. Gene Cloning
    a. Restriction of vectors and passengers
    b. Ligation.
    c. Preparation of competent cells through $CaCl_2$ treatment method.
    d. Transformation.
    e. Screening of recombinant clones.
2. Isolation of Chromosomal DNA from human blood.
3. Gene amplification - PCR

C. **Immunology**

1. Organs of immune system
2. Histology of spleen, lymph node and thymus
3. Demonstration of animal handling for experimental purposes, breeding and immunization
4. Blood sample preparation – Collection of blood- separation of serum & plasma.
5. Precipitation methods –Single Radial Immunodiffusion, Ouchterlony double immuno diffusion techniques (Quantitative and Qualitative), Immunoelectrophoresis, Counter current immunoelectrophoresis, Rocket Immunoelectrophoresis
6. Agglutination methods – Blood grouping,

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	Major Core 16 – Genomics & Proteomics, Drug Biology & Nanotechnology
Total Hours	60
Hours/Week	3 Hrs Wk
Code	U18BT5MCP16
Course Type	Practical
Credits	3
Marks	100

General Objective:

The practical helps the student to learn the skills in practicing the *in-silico* approaches of genomics and proteomics and apply in drug biology applications of pharmaceutical chemistry.

A. Genomics And Proteomics

1. 2D gel electrophoresis - Demonstration.
2. Nucleotide and protein sequence databases
3. Protein structure database - PDB
4. Searches on MEDLINE, PUBMED bibliographic databases.
5. Pair wise sequence alignment- BLAST.
6. Phylogenetic analysis - Multiple Sequence Alignment – ClustalW and ClustalX.
7. Sequence annotation tool- GenScan, Interpro Scan.
8. ORF prediction tools.
9. Primer designing.
10. Calculation of phi – psi angles – Ramachandran Plot.

B. **Drug Biology**

1. Chemical database - PubChem, Drug Bank
2. Small molecule building, using CHEM SKETCH.
3. Protein modeling - SPDBV and MODELLER
4. Model structure refinement using SPDBV.
5. Validation of protein structures using What Check
6. Active site prediction – GHECOM
7. Molecular Docking-Patch Dock, AUTODOCK (Demo).
8. Virtual screening using NCI database.
9. Molecular visualization tool – RASMOL

C. Nanotechnology

1. Green synthesis of silver & iron nanoparticles

2. Characterization of nanoparticles by UV-visible and IR spectroscopy.

3. Evaluating the stability of nanoparticles

4. Evaluation of Encapsulating and drug releasing capacity of nanoparticles
5. Antibacterial activity against- *E. coli* and *S. aureus* (Disc Diffusion method).

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Elective 2– Drug Biology and Nanotechnology**
Total Hours	**45**
Hours/Week	**3Hrs Wk**
Code	**U18BT5MET03**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

The course is designed to study about the basic techniques, methods and applications involved in Drug Designing and nanoparticles.

Course Objective (CO):

The learners will be able to

CO No.	Course Objectives
CO-1	Apply the concept of drug molecules and receptors in developing a new molecule.
CO-2	Evaluate the metabolism and kinetics of a drug molecule.
CO-3	Analyze the stages of drug discovering process.
CO-4	Design a method for the production and characterization of a nanoparticle.
CO-5	Explain applications of nanotechnology in different fields.

UNIT I **9hrs**

Drugs – Definition, sources and nature, classification, nomenclature, dosage and routes of administration. Drug – Protein interactions.

Types of Receptors – Hormone, developmental-protein, carbohydrate and lipid receptors. Biological role and significance of each receptor. Neurotransmitters.

Extra Reading (Key words): *Toxins as Lead molecule*

UNIT II **9hrs**

Drug metabolism - Drug metabolizing enzymes and their induction- absorption, distribution, metabolism and excretion of drugs. Mechanism of action. Pharmacokinetics and Pharmacodynamics. Protein therapeutics.

Drug toxicity - definition, classification. Factors affecting toxicity.

Extra Reading (Key words): *Pharmacoinformatics*

UNIT - III **9hrs**

Stages of Drug development- Target identification, Target validation, Lead discovery and Optimization- Role of FDA. Candidate drug assessment – Use of Animal models, Clinical trials. Computer aided drug designing (CADD), structure based drug design, QSAR, HTP screening, molecular docking.

Extra Reading (Key words): *Discovery Studio and Schrodinger*

UNIT IV **9hrs**

Nano Materials And Nanotechnology Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nano materials – Carbon Nanotubes and applications – Material processing by Sol – Gel method, Chemical Vapour deposition and Physical Vapour deposition – Microwave Synthesis of materials.

Production of nanoparticles and applications - Methods - physical, chemical and biological- Fungi, Yeast, Bacteria and Actinomycetes. Collision/Coalescence mechanism of primary particle formation, agglomertates and aerogels.

Techniques used in Nanobiotechnology- Optical microscopy, Atomic force microscopy, SEM & TEM, optical microscopy and x-ray diffraction to study the dynamic events in cell.

Extra Reading (Key words): *Production of Superflexible Chips and Biodegradable Electrodes*

UNIT V **9hrs**

Applications of Bionanotechnology. Microarray technology. Principle, types and Applications of Bionanoimaging. Magnetic Nano particles, Nanobiosensors, Biochips, Biorobotics, Nanopore technology.

Nanobiotechnology for Human health- A remedy for all diseases. *In-vitro* diagnosis. Medical Applications of Nanoparticles and Nanosystems.

Drug Delivery: Nano drug delivery - Conventional drug delivery and targeted drug delivery and advantages. Delivery profile, Role of Nanotechnology in drug delivery and Cancer Biology.

***Extra Reading (Key words)**: Revolutionizing Eye Surgery and Nanotech Cancer Apps*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Classify drugs based on their source, nature, nomenclature and dosage and routes of administration.	PSO 1	R, U
CO-2	Identify and explain drug protein interactions and receptors involved at the molecular level.	PSO 4	An
CO-3	Investigate drug metabolism and kinetics patterns, toxicity and pharmacogenetic analysis.	PSO 2	An
CO-4	Discriminate the various stages of drug development and appraise the role of computer aided drug designing for developing novel customized drugs.	PSO 3	R
CO-5	Examine the basic principles and techniques of nanobiotechnology and categorize their functional principles.	PSO 4	An
CO-6	Develop strategies to produce and characterize novel nanoparticles for research purposes.	PSO 4,5	Ap
CO-7	Outline the applications of nanotechnology in medical diagnostics and therapeutic procedures.	PSO 3	Ap

The learners will be able to nurture employability skill in biotechnology industries or as R&D scientist in the companies

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Barar, FSK, (2004) Essentials of Pharmacotherapeutics, S. Chand and Co., Ltd., New Delhi.
2. M.Ratner and D.Ratner, (2007) Nanotechnology, 1st edition, Pearson education.
3. Bionanotechnology by David S.Goodsell, 2004, Wiley Publications. Pages-337

REFERENCE BOOKS:

1. Andrew R. Leach, (2001) Molecular Modeling: Principles and Applications, Second edition, Pearson Education EMA.
2. Arthur J. Atkinson Jr (2007) Principles of Clinical Pharacology Second edition, Acadeic Press publications, Elsevier, UK.
3. Drug delivery systems (Methods in Molecular Biology volume 437) (2008) Publisher: Humana Press
4. Gary Walsh, (2003) Biopharmaceuticals: Biochemistry and Biotechnology, Second edition, John Wiley and Sons, Chichester.
5. Werner Kalo et al., (2005) Pharmacogenomics II Ed Taylor and Francis, LLC, London.
6. Glenn Fishbine.,(2002). The Investor's Guide to Nanotechnology and Micromachines. Wiley.
7. Mick Wilson , Kamali Kannangara , Geoff Smith , Michelle Simmons , Burkhard Raguse.,(2002). Nanotechnology: Basic Science and Emerging Technologies. Chapman and Hall/CRC.
8. Nicholas Peppas, J. Zach Hilt and J. Brock Thomas .,(2007). Nanotechnology in Therapeutics: Current Technology and Applications (Horizon Bioscience). Taylor & Francis.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Elective 2– Cheminformatics**
Total Hours	**45**
Hours/Week	**3Hrs Wk**
Code	**U18BT5MET04**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective:

To understand, how to extract knowledge from reaction information. Students will familiarize with basic models of chemical reactivity and to know simple approaches to quantify chemical reactivity.

Course Objective (CO):

The learners will be able to

CO No.	Course Objectives
CO-1	Apply the concept of cheminformatics on the interference of chemistry and nomenclaturing.
CO-2	Evaluate the elements of graph theory, types of matrix and 2D molecular description.
CO-3	Implement computation of molecular descriptors and chemical similarity by analyzing chemical databases.
CO-4	Analyze the conformational changes of protein and nucleic acid.
CO-5	Explain the stereochemistry of proteins and nucleic acid.

UNIT – I **9hrs**

Cheminformatics Introduction; Representation of molecular structures – IUPAC Representations of chemical molecules, Structure diagram, Line notation, Chemical, nomenclature, Connectiontables, Tautomerism, Markuh structure, SMILES-Natureoflanguage, Specifications– Atom, Bond, Ring, Branch, Reactions; SMILE-Representation– isomerism, Tetrahedral stereocenters; SMILE Conventions; SYBYL Line notation, MOL, MOL2, SDF, MMICF, SMD and MIF

Extra Reading (Key words): Algorithmic molecular design

UNIT – II **9hrs**

Graph theory in Chemistry – elements of graph theory, molecular graphs – Vertex and edge weighted molecular graphs; Molecular graph matrices- Adjacency matrix, Burden matrix, Laplacian Matrix Distance matrix – Types; Molecular descriptors,2D and substructure search.

Extra Reading (Key words): Pharmacophore Modelling

UNIT – III **9hrs**

Chemical databases- Belilsteien database- The cross fire revolution, retrieval performance of Cross fire, Abstracts, Reactions and echopharm extensions to the Belilsteien file; Databases in Organic Chemistry –Databases of chemical abstracts, INSPEC and GMELIN database; Small molecules databases – CSD, The CSD software system, CCDC Application software. Databases of chemical reactions – CAS REACT, Organic reaction database -CHEMINFO RX, CCR and ISI database.

Extra Reading (Key words): Quality Structure- Activity Relationship(QSAR),

UNIT – IV **9hrs**

Conformational Analysis – Forces that determine protein and nucleic acid structure, polypeptide chain geometries – Ramachandran Map – potential energy calculations – observed values for rotation angles – hydrogen bonding – hydrophobic interactions and water structure – ionic interactions – disulphide bonds – prediction of protein structure. Nuclei acids-rotational isomers and ribose puckering - forces stabilizing ordered forms – base pairing – base stacking.

Extra Reading (Key words): Chemogenomics

UNIT – V **9hrs**

Stereochemistry: Principles – Chirality, Chiral compounds. Symmetry in organic compounds, Molecular isomerism: Time scales and energy criteria, Types of movements – vibrational, Rotational, torsion angles, Conformational analysis

- Conformation of open chain compounds, Conformation of closed chain compounds, Determination of relative and absolute configuration. Stereochemistry of proteins and nucleic acids.

Extra Reading (Key words): Didactic Drug Design Targets

REFERENCES

1. Cantor CR & Schimmel PR, Biophysical Chemistry Part - I, W.H. Freeman & Co., in San Fransisco, 1980.
2. Branden C and Tooze J, Introduction to Protein Structure, Garland Publishing Inc., New York., 1991.
3. Handbook of Cheminformatics – From data to knowledge, Vol1. Johann gasteiger .2003
4. R. Glaser, Biophysics, Springer, 2000.
5. Sterochemistry of Organic Compounds by Ernest. L.Eliel etal., John Wiley & Sons, 1994.
6. Sterochemistry – Conformation & Mechanism by P.S.Kalsi, New Age International Ltd., 1990.

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Discriminate the fundamental basic concept in the relationship between informatics & biology.	PSO 5	R, U
CO-2	Investigate and implement computation of molecular descriptors and chemical similarity.	PSO 2	R
CO-3	Evaluate and apply the chemical bases using softwares in cheminformatics. Classify small molecules and interpret results from chemoinformatics analysis	PSO 2	U
CO-4	Discriminate the protein and nucleic acid structure by Conformational Analysis method.	PSO 3	R
CO-7	Outline the relative and absolute configuration and Stereochemistry of proteins and nucleic acids.	PSO 2	U

The learners will be able to nurture employability skill in biotechnology industries or as R&D scientist in the companies

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – V

(For Candidates Admitted from 2018 Onwards)

Course Title	**Non Major Elective 1– Nutrition A Life Span Approach**
Total Hours	**30**
Hours/Week	**2 Hrs Wk**
Code	**U18BT5NMT01**
Course Type	**Theory**
Credits	**2**
Marks	**100**

General Objective:

To understand, how to extract knowledge from reaction information. Students will familiarize with basic models of chemical reactivity and to know simple approaches to quantify chemical reactivity.

Course Objective (CO):

The learners will be able to

CO No.	**Course Objectives**
CO-1	Analyze the importance of nutrients and their role played in fitness & health.
CO-2	Evaluate the nutrient requirements & weight management in maintaining healthy life.
CO-3	Implementing the nutritional guidelines for good health in adulthood and old age persons.
CO-4	Evaluating the nutritional requirements and the effect of nutritional status on pregnancy outcomes.
CO-5	Explain and estimate the meal plan in pregnant women & infants.

UNIT I **6hrs**

Importance of nutrition- Role of nutrition in fitness. Nutritional guidelines for health and fitness. Nutritional supplements

Principles of meal planning: Balanced diet. Food groups. Food exchange list. Factors effecting meal planning and food related behaviour. Dietary guidelines for Indians and food pyramid.

Extra Reading (Key words): Nutraceutics

UNIT II **6hrs**

Nutrient requirements: Concept of Dietary Reference Intakes. Overview of methods for assessment of nutrient needs

Weight Management. Assessment, etiology, health complications of overweight and obesity. Diet and exercise for weight management. Fad diets. Principles of planning weight reducing diets.

Extra Reading (Key words): Anthropometric

UNIT III **6hrs**

Nutrition for adulthood and old age Adult: Nutrient requirements for adult man and woman, RDA, nutritional guidelines, nutritional concerns, diet and lifestyle related diseases and their prevention. Elderly – Physiological changes in elderly, RDA, nutritional guidelines, nutritional and health concerns in old age and their management, factors contributing to longevity.

Extra Reading (Key words): Nutrigenomics

UNIT IV **6hrs**

Nutrition during pregnancy and lactation: Pregnancy – Physiological changes in pregnancy, RDA, nutritional guidelines, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them. Lactation – Physiology of lactation, RDA and nutritional needs of a nursing mother, nutritional guidelines

Nutrition during childhood

Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Infants - Preschool children - School children – Adolescents.

Extra Reading (Key words): Clinical Nutrition

UNIT V **6hrs**

Introduction to meal planning: Use of food exchange list.

Planning of diets and dishes for- pregnant and lactating woman-preschool child-school age child and adolescents- young adult & elderly of different activity levels for various income groups. Planning complementary foods for Infants. Planning of nutritious snacks for different age and income groups. Preparation of nutritious snacks using various methods of cooking.

Estimation of BMI and other nutritional status parameters.

Nutritional labeling of food products.

Extra Reading (Key words): Nutrimetabonomics: applications for nutritional sciences

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Apply knowledge of the role of nutrition and healthy eating for disease prevention and wellness.	PSO 2	Ap
CO-2	Investigate Explain rationale for nutrient intake recommendations across the lifespan	PSO 3	An
CO-3	Summarize Explain functions of specific nutrients in maintaining health.	PSO 1	R
CO-4	Discriminate the Nutrition Care Process to deliver state-of-the-art, safe and effective nutritional needs of women and growing children.	PSO 4	R
CO-7	Understand the nutritional requirement of adults, nutritional needs during pregnancy and lactation, physiological changes and hormones involved during pregnancy and lactation, effects of ageing and life expectancy.	PSO 4	U,Ap

The learners will be able to nurture employability skill in biotechnology industries or as R&D scientist in the companies

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.
2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

REFERENCE BOOKS:

1. Khanna K, Gupta S, Seth R, Passi SJ, Mahna R, Puri S (2013). Textbook of Nutrition and Dietetics. Phoenix Publishing House Pvt. Ltd.
2. Wardlaw GM, Hampi JS, DiSilvestro RA (2004). Perspectives in Nutrition, 6th edition. McGraw Hill.
3. ICMR (2011) Dietary Guidelines for Indians.Published by National Institute of Nutrition, Hyderabad.
4. ICMR (2010) Recommended Dietary Allowances for Indians.Published by National Institute of Nutrition, Hyderabad.
5. Chadha R and Mathur P eds. (2015) Nutrition: A Lifecycle Approach. Orient Blackswan. New Delhi. • Seth V and Singh K (2006).
6. Diet Planning through the Life Cycle: Part 1 Normal Nutrition. A Practical Manual. Elite Publishing House Pvt. Ltd. New Delhi.
7. Gopalan C, Rama Sastri BV, Balasubramanian SC (1989) Nutritive Value of Indian Foods. National Institute of Nutrition, ICMR, Hyderabad.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 17 – Animal Biotechnology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT6MCT17**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

To inculcate a thorough knowledge in the various aspects of animal biotechnology. To enable the students to associate and appreciate the techniques involved in various types of cell culture, gene therapy and DNA microarrays and integrate them in ongoing cutting edge research.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Demonstrate the structure and cellular functions of DNA & chromosome.
CO-2	Outline and examine the mechanism of DNA replication and the function of chromosomes in replication.
CO-3	Criticize and relate to the concept of processing of prokaryotic & eukaryotic RNA synthesis.
CO-4	Comprehend the mechanism of protein synthesis.
CO-5	Critically assess and predict the mechanism of gene regulation and recombination.

UNIT-I **12hrs**

Introduction to Animal Biotechnology -Animal tissue culture, history, requirements for animal cell culture. Substrate, liquids, culture mediums-Natural (Clots, Biological fluids, Tissue extracts), complex natural and chemically defined media. Explant-culture of explants, Cell culture technique- initiation, preparation and sterilization of media, isolation of explants, disaggregation of explants, culture, subculture.

Extra Reading (Key words): *three-dimensional microtissues, "Body on a Chip"*

UNIT-II **12hrs**

Cell lines- Evolution of cell lines, maintenance of cell lines, Large scale culture of cell lines monolayer, suspension and immobilized cell culture, Development of primary culture and cell lines, subculture

Secondary Cultures: Cultured cells and evolution of continuous cell lines (established cell lines). Commonly used cell lines - their origin and characteristics. Cell line preservation and characterization. High level expression of foreign gene in animal cells-expression vectors, enhancers, regulatory sequences. The need to express foreign genes in animal cells: advantage and disadvantages.

Extra Reading (Key words): *genetically tailored stem cells,*

UNIT-III **12hrs**

Transfection of animal cell lines: Calcium phosphate, DEAE-dextran, Lipofection, Electroporation, Microinjection, Embryonic stem cell transfer.

Stem cells: Characteristic features, maintenance, culture and Applications of Embryonic and adult stem cells, Animal cloning- Nuclear transfer and embryonic stem cell method.

Molecular pharming: Transgenic animals and their applications, methods used for transgenesis with reference to transgenic mice ,cattle, sheep, goats, pigs, chicken and fish.

Extra Reading (Key words): *Genetically tailored stem cells*

UNIT-IV **12hrs**

Vaccines: Recombinant vaccines (r-subunit vaccine, r-live vaccines, Anti-idiotipic, edible vaccines, HIV, Malarial vaccine), Interferon and growth factor and other therapeutic proteins. **Animal Biotechnology in Reproduction** - Artificial insemination, Super ovulation, Oestrus Synchronization. In vitro maturation of animal oocytes - Methods of transferring genes into animal oocytes, eggs, embryos and specific tissues - IVF -gamete selection – In-vitro culture of Oocyte / embryo and storage. Embryo - collection, sex selection and transfer. Somatic cell cloning- Social, ethical and legal issues.

Extra Reading (Key words): *Covaxin and its mechanism*

UNIT-V **12hrs**

Application of animal cell culture. Production of transgenic animals (Mice, Cattle, Sheep, pigs, Fish and Birds). Animal cells as bioreactors for the production of commercially important products. Applications, advantages and disadvantages of animal tissue culture and Ethical issues related to transgenic animals.

Gene therapy – types, vectors and sites of gene therapy, ex-vivo and in-vivo methods, clinical trials, treatment of genetic disorders, ethical issues, ethical committee functions. Antisense and ribozyme therapy, Protein Aptamers, Intrabodies.

Extra Reading (Key words): *Humanized animals for transplantation.*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Construct a model depicting the structure and function of chromosome.	PSO 2	Ap
CO-2	Describe the mechanism of replication in relation to the structure, function and numerical alterations of chromosomes in prokaryotes and eukaryotes.	PSO 3	An
CO-3	Reason out the mechanism of construction, damage of DNA and interactions.	PSO 4	U
CO-4	Examine in detail the factors affecting the regulation of RNA and protein synthesis and their properties.	PSO 2	An
CO-5	Present an elaborate account on insertional elements and transposons involved in recombination and interpret the mechanism of tumour formation.	PSO 5	C

The learner will be able to cultivate laboratory skills to enhance understanding of cell structure and function while participating in a group environment.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply;

An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Freshney. R.I. (2000), Culture of Animal cells : Manual of Basic technique, 4th edition. John Wiley Publications.
2. Ranga. MM, (2004), Animal Biotechnology, 2nd Edition. Agrobios (India), Jodhpur.

BOOKS FOR REFERENCE:

1. Ashish Verma, Anchal Singh, (2013). Animal Biotechnology: Models in Discovery and Translation, Academic Press.
2. Jose and Robert, 2005, Principles of cloning, Academic press.
3. Primrose SB, (2001), Molecular Biotechnology – Panima Publications, New Delhi.

4. *Winnacker, E*L, *(1987) From Genes to Clones*, Publishers Wiley-VCH Verlag GmbH.

5. James D. Watson, Amy A. Caudy, Richard M. Myers, Jan A. Witkowski, (2006), Recombinant DNA: Genes and Genomics: A short course–III edition, W.H. Freeman and Co Ltd.

6. Primrose, SB, Twyman, R.W. (2006), Principles of Gene Manipulation and Genomics, VII edition, Wiley Blackwell.

7. Stewart Sell, (2003) (Ed) Stem Cells Handbook, Humana Press, NY.

8. Glick B.R and Pasternak Jack J, (2003), Molecular Biotechnology– Principles and applications of Recombinant DNA, III edition, American Society for Microbiology.

9. Babiuk , L .A ., John . P.Phillips and Murray Moo-young (1989), Animal Biotechnology Pergamm press , Oxford.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 18 – Plant Biotechnology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT6MCT18**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective

Gain knowledge to improve the crops to increase yield, improve tolerance to pests and drought, to alter the characteristics of the plants

Course Objectives:

After completion the student will be able to

CO No.	**Course Objectives**
CO-1	Demonstrate culture media, tissue culture method and somatic hybridization techniques
CO-2	Comprehend suspension, meristem culture and somatic embryogenesis techniques to improve the plant verities
CO-3	Gain knowledge of protoplast fusion and cryopreservation techniques
CO-4	Understand the preparation of vectors for transformation techniques.
CO-5	Describe the applications in biotechnology industries.

UNIT I **12hrs**

Introduction: Historical perspectives of plant tissue culture, and Basic requirement for tissue culture laboratory

Culture mediums for plant tissue culture- MS medium and B5 Medium. Sterilization of media-steam, dry and filter sterilization- Explants sterilization. Plant growth regulators and differentiation.

Method of tissue culture-formulation of medium explants collection, surface sterilization, inoculation, Callus induction, subculture and regeneration of plants.

Somatic Hybridization: Protoplast isolation, fusion, regeneration of hybrids. cybridization, Somaclonal Variation-Haploid production - pollen culture. Applications of plant tissue culture**.** Gene Bank – Germplasm and Cryopreservation.

Extra Reading (Key words): *graphene, carbon nanotubes*

UNIT II **12hrs**

Suspension cultures- growth and subculture, types and synchronization of suspension cultures

Meristem culture- method and its uses in production of virus free plants. Clonal propagation, Micro propagation of plants – medicinal plants and endangered plants –method and advantages

Somatic embryogenesis- Principle, protocol and importance. Artificial seeds – production, applications and limitations. 2.4. Anther culture and production of androgenic haploids. 2.5. Somaclonal variations; - sources of somaclonal variatins, selection of soma clones, progeny testing of soma clones, applications of somaclonal variations to crop improvement, Embryo rescue

Extra Reading (Key words): *dendrimers in tissue culture*

UNIT III **12hrs**

Protoplast – properties of protoplast ,Protoplast – Isolation (mechanical and enzymatic methods), Culturing and regeneration of protoplasts , Different methods of protoplast fusion (mechanical fusion, chemo fusion, electro fusion) and Selection of somatic hybrids and cybrids.

Cryopreservation- cryopreservation of plant cultures and application of plant tissue culture. The effect of elicitors on the production of secondary metabolites of commercial value.

Extra Reading (Key words): *plant breeding genetics*

UNIT IV **12hrs**

Plant viral vectors - Gene transfer techniques to transform plant cells. Expression of induced genes. *Agrobacterium* mediated transgenesis and Protoplast fusion. Applications of Transgenic plants - RUBISCO, Chlorophyll binding proteins, heat shock genes , alcohol dehydrogenase (ADH) , Seed storage proteins in legumes and cereals, Enolpyruvyl shikimate phosphate Synthase (EPSPS) pathway.

Extra Reading (Key words): *Transgenics for herbicide bioremediation*

UNIT V **12hrs**

Agricultural applications- Mechanism of Herbicide resistance, Bacterial resistance, Nematode Resistance, Pest resistance and Viral resistance with suitable examples and their applications in agriculture. Protease inhibitors, genes for other insecticidal secondary metabolities. Stress resistance**:** Fungal pathogen resistance- fungal toxin resistance. Abiotic and Biotic Stress resistance.

Agroindustrial applications- Production of Secondary metabolites, phytochemicals, antibodies, enzymes, pharmaceutical proteins in plants, plant derived drugs for medicine, Agroindustrial products

Marketing – Rules and Regulations, IPR, GATT, TRIPS, Plant Breeder's Right (PBR) and Farmer's Rights.

Extra Reading (Key words): *GM crops in Agroecology***,** *Golden rice*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	**Course Outcomes**	**PSOs Addressed**	**Cognitive Level**
CO-1	Implement plant tissue culturing methods and hybridization technique.	PSO 1	Ap
CO-2	Perform meristem culture and somatic embryogenesis to develop new verities	PSO 2	Ap
CO-3	Learn to perform protoplast culture and cryopreservation techniques	PSO 3	U
CO-4	Create a vector for effective gene transformation techniques	PSO4	C
CO-5	Apply the gained knowledge to develop resistant plant verities	PSO 4	Ap

The learner will be able to cultivate laboratory skills to enhance understanding of cell structure and function while participating in a group environment.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Mishra.SP.,(2009). Plant Tissue Culture. Ane Books Pvt Ltd.
2. Roberta Smith (2000) Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic Press.
3. Chawla HS. (2000) Introduction to Plant Biotechnology, Taylor and Francis Inc Science Publishers, U.S.

BOOKS FOR REFERENCE:

1. A. Altman, Paul M. Hasegawa, (2012). Plant Biotechnology and Agriculture: Prospects for the 21st Century, Academic Press.
2. Arie Altman, Paul Michael Hasegawa.,(2011). Plant Biotechnology and Agriculture: Prospects for the 21st Century. Academic Press.
3. Neal C Stewart, Jr.,(2008). Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & Sons
4. Adrian Slater, Nigel Scott, Mark Fowler (2008) Plant Biotechnology- The genetic manipulation of plants, Oxford University Press, Oxford.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 19 – Microbial & Bioprocess Technology**
Total Hours	**60**
Hours/Week	**4 Hrs Wk**
Code	**U18BT6MCT19**
Course Type	**Theory**
Credits	**4**
Marks	**100**

General Objective:

This subject puts emphasis on the basic engineering principles of bioprocess. it also highlights the modern application of biotechnological process and the role of bio process engineer in biotechnological industry.

Course Objective:

After completion the student will be able to

CO No.	**Course Objectives**
CO-1	Distinguish and differentiate the characteristic features of various microbial classes and explain the architecture of different viruses.
CO-2	Assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches and demonstrate the beneficial role of microorganisms in food processing and employ novel industrial microbes for the production of various products
CO-3	Identify and preserve industrial microbes and attempt to produce new varieties of industrial microbes for various purposes.
CO-4	Comprehend the types and design of a fermentor in microbial mass growth culturing and examine in detail, the mechanics involved in design and operation of bioreactors
CO-5	Relate to the kinetics and mechanism of microbial growth and comprehend the technological aspects of producing novel engineered products.

UNIT I **12hrs**

Introduction- Whittaker's classification and characteristic features of Microorganisms - Virus, bacteria, algae, fungi and protozoa – Microbial association. Bergey's manual of classification of bacteria, Gene transfer mechanism- conjugation, transformation and transduction, Scope of microbiology.

Methods in microbial culture – sterilization, inoculation and incubation; preparation of pure culture and maintenance. Nutritional requirements, types of culture media, culture and growth characteristics. Current methods of microbial identification.

Algae – N_2 fixation, cyanobacteria; **Fungi** – mushrooms, superficial mycosis, spirullina, candida – oral and vaginal.
Extra Reading (Key words): *Dicer protein to kill viruses.*

UNIT II **12hrs**

Medical microbiology -Study of common bacterial and viral diseases in man: causative organisms, mode of transmission, pathogenicity, symptoms and preventive measures.

Environmental and Industrial microbiology- Common air and soil microbes. Food microbiology: Microbial food spoilage and food poisoning. Water microbiology: Common pathogenic microbes in water.

Production of useful products through microbial fermentation: Industrial fermentation of ethanol, penicillin, Antibiotics, vitamins and enzymes.
Extra Reading (Key words): *Principle of Sourdough in food fermentation*

UNIT III **12hrs**

Introduction to bioprocess- Historical development of bioprocess technologies, Nutritional group of microbes and their importance in fermentation industry. Improvement of strains for increased yield and for other desirable characters (mutation, selection and recombination). Detection and Assay of fermentation products. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses.
Design of bioreactors: Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings.
Extra Reading (Key words): *Pre and probiotics, Insilico screening*

UNIT IV **12hrs**

Media for Industrial fermentation: Basic design and construction of fermentor and ancillaries, An overview of aerobic and anaerobic fermentation processes. Designing of media for fermentation processes, Solid Substrate fermentation and submerged fermentation; Process parameters: measurement of temperature; pressure and pH; dissolved Oxygen; foam, design and usage of various commercial media for industrial fermentations, thermal death kinetics of microorganism's, batch and continuous heat sterilization of liquid media.
Extra Reading (Key words): *Electroflocculation*

UNIT V **12hrs**

Kinetics of microbial growth and product formation- Phases of cell growth in batch cultures, simple unstructured kinetic models for microbial growth. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudking – Piret models, substrate and product inhibition on cell growth and product formation and their application in the biotechnology industry solid-substrate fermentation and its applications.
Extra Reading (Key words): *GO immobilization, Magnetic support matrix.*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the concept of microbial taxa, species and strains and demonstrate the methods of measuring bacterial growth and gene transfer mechanisms in bacteria.	PSO 1	U
CO-2	Produce industrial value added products using microbial fermentation at a commercial level.	PSO 5	An
CO-3	Examine the methods for the isolation, screening and preservation of industrially important microbial strains.	PSO 1	U
CO-4	Investigating and implementing the knowledge on the mechanics involved in bioreactor designing, operation and the role of computers in bioprocess control.	PSO 4	E, Ap
CO-5	Produce commercially valued fermentation products by manipulating and enhancing their recovery and purification methods.	PSO 4, 5	Ap
CO-6	Categorize the industrial scale production and therapeutic applications of enzymes and deconstruct the design of immobilized enzyme reactors.	PSO 3	E

The learners will be able to cultivate their skills in teaching and take up their future research in microbial technology or to choose higher education in developing their skills towards Entrepreneurship and biotechnological companies.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

TEXT BOOKS:

1. Prescott LM., Harley JP., Klein DA., (2006). Microbiology sixth edition. McGraw –Hill, New York.
2. Jeffry.C.Pommerville Jones and Bartlett, (2006) Fundamentals of Microbiology, Seventh Edition

3. Brenner, D.J., Krieg, N.R., Staley, J.T., (2005), Bergey's manual of systematic bacteriology. Vol. II edition, New York: Springer.

4. Patel AH. (2005) Industrial Microbiology, Macmillan Private Limited.

5. Whitaker, Hall SJ., (2004). Principles of Fermentation Technology, 2 nd ed., Butterworth Heinemann, Oxford, ed.

6. Casida. LE (1999) Industrial Microbiology. New Age International Pvt. Ltd., New Delhi.

7. Ganguli P, (2001), Intellectual Property Rights, Tata Mcgraw Hill.

8. Ramesh Chandra, (2004), Issues Of Intellectual Property Rights, Isha Books

BOOKS FOR REFERENCE:

1. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, (2015). Microbiology: An Introduction, XII edition, Pearson Education.

2. Jacquelyn G.Black, (2008), Microbiology Principles and Explorations, seventh edition.

3. Glazer and Nikaido, (2007), Microbial Biotechnology, II edition, Cambridge University Press.

4. Gerard J. Tortora, Berdell R. Funke, Christian L.Case, (2006), Microbiology: An Introduction, nineth edition, Benjamin Cummings Publications

5. Adams, Martin.R.Moss, Maurice.O, (2004), Food Microbiology, Third edition, Royal Society of Chemistry Cambridge.

6. Cruger. W. A. Cruger (2003) A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi.

7. Shuler. M. L. F. Kargi (2003) Bioprocess engineering: Basic Concepts, Prentice Hall,Engelwood Cliffs.

8. Stanbury, PF., Whitaker, A. (2003) Principles of Fermentation Technology, Pergamann Press, Oxford.

9. Samuel. C. Prescott, Cecil. G. Dunn (2002) Industrial Microbiology, First Edition, Agrobios (India) Ltd

10. Flickinger, M.C. Drew, S.W. (1999) Encyclopedia of Bioprocess Technology-Fermentation Biocatalysis and Bioseparation, (Volumes I-V), John Wiley and Sons, Inc., New York.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 20 – Practical VII-Animal Biotechnology & Plant Biotechnology**
Total Hours	**60**
Hours/Week	**3 Hrs Wk**
Code	**U18BT6MCP20**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objectives:

This practical is focused to make the student know and expertise in handling basic animal cell culture techniques and produce more saplings using plant tissue culture techniques

A Animal Biotechnology

1. Preparation of media
2. Isolation and quantification of total RNA from animal organs.
3. Isolation and quantification of DNA from animal organs.
4. Preparation of Cell Culture medium and membrane filtration.
5. MTT assay for cell viability and growth.
6. Cell counting.

B. Plant Biotechnology

7. Preparation of plant tissue culture medium- Murashige and Skoog's.
8. Sterilization methods of explants (seed leaf, inter node &root) & medium
9. Callus induction, propagation, regeneration.
10. Micro propagation – Nodal and apical meristems.

11. Organogenesis and transfer of plants to soil.
12. Preparation of synthetic seeds.
13. Isolation of genomic DNA from plant cells by CTAB method.
14. RNA isolation from plants.
15. Protoplast isolation.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Core 21 – Practical-VII-Bioprocess Technology & Microbiology, Bioinformatics & Computational Biology**
Total Hours	**60**
Hours/Week	**3 Hrs Wk**
Code	**U18BT6MCP21**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objectives:

The practical aims at making the students practice the techniques in bioprocess technology & microbiology. They can retrieve the gene and protein sequences and align those sequences using computational tools.

A Microbial Technology

1. Isolation of microorganism using spread plate, pour plate and streak plate methods
2. Colony counting
3. Single colony isolation and measurement of growth rate.
4. Identification of microbe – Microscopic, color and morphology.
5. Identification of bacteria – Simple & Gram's staining.
6. Identification of products of metabolic pathways (IMViC)
7. Microbiological examination of water, soil and food.
8. Isolation of *Rhizobium, Azotobacter.*

9. Isolation of pure culture – *E.coli*, *Streptomyces.*
10. Starch plate assay.
11. Test for motility in micro-organism.

B Bioprocess Technology

1. Enumeration of Microorganisms from bread.
2. Determination of TDT & TDP.
3. Analysis of Aflatoxin by TLC.
4. Qualitative analysis of milk.
5. Isolation of industrially important microorganism.
6. Production & estimation of biomass (SCP), dry weight & Wet weight methods.
7. Production of wine.
8. Immobilization of cells and enzymes.
9. Determination of Microbial growth curve - effect of pH and temperature on microbial growth curve.
10. Waste water quality indicator – COD and BOD

C. Bioinformatics & Computational Biology

1. Nucleotide and protein sequence databases and structure databases
2. Searches on MEDLINE, PUBMED bibliographic databases
3. Pair wise sequence alignment- BLAST
4. Multiple Sequence Alignment – CLUSTAL.
5. Phylogenetic analysis
6. Sequence annotation tool- GenScan, Interpro Scan
7. ORF prediction tools
8. PCR Primer designing
9. Homology Modeling - Modeler.
10. Calculation of phi – psi angles – Ramachandran Plot.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Major Elective 3 – Bioinformatics & Computational Biology**
Total Hours	**60**
Hours/Week	**3 Hrs Wk**
Code	**U18BT6MET05**
Course Type	**Theory**
Credits	**3**
Marks	**100**

General Objective

The paper enables the students to familiar with all the available databases and their related software to analyze and compare the sequence and structure of the biomolecules. The students can predict the genes responsible for the defect using gene prediction method**.**

Course Objectives:

After completion the student will be able to

CO No.	**Course Objectives**
CO-1	Demonstrate the available databases of proteins to visualize structural details and outline the basics of bioinformatics and the set of databases utilized for data retrieval, analysis and manipulation.
CO-2	Perform gene and protein sequence alignments to find similar sequences and compute the significant relationship between two or more biological sequences using bioinformatics tools.
CO-3	Describe phylogenetic tree preparation based on sequences similarities

CO-4	Study the different types of protein structures and its associated structure prediction tools in bioinformatics.
CO-5	Explain genome sequencing, gene analysis and annotation methods

UNIT- I **9hrs**

Bioinformatics and its application. Information networks- NCBI, EMBL, DDBJ. Analysis of DNA and Protein Sequences – distributions, frequency statistics –Protein and Nucleic Acid Sequence Databases – PIR, MIPS, Swiss-prot, TrEMBL, NRL-3D – pattern and motif searches – BLOCKS, PROSITE, PROFILES, IDENTIFY, PRINTS, PFAM – Structure Databases – PDB, MMDB – Structure – Classification, alignment and analysis – SCOP, CATH, FSSP.

Extra Reading (Key words: *Statistical methods and scoring functions.*

UNIT – II **9hrs**

Sequence similarity search tools. Sequence alignment: Dot Plot, Dynamic Programming. Local and Global alignment concepts – dynamic programming methodology – Needleman and Wunsch algorithm, Smith-Waterman algorithm. Scoring matrices – PAM and BLOSUM. Databases searches for homologous sequences FASTA and BLAST -Multiple sequence alignment -sequence assembly tools and sequence clustering tools. – Progressive alignment and Iterative alignment.

Extra Reading (Key words: *Tools and software packages used in homology modeling.*

UNIT- III **9hrs**

Evolutionary analysis: distances – clustering methods – Rooted and un-rooted tree representation – Bootstraping strategies – Phylogenetic trees and its construction– softwares for phylogenetic analysis.

Extra Reading (Key words: *Newly developed phylogenetic databses.*

UNIT- IV **9hrs**

Protein sequences- Sequence pattern, motifs, Sites(PTM)-Phosphoaylar (EXPASY site). Protein Secondary structure prediction – Chou-Fasman, Garnier-Orguthorpe – Robson (GOR) methods – Predicting 3D structure – comparative (homology) modeling, threading (fold recognition) and ab initio methods – ANN & HMMs– Neural network concepts – CASP – Protein structure visualization tools – RasMol, chime, Swiss PDB Viewer.

Extra Reading (Key words: *Tools and software packages used in homology modeling.*

UNIT – V **9hrs**

Restriction enzyme analysis. Fragment analysis. Fragment assembly – Genome sequence assembly – Gene finding methods -EST analysis tools, gene finding and primer/probe design. Background of transform techniques – Fourier Transform and gene prediction – Analysis and prediction of regulatory regions -Genome annotation.

Extra Reading (Key words: *Significance of ancestral nodes in evolution.*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Understand and summarize the history and basic concepts in bioinformatics.	PSO 1	U
CO-2	The global and local sequence alignment tools and their importance were conceptualized.	PSO 2, 3	An
CO-3	Generate phylogenic tree for species analysis and reason out the need for phylogenetic trees in evolutionary studies.	PSO 2	R
CO-4	Study of various protein structure prediction methods through computational approaches.	PSO 3	R
CO-5	Comprehend the analysis of gene, gene annotation and sequencing	PSO 2	R

The learners will be able to nurture employability skill in laboratories as skilled person, research analyst in biotechnology industries or as R&D scientist in the companies after taking up their research career, develop new software and bioinformatics tools.

PO – Programme Outcomes; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create

TEXT BOOK:

1. Attwood. T.K and Parry Smith D.J,(2004), Introduction to Bioinformatics, 1st Edition, Pearson Education Ltd, NewDelhi.

REFERENCE BOOKS :

1. Arthur M. Lesk , (2004), Introduction to Bioinformatics, Oxford University Press, London.

2. Baxevanis & BFF Ouellette, (2001), Bioinformatics: A practical guide to the analysis of genes and proteins, AD - Wiley Interscience New York.

3. Cantor. C.R & Schimmel. P.R, (1980) Biophysical Chemistry Part - I, W.H.Freeman & Co., San Fransisco.

4. Des Higgins & Willie Taylor (2000). Bioinformatics: Sequence, Structure and databanks Oxford University Press.

5. Gibson.G. and Muse. S.V, (2002), A primer of Genome Science. Sinauer Associates, Inc.Publishers, Sunderland.

6. Primrose. S.B and Twyman. R.M, (2003), Principles of Genome analysis and Genomics,3rd Edition. Blackwell Publishers, Japan.

7. Stephen Misener & Stephen A. Krawetz, (2000), Bioinformatics : Methods and Protocols Humana Press, New Jersey.

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Non Major Elective 2 – Women & Health**
Total Hours	**60**
Hours/Week	**2 Hrs Wk**
Code	**U18BT6NMT02**
Course Type	**Theory**
Credits	**2**
Marks	**100**

General Objective

Students will learn the need of women health care and access the health care system for reproductive and chronic non-reproductive health issues of women.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Summaries the hormonal factors that influence women's health
CO-2	Describe healthy dietary habits and mental health
CO-3	Comprehend the lifestyle diseases and management
CO-4	Demonstrate the concept of food, nutrition and lifestyle
CO-5	Clarify pregnancy related issues and related healthcare maintenance

UNIT I **6hrs**

Introduction- defining women's health- Feminism.

Women's health status: Factors influencing women's health- female physiology, endocrine system and female hormones, menstruation, PCOS, osteoporosis.

Extra Reading (Key words: *Maternal morbidity*

UNIT II **6hrs**

Trends in health: body image- beauty myths-thinness: a cultural obsession.

Dietary habits: diet, eating disorders- anorexia nervosa.

Exposure of women to physical environments- salient physical and chemical exposures of non-occupational environments- women's responses to toxic exposures.

Women in the workplace: ergonomic conditions and reproductive risks- job-related stress: behavioural and chronic disease correlates of work-related stress -work-related and family-related stresses interactions and their role in health.

Extra Reading (Key words: *Prenatal Care*

UNIT III **6hrs**

Lifestyle diseases and their management: lifestyle/hypo-kinetic diseases and its management - Diabetes - Hypertension - Obesity - Osteoporosis - CHD - Back pain.

Health related physical fitness and assessment Body Mass Index/Skin Fold Measurement, BMR, pulse rate, blood pressure. Health related physical fitness tests.

Extra Reading (Key words): *Psychoanalytic feminism.*

UNIT IV **6hrs**

Concept of food and nutrition: Balanced diet. vitamins and role of vitamins in women health. Malnutrition and other deficiency diseases. Determining caloric intake and expenditure obesity, causes and preventing measures – role of diet and exercise.

Physical exercise: practical applications of all the concepts, principles of training, and types and modes of exercise.

Intervention in lifestyle diseases: type-2 diabetes mellitus, obesity and weight management, cardiovascular diseases like atherosclerosis, heart disease (coronary heart disease), stroke, hypertension, dyslipidaemia and diseases associated with smoking.

Extra Reading (Key words): *Eating & sleeping disorder*

UNIT V **6hrs**

Pregnancy and Exercise: physiologic changes and signs of pregnancy, routine prenatal care, complications during pregnancy, normal embryonic/fetal development. Pre-natal, Post-natal exercise, Strength Training, Cardio- Vascular training and Flexibility Training during Pregnancy – Special precautions. Nutrition-need for supplementation during pregnancy. Pertinent risk factors- occupation, environment, tobacco, alcohol, other drugs and genetic factors. Therapeutic recommendations.

Lactation: Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and counseling.

Child care: Newborn care, paediatric care, selected paediatric alterations. Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding.

Extra Reading (Key words: *Family Therapy- Recent trends.*

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Analyze hormonal imbalance that influence women's health	PSO1	An
CO-2	Practice healthy dietary habits and mental health	PSO2	Ap
CO-3	Identify the lifestyle diseases and management	PSO 2	An
CO-4	Formulate the concept of food, nutrition and lifestyle	PSO 3	Ap
CO-5	Describe pregnancy related issues and related healthcare maintenance	PSO 3	U

TEXTBOOK

1. Das Gupts Monica & Krishnan T.N. (1998). "Women and Health". Oxford, New Delhi.
2. J.R. Park and K.Prak. (1983). "Text Book of Preventive and Social Medicines". Habalpure, M.S.Banarside.
3. K.AjitDalal and Subha Ray. (2005). "Social Dimensions of Health". Rawat Publications, Jaipur.

REFERENCE BOOKS:

1. Mohan Rao (Ed). (2004). "The Unheard Scream: Reproductive Health and Women"s Rights in India". Zubaan, New Delhi.
2. Rosalind Pollack Petchesky. (2003). "Gendering Health and Human Rights". Jed Book, London.

3. Shukla P.K. (1982). “Nutritional Problems of India”. Prentice Hall of India, New Delhi.
4. Denmark, Florence. & Scchzer, Jeri. A., 2004, Engendering Psychology: Women and Gender, Revised Edition, Wesley
5. Radakrishnan.S., 2003, Psychology an Introductory Guide, Zig Zag printers, Coimbatore
6. Ussher, Jane 1992, Gender Issues in Clinical Psychology Routledge

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	Skill Based Elective 5- Food Toxicology
Total Hours	60
Hours/Week	3 Hrs Wk
Code	U18BT6SBP05
Course Type	Lab
Credits	3
Marks	100

General Objectives:

Students will learn the nature, properties, effects and detection of toxic substances in food and their disease manifestation in humans.

1. **What are Toxicants?**

- Types of Toxicants
- Natural constituents vs. natural¬ contaminants
- Natural constituents as toxicants¬ Glycosides
- Goitrogenic glycosides

2. **Determination of Toxicants in Foods**

- Qualitative and Quantitative Analyses of Toxicants in Foods
- Sample Preparations for Determination of Toxicants
- Sampling
- Extraction
- Cleanup
- Chromatography

3. **Toxicity Testing**

- Preliminary Steps for Toxicity Testing
- Acute Toxicity
- Chronic Toxicity
- Metabolism
- Evaluation of LD50

HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Skill Based Elective 5 – Dairy Microbiology**
Total Hours	**60**
Hours/Week	**3 Hrs Wk**
Code	**U18BT6SBT05**
Course Type	**Theory cum lab**
Credits	**3**
Marks	**100**

General Objectives

Students will learn the composition and processing of dairy products. In addition, they will learn the significance of different food microorganisms, their control and other related aspects.

Course Objectives:

After completion the student will be able to

CO No.	Course Objectives
CO-1	Summaries the physic chemical properties of milk
CO-2	Describe different dairy products and classification
CO-3	Comprehend the microbes that spoil dairy foods
CO-4	Demonstrate the role of beneficial microbes in dairy industries
CO-5	Hands on training to survey, detect contamination and adulteration in milk

UNIT I **9hrs**

Composition of Milk: Composition of milk, factors affecting composition of milk Properties Physical and Chemical properties- Physical state of milk, Flavor Color, Freezing point, Specific gravity, Effect of heat, Acid, Alkali, and Enzymes on milk.

Extra Reading (Key words: *Starter culture*

UNIT II **9hrs**

Dairy products: Technology of Butter, Ice cream, Skim & Whole milk powder, Cheese – Classification, Cottage Cheddar Cheese, Fermented Milk - Butter milk, yoghurt, Acidophilus milk.

Extra Reading (Key words: *Bio preservation of food*

UNIT III **9hrs**

Dairy spoilage: microbial flora of milk, sources of milk contamination.

Extra Reading (Key words: *Vacuum Packaging*

UNIT IV **9hrs**

Microbiology of dairy products: Microbiology of cream, butter, ice-cream and indigenous dairy products such as khoa, peda, yoghurth, acidophilus milk, dahi, kefir, koumiss, shrikhand, cultured butter milk, cheese and other fermented milk products; use of rennet and microbial rennet substitutes in cheese making.

Extra Reading (Key words: *Intermediate moisture foods (IMF)*

UNIT V (PRACTICAL) (Report will be submitted) **9hrs**

5. Visit to diary testing lab /or any agency of food standards
6. Market survey of milk and milk products
7. Detection microbes in milk
8. Detection of Adulterants in Milk
    - Detection of Cane Sugar
    - Detection of Starch in Milk
    - Detection of Cellulose in Milk
    - Test for Presence of Skimmed milk Powder in Natural milk (Cow, buffalo, goat, sheep)

Note: Texts given in the Extra reading /Key words must be tested only through assignment and Seminars.

Course Outcomes:

CO No.	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Analyze the properties of milk and the effect of heat and alkali on milk production.	PSO 1	An
CO-2	Identify different dairy products and their Industrial applications	PSO 2	An

CO-3	Find the microbes that spoil the dairy products and their source of contamination	PSO 2	Ap
CO-4	Formulate the dairy products with the help of beneficial microbes	PSO 3	Ap
CO-5	Evaluate the quality of dairy products	PSO 3s	U

TEXT BOOKS

3. Dairy Microbiology, (2015)2nd edition, Agrobios Publishers, Jodhpur, India.
4. Manual of methods of analysis of foods, milk and milk products(2015).Food Safety And Standards Authority Of India Ministry Of Health And Family Welfare Government Of India New Delhi.

REFERENCES BOOKS:

9. Downes, F.P and Ito, K.2001. Compendium methods for the Microbiological Examination of Foods, 4 th edition, APHA, Wahington, DC
10. Doy le, M.P., Beuchat, L.R. and Montville, T.J. 2001. Food Microbiology, Fundamentals and Frontiers, 2nd edition ASM Press Washington DC.
11. Frazier, W.C and Westhoff, D.C.1988. Food Microbiology, 4th edition, Tata McGraw-Hill Publishing Company, New Delhi
12. Marth, E.H and Steele, J.L.2001. Applied Dairy Microbiology, R, Marcel Dekker AG Publishers, Switzerland. 5. Parihar, P and Parihar, L.2006.
13. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
14. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
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HOLY CROSS COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Programme: B.Sc., Biotechnology

Third Year - Semester – VI

(For Candidates Admitted from 2018 Onwards)

Course Title	**Skill Based Elective 6 – Research Methodology (Theory cum Project)**
Total Hours	**60**
Hours/Week	**2 Hrs Wk**
Code	**U18BT6SBT06**
Course Type	**Theory**
Credits	**2**
Marks	**100**

OBJECTIVE

Students get introduced to concept of research and to carry out research projects.

Unit I

Introduction to research: Concept of research – types of research – introduction to research literature base – collection of research information from different sources; maintenance of information.

Unit II

Research focusing: identifying research area – drawing objectives\ hypothesis – designing the work – data collection – analysis.

Unit III

Preparation of dissertation: Structure of dissertation – editing – bibliography.

Unit IV

Project work

REFERENCE BOOKS

1. Blaxter, L., Hughes, C. aned Tight (1999) How to research? Viva Book private Limited
2. Kothari, C.R. (2004) research Methodology- Methods and Technioques, New Age International Publishers, India
3. Lal, B.(2002) Research Methodology, ABD Publishers. India

Note:

The students will be evaluated internally by a test for 50 marks. The Project will be evaluated by an external evaluator and a viva- voce will be conducted for 50 marks.

The students can carry out their projects individually or in groups.