Curriculum for B. Sc Biotechnology

Bachelor of Science

B. Sc SYLLABUS

[*For the Candidates admitted under Autonomous, CBCS & OBE pattern*]

(ODD SEMESTER)

DEPARTMENT OF BIOTECHNOLOGY

VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

[AUTONOMOUS]

An ISO 9001:2015 Certified Institution | Affiliated to Periyar University
Approved by AICTE | Re-accredited with "A" Grade by NAAC|
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

Preamble

Biotechnology is an area of biology that uses living processes, organisms or systems to manufacture products or technology intended to improve the quality of human life. It is an integrated science with interdisciplinary knowledge of biochemistry, Molecular Biology, Microbiology, Genetics, Plant and Animal sciences, Environmental and Pharmaceutical sciences.

Biotechnology has the potential to bring a tremendous change in the socio-economic status of the people by creating a positive impact with food security, Animal husbandry, fisheries, assurance of quality food products to the consumers, environmental protection, health care etc.

The Biotechnology course has the opportunities in health care sector and diagnostics, Research with Institutes, Universities, Animal health, Vaccine industry, Agriculture, Food technology, Pharmaceutical industry, Industrial and Environmental Sciences, Bioinformatics, Biosafety and Education.

The syllabus of Biotechnology is framed in such a way so as to give a fundamental understanding in the different inter disciplinary areas of Cell Biology, Biochemistry, Microbiology, Genetics, Immunology, Animal and Plant Science, Environmental and Pharmaceutical sciences.

The practical syllabus has been designed to enable the students to link and support with their theory background. This also imparts the knowledge of handling instruments and the understanding of interdisciplinary facet of Biotechnology.

The syllabus is also equipped with Entrepreneurial development to help students to start their own enterprises as job providers, which will instill confidence, and to make smarter plans for future development.

Aim of the Programme:

The aim of the programme is to provide students with a wide knowledge in different areas of Biotechnology and to prepare them for employment and research in this rapidly growing field. This programme enables the students with innovative ideas for business creation, creating job opportunities, and the importance of entrepreneurship for facing the challenges and to improve the economy of the nation.

Nature and extent of the Programme:

The field of Biotechnology is an interdisciplinary science and is growing at a tremendous rate with application in medicine, agriculture, environment and nanotechnology. This tremendous growth is because of the integration of new technologies in biological research.

New upcoming thrust areas like Marine Biotechnology, Research Methodology, Bio entrepreneurship and Nanotechnology is introduced in this programme. The programme also offers students the freedom to choose the electives based on their preferences. This will help the students to start, grow their own enterprises and make smarter plans for future development.

Graduate attributes:

The graduate after completing the course becomes a full-fledged Bio entrepreneur with a complete understanding of the various concepts of Biotechnology. This course is designed in such a way as to kindle creative thinking abilities with problem solving capacity and also research attitude. This programme will enable the students to be self-employed, and bring constructive changes to their professional life, work place and to the community at large.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc. BIOTECHNOLOGY
Programme Code:	
Duration:	3 Years [UG]
Programme Outcomes:	**PO1:** Students understand the major concepts in Biologyand understand the fundamental principles.
	PO2: Students will develop scientific outlook not only with respect to life science, but in all aspects related to life.
	PO3: Students are trained to apply and adapt appropriate techniques, resources, and instrumentation which will help them to pursue higher education or jobs after the programme.
	PO4: Students develop the ability to effectively communicate scientific information with strong ethics in written and oral formats.
	PO5: Students will understand their roles and responsibilities especially the protection of the people.
	PO6: Students become eligible to pursue higher education in their respective fields and engage in lifelong learning and enduring proficient progress.
Programme Specific Outcomes:	**PSO1:** Recall the fundamentals of Biotechnology which would enable them to comprehend the emerging and advanced biotechnology concepts in life sciences.
	PSO2: Inculcate deeper knowledge in practical skills enabling them to work with disciplinary and interdisciplinary aspects of biotechnology.
	PSO3: Enhance students' learning abilities,technological solutions in domains of biotechnology fortheir applications in industry and research and entrepreneurial skills.
	PSO4: Evaluate the need and impact of scientific techniques on the environment and the society, keeping in view their sustainable development.
	PSO5: Analyze the knowledge gained in Biotechnologyfor lifelong learning.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2024-2025** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER - I									
1	Language –I	23U1LT01	Foundation Tamil - I	3	5		25	75	100
2	English – I	23U1CE01	English - I	3	5		25	75	100
3	Core – I	24U1BTC01	Cell Biology	4	4		25	75	100
4	Core – II	24U1BTC02	Basics in Lab Safety	2	2		25	75	100
5	Core Practical - I	24U1BTCP01	Lab in Cell Biology	3		3	40	60	100
6	Allied – I	24U1MBA01	Microbiology	2	3		25	75	100
7	Allied Practical - I	24U1MBAP01	Lab in Microbiology	2		3	40	60	100
8	AECC	23U1ENAC01	Soft Skills for Effective Communication	2	2		25	75	100
9	Value Education	23U1VE01	Health, Human values and Yoga	2	2		25	75	100
Total				**22**	**23**	**6**	**255**	**645**	**900**

Theory	07
Practical	02

24U1BTCP01	Lab in Cell Biology	3 Hrs
24U1MBAP01	Lab in Microbiology	3 Hrs

Year	I	Program	B.Sc., Biotechnology	Code	24U1BTC02
Sem	I	Core – II : BASICS IN LAB SAFETY		Credits	2
Hrs	30			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. Students will comprehend the appropriate lab clothing and regulations.
2. Students will be knowledge able with laboratory emergencies, chemical risks, electrical hazards, waste management and laboratory accident response.
3. Upon successful completion of the course, students should have a clear understanding of laboratory safety precautions, emergency first aid, and response.

Course Outcomes:

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

CO1	Respond to laboratory emergency procedures of laboratory incidents or accidents.	K1
CO2	Know the laboratory safety signs.	K2
CO3	Differentiate the various biological safety levels.	K3
CO4	Adopt for PPE usage and protective measures.	K4
CO5	Understand the disposal of experimental wastes and spill clean-up.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**General Lab Safety**	**06 Hrs**

Lab rules and safety signs, Personal protective equipment, protecting clothing, hand protections, foot protection, hearing protection, respiratory protection, Eye and face Protection.

Unit – II	**Glass Ware Safety**	**06 Hrs**

Inspecting glassware before use, safe handling and storage, vacuum and pressure operations, cleaning and drying, disposal and spill clean-up.

Unit – III	**Chemical and Electrical Safety**	**06 Hrs**

Safety Datasheet, storage guidelines, chemical spills, chemical exposure monitoring; Electricitygeneral specifications, electrical system usage guide lines, preventing electrical Hazards.

Unit– IV	**Biological Safety**	**06 Hrs**

Biologicalsafety levels, safety data sheets for infectious substances, decontamination, transport and shipment of biological materials, emergencies, exposures and spills, biological waste disposal.

Unit – V	**Emergency Procedures and Response to Accidents**	**06 Hrs**

Emergency procedures- Spill, First aid and Emergency kits, protective procedures, Fire extinguishers, eye wash stations, Emergency showers, Responses–chemical spills, gas leakages, fire and explosions, personal injury and contamination.

References

1. Laboratory Safety Handbook, 1st Edition, Sabanc University (2016).
2. Raj Mohan Joshi(Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
3. Bioethics & Biosaftey By Sateesh Mk (2008),Ik Publishers.
4. https://www.ccri.edu/safety/lab_safety_for_st7udents.html.
5. https://www.esafety.com/courses/spill-response-awareness/.
6. https://ehs.ucsc.edu/programs/research-safety/video-resources.html#fire-safety.

Year	I	Program	B.Sc., Biotechnology	Code	24U1BTC01
Sem	I	Core – I : CELL BIOLOGY		Credits	4
Hrs	60			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. Students will understand how these cellular components are used to generate and utilize energy incells.
3. Students will understand the cellular components, Structural features, Organelles and the cellularmechanisms and mitotic cell division.

Course Outcomes:

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

CO1	Design the model of a cell	K1
CO2	Differentiate the structure of prokaryotic and eukaryotic cell.	K2
CO3	Explain the organization of cytoskeleton, morphology and its aberrations	K3
CO4	Compare and contrast the events of Membrane trafficking, cellular organelles.	K4
CO5	Explain the microscope and cell fractionation.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	Fundamentals of Cell Structure	12 Hrs

Discovery of cells; Basic properties of cells; Different classes of cells – Prokaryotic and Eukaryotic cells. Celldivision: Prokaryotic cell division and Eukaryotic cell division - mitosis, meiosis, and Cell cycle.

Unit – II	Cellular Membranes and Matrices	12 Hrs

Cell membrane- Chemical composition, Structure, functions and transportation Unit membrane model, Sandwich; Fluid Mosaic model. Simple diffusion, facilitated Diffusion, Osmosis; Active and Passive transport.

Unit – III	Cell Signaling and Cytoskeleton	12 Hrs

Microtubules- Cilia, flagella and intermediate filaments; Microfilaments- actin and myosin; cytoskeleton; Junctions- Gap Junction, Tight Junction and Desmosomes. Cell signaling – Paracrine, Autocrine, Endocrine – Ligand, Receptor, Secondary Messengers.

Unit– IV	Structure and Function of Cellular Organelles	12 Hrs

Nucleus, Nucleolus, Ribosomes, Endoplasmic reticulum-(RER and SER), Golgi complex, Lysosomes, Mitochondriaand Chloroplast Membrane trafficking – Nuclear Protein Pathway.

Unit – V	Techniques in Cell Biology	12 Hrs

Microscopy: Types of Microscopes, Principles of light and compound microscope; Centrifugation – Principles and types. Cell fractionation.

References:

1. Paul, A. 2007. Text book of cell and molecular biology, Books and Allied (P) Ltd. 2nd edition,Kolkata 700 009, pp-1310.
2. Lodish et al Molecular Cell biology 8th ed. Freeman, 2016.
3. Alberts et al Molecular biology of the cell. 6th ed. Garland Sci. 2014.
4. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu, 2013.
5. Genes and Genomes by M Singer, and P Berg, Blackwell Scientific Pub.
6. R.C. Rastogi. 2010. Cell and Molecular Biology. New Age International Publishers

Year	III	Program	B.Sc., Biotechnology	Code	24U1BTCP01
Sem	V	Core Practical – I: LAB IN CELL BIOLOGY		Credits	3
Hrs.	45			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. To introduce fundamentals of cell biology techniques.
2. To teach students the basic techniques and instrument principles in biotechnology
3. To give hands on cell biology experiments

Course Outcomes:

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

CO1	Be aware of the laboratory preparation of solutions	K1
CO2	Understand the importance, preparation of buffers.	K2
CO3	Learns to visualize the cells by employing different types of microscopes	K3
CO4	Bring in the basic techniques of cell biology	K2
CO5	Analysis of characterization of known and unknown microbes and cells	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Handling of Light Microscope (10X,40X and 100X)	3
2	Viewing of Permanent slides.	3
3	Staining of Organelles - Chromosome, DNA, RNA, Mitochondria and Chloroplast.	3
4	Observation of Prokaryotic and Eukaryotic cell	6
5	Cell Counting using Hemocytometer	6
6	Buccal smear preparation and Identification of squamous epithelial cells.	6
7	Mitosis from onion root tip	6
8	Meiosis from Tradescantia / flower bud.	6
9	Cell fractionation	3
10	Human karyotyping (Demo)	3

References:

1. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
2. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia
3. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition:
4. 2. Published by RonJon Publishing. Incorporated. Related Online Contents [MOOC, SWAYAM, NPTEL,
5. Websites etc.] https://www.azolifesciences.com/article/What-is-a-pH-Meter-and-How-Does-it- Work.aspx
6. Ruban. P. Basic Biotechniques. 1st Edition. Notion press. 2020

Year	I	Program	B.Sc., Biotechnology	Code	24U1MBA01
Sem	I	Allied - I : MICROBIOLOGY		Credits	2
Hrs	45			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. To make students understanding and identification of basic microbiology.
2. The students about various methods of sterilization and also about antimicrobial chemotherapy.

Course Outcomes:

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

CO1	To understand historical prospective on the evolution of microbiology.	K1
CO2	To acquire knowledge on the basic concepts on prokaryotic cellular structure.	K2
CO3	To acquaintance of basic nutritional requirements of microorganism.	K3
CO4	To know about the anti-microbial therapy and their mode of action.	K4
CO5	To understand historical prospective on the evolution of microbiology.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Microbial Cell Structure and Function**	**09 Hrs**

History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Role of microbes in biotechnology.

Unit – II	**Microbial Cell Structure and Function**	**09 Hrs**

Microbial Cell Structure and Function: bacteria, viruses, fungi, and protozoa. Topics include cell morphology, cell wall composition, membrane structure, and organelles unique to microbial cells.

Unit – III	**Microbial Growth and Nutrition**	**09 Hrs**

Microbial Growth and Nutrition: Explores the factors influencing microbial growth, including nutritional requirements, environmental conditions (such as pH, temperature, and oxygen), and growth curves. Covers different methods for measuring microbial growth and factors affecting growth rates.

Unit– IV	**Microbial Disease**	**09 Hrs**

Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria)

Unit – V	**MICROBIAL APPLICATION**	**09 Hrs**

Microbial application: Bioinsecticides - Bacillus thuringiensis, Baculoviruses- Biofertilizers - Azospirillum and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).

References

1. Microbiology: An Introduction by Tortora, Funke, and Case. 13th Edition, Pearson Education,2019.
2. Brock Biology of Microorganisms by Michael T. Madigan et al. 16th Edition, Pearson Education,2021.
3. Microbiology: Principles and Explorations by Jacquelyn G. Black. 9th Edition, John Wiley &Sons, 2020.
4. Medical Microbiology by Patrick R. Murray et al. 9th Edition, Elsevier, 2020.
5. Industrial Microbiology: An Introduction by Michael J. Waites et al. 2nd Edition, John Wiley &Sons, 2019.

Year	III	Program	B.Sc., Biotechnology	Code	24U1MBAP01
Sem	V	Allied Practical – I : LAB IN MICROBIOLOGY		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To make students understand on microbiological techniques, aseptic practices in laboratory.
2. The candidate also shall know how to maintain and culture the microorganisms. In laboratory and their biochemical identification mechanisms

Course Outcomes:

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

CO1	To understand and implement the principles of aseptic practices in Laboratory.	K1
CO2	To gain knowledge on the media preparation and culturing the Microorganism.	K2
CO3	To identify the microorganisms by staining techniques and biochemical tests.	K3
CO4	To check the growth pattern of microorganisms towards various classes of antibiotics	K4
CO5	To understand and implement the principles of aseptic practices in Laboratory.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Sterilization techniques	3
2	Preparation of Media	3
3	Pure culture techniques- Pour, Spread and Streak plate.	3
4	Enumeration of bacteria from air, water and soil.	4
5	Staining techniques: Simple, Gram's, Capsule (Negative), Spores.	4
6	Preparation of Wet mount - Lacto phenol cotton blue.	4
7	Motility test: Hanging drop technique.	3
8	Biochemical characterization - Catalase, Oxidase and IMVIC test.	3
9	Antibiotic sensitivity test (demonstration).	3

References

1. Fundaments of Microbiology-Frobisher, Sauders &Toppan publications1975.
2. Microbiology-Ronald M. Atlas1993.
3. Introductory Biotechnology – R.B.Singh C.B.D. India (1990)
4. Industrial Microbiology – Casida, E.Wiley Eastern Ltd1962.

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DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2023-2024** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER - III									
1	Language –III	23U3LT03	Foundation Tamil – III	3	5		25	75	100
		23U3LM03	Malayalam – III						
		23U3LH03	Hindi - III						
2	English – III	21U3CE03	English III	3	5		25	75	100
3	Core – III	23U3BTC03	Molecular Biology	4	4		25	75	100
4	Core Practical –III	23U3BTCP03	Lab in Molecular Biology	2		5	40	60	100
5	Core –IV	23U3BTC04	Basic Calculations in Biology	3	3		25	75	100
6	Core Practical –IV	23U3BTCP04	Lab in Basic Calculations in Biology	2		3	40	60	100
7	DSE – I	23U3BTDE01	Forensic Science and Technology	3	3		25	75	100
		23U3BTDE02	Food Biotechnology						
8	NMEC - I	23U3BTN01	Biosafety, Bioethics & IPR	2	2		25	75	100
		23U3BTN02	Concepts of Biotechnology						
Total				**22**	**22**	**8**	**230**	**570**	**800**

Theory	06
Practical	02

23U3BTCP03	Lab in Molecular Biology	5 Hrs
23U3BTCP04	Lab in Basic Calculations in Biology	3 Hrs

Year	II	Program	B.Sc., Biotechnology	Code	23U3BTC03
Sem	III	Core – III : MOLECULAR BIOLOGY		Credits	4
Hrs	60			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. Understand the structure and function of genetic material, focusing on DNA and its role in heredity.
2. Explore the processes of DNA replication, transcription, and the genetic code, elucidating their mechanisms and significance in molecular biology.

Course Outcomes:

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

CO1	Demonstrate proficiency in analyzing genetic material and its structural components.	K3
CO2	Execute DNA replication processes with precision and understanding.	K2 & K3
CO3	Apply transcription mechanisms to interpret genetic information accurately.	K3& K6
CO4	Interpret and decode the genetic code effectively.	K2,K3&K5
CO5	Evaluate the implications of genetic processes in biological systems.	K2,K3,& K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Genetic Material**	**12 Hrs**

Griffith's Experiment -Avery, MacLeod, and McCarty Experiment -Hershey-Chase Experiment - Fraenkel-Conrat and Singer Experiment -Gierer and Schramm Experiment.Chemical Composition of DNA- Molecular Structure of DNA- Watson and Crick's Model of DNA. Structural forms of A-DNA, B-DNA, AND Z-DNA. Overview of Central Dogma of Molecular Biology.

Unit – II	**DNA Replication**	**12 Hrs**

Types of Replication:Conservative Model, Semi-Conservative Model and Dispersive Model, Theta Replication (θ Replication), Rolling Circle Replication, Linear Replication with Multiple Origins, Telomere Replication and D-loop Replication. DNA replication in prokaryotes and eukaryotes. Enzymes involved in DNA replication.Overview of Prokaryotic DNA Repair and Eukaryotic DNA repair.

Unit – III	**Transcription**	**12 Hrs**

RNA types and functions- Enzymes in transcription- Transcription in prokaryotes and eukaryotes. Post transcription modifications. Splicing,spliceosomes, RNA editing , Nuclear export of mRNA.

Unit– IV	**Genetic Code**	**12 Hrs**

History, Definition, Characterisation,Properties. Wobble base pairing- Complementary base pairing- Ribosomal binding. Translation in prokaryotes and in eukaryotes. Post translation modification.Protein folding- Chaperones- misfolding and disease.

Unit – V	**Regulation of Gene Expression**	**12 Hrs**

Overview- Epigenetic Regulation. Transcriptional Regulation, Post-Transcriptional Regulation.Translational Regulation: Post-Translational Regulation. protein synthesis and transport inside a cell and Protein Transport Outside the Cell.

References

1. "Molecular Biology of the Cell" (Seventh Edition, 2023) Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter.ISBN: 978-0393884825
2. "Diagnostic Molecular Biology" (Second Edition, 2022)Chang-Hui Shen, ISBN: 978-0128186639
3. "Molecular Biology: Principles and Practice" (Second Edition, 2020), Michael M. Cox, Jennifer Doudna, Michael O'Donnell,ISBN: 978-1464187467
4. "Essential Cell Biology" (Fifth Edition, 2019)Bruce Alberts, Karen Hopkin, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter,ISBN: 978-0393680366
5. "Molecular Biology of the Gene" (Seventh Edition, 2017)James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. ISBN: 978-0321762436
6. "Genes XII" (Twelfth Edition, 2017) Benjamin Lewin. ISBN: 978-1284104493

Year	II	Program	B.Sc., Biotechnology	Code	23U3BTCP03
Sem	II	Core Practical – 3: LAB INMOLECULAR BIOLOGY		Credits	2
Hrs	30			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. The practical will establish a basic study skill on the subject and will improve the student stabilityto calculate and improve their practical skill and knowledge.
2. Explore cellular mechanisms through experimentation.
3. Separation analysis of DNA and Proteins using different practical methods.
4. Investigate gene expression and regulation and Study protein interactions and signaling pathways.

Course Outcomes:

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

CO1	Illustrate basic separation procedures	K3,K4 &K5
CO2	Study the methods of estimation of biomolecules	K3,K4 &K5
CO3	Isolate &analyze DNA, RNA & protein	K3,K4 &K5
CO4	Evaluate the quality and purity of DNA, RNA & Protein	K3,K4 &K5
CO5	Critically analyze the isolated biomolecules	K3,K4 &K5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

S.No	Experiments	Hours
1	Separation of DNA by Agarose Gel Electrophoresis	3
2	Quantification of DNA by UV-Visible spectrophotometer	3
3	Bacterial Conjugation	3
4	Induction of Mutation in bacterial cells by UV Light	3
5	Isolation of auxotrophic mutants by replica plating technique	3
6	Bacterial DNA transformation by CaCl method	3
7	Isolation of Proteins	3
8	Purification of proteins by dialysis	3
9	Estimation of protein by Lowry's method	3
10	Separation of proteins by native PAGE	3

References

1. Molecular Cloning: A Laboratory Manual by Joseph Sambrook, David W. Russell, and Michael R. Green - This is a classic reference for techniques in molecular cloning, gene expression analysis, and DNA manipulation
2. Current Protocols in Molecular Biology - A comprehensive collection of protocols covering various aspects of molecular genetics, including PCR, cloning, sequencing, and mutagenesis.
3. Cell and Molecular Biology: Concepts and Experiments by Gerald Karp
4. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard M. Twyman.

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Year	II	Program	B.Sc., Biotechnology	Code	23U3BTC04
Sem	III	Core – IV : BASIC CALCULATIONS INBIOLOGY		Credits	3
Hrs	45			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. Students will comprehend the appropriate solutions for biological problems.
2. Students can prepare chemical solutions required for their experiments without the help from tutors
3. Students can understand the application of biological principles through simple calculations
4. Uponsuccessfulcompletionofthecourse,studentsshouldhaveaclearunderstandingof various calculations need for the understanding of life sciences experiments

Course Outcomes:

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

CO1	Know about the application and the usage of basic mathematical notations and prefixes of SI unit.	K3
CO2	Know about the successful preparation of solutions with desired concentration	K3, K4&K6
CO3	To acquire knowledge about the pH and buffer solutions	K3& K6
CO4	To gain over all information regarding the principles and applications of microbiology, Centrifugation and Spectrophotometer	K2,K3& K5
CO5	Gain knowledge about mendelian and non mendelian principles, genotype and allele frequency using Hardy -Weinburg equation	K2,K3,& K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Scientific Notation, Prefixes and Conversion Factors**	**09 Hrs**

Rounding off significant digits in calculations. Converting numbers from scientific notation to decimal notation. Conversion factors and canceling terms.

Unit – II	**Solutions and Mixtures**	**09 Hrs**

Solutions and mixtures - Preparation of molarity, molality, and normality solutions. Concentrations by a factor of X - Preparing percent solutions - Diluting percent solutions - Moles and molecular weight: Definitions and converting molarity to percent - Converting percent to molarity.

Unit – III	**P^H and Buffer**	**09 Hrs**

Ionic product of water - pH of monoprotic strong acid, multiprotic acid, pH of strong base, pH of dilute solutions, pH of the mixture of two acids/two bases and acid and base, pH of weak acids, pH calculations in buffer solutions, isoelectric pH calculations.

Unit– IV	**Microbiology, Spectrophotometery and Centrifugation**	**09 Hrs**

Generation time - Growth rate - Calculation of growth rate constant - Serial dilution - Problems on Beer-Lambert's law - Centrifugation - RCF - RCM - Sedimentation time.

Unit – V	**Genetics**	**09 Hrs**

Mendelian (Mono, di-hybrids) and non-Mendelian genetics (incomplete dominance, codominance, lethal genes) - Pedigree analysis - Hardy-Weinberg equilibrium - Allele frequency - Genotype frequency.

References

1. Calculations in Molecular Biology and Biotechnology: A Guide to Mathematics in the Laboratory by Frank H. Stephenson (2003), ACADEMIC PRESS, An Imprint of Elsevier.
2. Handbook of Laboratory Culture Media, Reagents, Stains, and Buffers by N. Kannan (2003), Panima Publishers, New Delhi.
3. Laboratory Manual of Biochemistry by J. Jayaraman (1988), Wiley Eastern.

Year	II	Program	B.Sc., Biotechnology	Code	23U3BTCP04
Sem	III	Core Practical – IV : LAB IN BASIC CALCULATIONS IN BIOLOGY		Credits	2
Hrs	30			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To make the students understand the basics of biology calculations aims to enhance practical skills in performing accurate and precise biological calculations.
2. Students also acquire proficiency in experimental procedures and reinforce their theoretical knowledge in biological calculations.

Course Outcomes:

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

CO1	To know the preparation of various solutions	K1
CO2	To gain knowledge on the calibration of pH meter.	K2
CO3	To gain knowledge about the various principles of the instruments	K3
CO4	To check the properties of DNA.	K4
CO5	To understand the measurement of cells.	K5&K6

K1-Remember;K2 -Understand; K3 -Apply;K4-Analyze;K5-Evaluate; K6-Create

S.No	Experiments	Hours
1	Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v).	3
2	Calibration of pH meter.	3
3	Preparation of biological buffer - phosphate buffer.	3
4	Plotting standard graph for unknown sample using Excel	3
5	Enumeration of cells using Hemocytometer.	3
6	Validation of beer and lamberts law	4
7	Measurement of size of a sample using micrometer	3
8	Calculation of Tm using BIOEDIT	4
9	Analysis of hyperchromicity.	4

References

1. An Introduction to Practical Biochemistry by Rodney Boyer (2003), Pearson Education.
2. Laboratory Manual of Biochemistry by J. Jayaraman (1988), Wiley Eastern.
3. Practical Biochemistry by Wilson and Walker (1994), Cambridge University Press.
4. Handbook of Laboratory Culture Media, Reagents, Stains, and Buffers by N. Kannan (2003), Panima Publishers, New Delhi.
5. Calculations in Molecular Biology and Biotechnology: A Guide to Mathematics in the Laboratory by Frank H. Stephenson (2003), Academic Press.

Year	II	Program	B.Sc., Biotechnology	Code	23U3BTDE01
Sem	III	DSE – I: FORENSIC SCIENCE AND TECHNOLOGY		Credits	3
Hrs	45			Effect from	2023-2024

Course Objectives:

Students can implement their forensic science and their applications to society

The main objectives of this course are:

1. To make students on understanding the importance of forensic principles and technology.
2. This to provide practical applicability in identifying the candidate who convicted the crime scenery.
3. The students also gain added skills in terms tracing the victim death by means of adapting the measurable molecular approaches.
4. To Identify the tools and techniques required for detection of deception

Course Outcomes:

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

CO1	Gain knowledge on forensic science laboratories across India	K1&K2
CO2	Acquires knowledge on fingerprint identification system	K2 &K3
CO3	Know whereabouts on the FAI and the concepts of fatality Forensics	K3 & K4
CO4	Understand the concepts of DNA finger printing technology	K4&K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit – I	Introduction to Forensic Science and Forensic Psychology	9 Hrs

Definitions and concepts in forensic science. Branches of forensic science. Need of forensic science. Basic principles of forensic science. Forensic Science Laboratories. Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology of evidence - eyewitness testimony, confession evidence. Ethical issues in forensic psychology.

Unit – II	Biological Evidence	9Hrs

Nature and importance of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of human and animal hair. Facial Reconstruction: Facial superimposition techniques, photographic super imposition

Unit – III	Fingerprinting	9Hrs

Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters - Plain and rolled fingerprints. Automated Fingerprint Identification System. Importance of footprints- Palm prints, Lip prints, Ear prints.

Unit– IV	Forensic Medicine and Pathology	9Hrs

Definition of forensic medicine. Death and its medico-legal importance - Death and its types and their medico-legal importance, Signs of death and their medico-legal importance, Injury and its medico-legal importance. Post-mortem examination (autopsy).

Unit – V	DNA Fingerprinting Technology	9Hrs

DNA Fingerprinting (DFP) technology: An overview, Applications of DFP inforensic investigations, paternity disputes. DNA Profiling practice in India withreference to criminal cases.

References

1. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2005
2. Saferstein R.: Criminalistics – An Introduction to Forensic Science, 10thedn, Prentice Hall, 1998
3. Lee, H. C., Palmbach T. and Miller M. T. Henry Lee's Crime Scene Hand Book, Elsevier, 2001
4. Hess, A. K. and Wiener, I. B., Hand Book of Forensic Psychology, 2ndedn., John Wiley, 19999.
5. Bruce, A. A: Introduction to Forensic Psychology, Academic Press, 2000.
6. Shapiro, D. L.: Forensic Psychology Assessment – An Investigative Approach, Allen &Bacon, 1991.
7. Barry, A. J., and Fisher: Techniques of Crime Scene Investigation, 7thedn CRC Press, 2003.
8. Sharma, B. R.: Forensic Science in Criminal Investigation and Trials, Universal Pub. 2003.
9. The Code of Criminal Procedure Code (1973) Amendment Act, (2001) Universal Law Pub. Co., 002.
10. Rattan Lal and Dhiraj Lal: The Indian Penal Code, 28thedn. Wadhwa & Co., 2002.

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Year	II	Program	B.Sc., Biotechnology	Code	23U3BTDE02
Sem	III	DSE – I: FOOD BIOTECHNOLOGY		Credits	3
Hrs	45			Effect from	2023-2024

Course Objectives:

Students can implement theirfood biotechnology knowledge & applications tosociety

The main objectives of this course are:

1. To make students on understanding the importance of food ingredients and technology
2. To make students on understanding basic concepts of food preservation methods by applying technological basics.
3. The paper also deals with the food spoilage, food adulteration and development of value-added products.
4. Students will be able to understand how biotechnology can be utilized for improving the nutritional content of foods stuff.
5. Provide conceptual inputs regarding bio-processes in foods.

Course Outcomes:

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

CO1	To understand the concepts of basic food preservation methods	K1&K2
CO2	To understand the role of water in food spoilage and preservation	K2 &K3
CO3	To explore the physical factors involving in food processing	K3& K4
CO4	To make familiar with food sanitation and its importance	K4&K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit – I	**Food preservation by Application of Heat**	**9 Hrs**

Food Preservation by application of Heat: Principles of Heat Transfer, Blanching, Pasteurization, Heat Sterilization.

Unit – II	**Food Preservation through Water removal**	**9Hrs**

Food Preservation through Water Removal: Forms of Water in Foods, Sorption of Water in Foods, Water Activity, Drying Technology, Evaporation Technology.

Unit – III	**Food Preservation through Physical and Chemical Methods**	**9Hrs**

Food Preservation through Physical and Chemical methods:Chilling, Freezing, Radiation, Ionizing, Microwave, Salt, Smoke, Sugar, Other Chemical Additives.

Unit– IV	**Food Safety, Evaluation and Food Processing**	**9Hrs**

Sensory evaluation of food quality, quality factors for consumer safety. FSSAI, HACCP, FDA. Food Packaging, Food Plant Sanitation, Environmental Aspects of Food Processing.

Unit – V	**Genetically Modified Food**	**9Hrs**

Genetically Modified Food: Bovine somatotropin, alpha lactalbumin & lactoferrin in milk, Edible vaccine (Cholera vaccine – potatoes & Hepatitis B vaccine - maize)

References

1. Rutledge, Food and Nutritional Biotechnology, Navyug Publishers &distributors, 2. 2009.
2. Ravishankar Rai V, Advances in Food Biotechnology, Wiley-Blackwell, 2015.
3. Donald Bills and Shain-dow Kung, Biotechnology and Nutrition Proceedings of theThirdInternational Symposium, Butterworth-Heinemann, Boston.
4. Kruger JE. *et al*. 1987. *Enzymes and their Role in Cereal Technology*. AmericanAssociation ofCereal Chemists Inc.
5. Nagodawithana T & Reed G. 1993. *Enzymes in Food Processing*.Academic Press.
6. Tucker GA & Woods LFJ. 1991. *Enzymes in Food Processing*. Whitehurst R & LawB. 2002.
7. *Enzymes in Food Technology*. Blackwell Publ.
8. Kalidas Shetty, Gopinath Paliyath, Anthony Pometto and Robert E, Levin, *FoodBitechnology*-Second Edition, CRC Press, 2005.
9. Journal of Food Biosciences, www.journals.elsevier.com/food-bioscience.
10. DebasisBagchi , Francis C. Lau and ManashiBagchi, Application of Genomics andBioinformatics Analysis in Exploratory Study of Functional Food, Wiley-Blackwell,Oxford, UK.

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Year	II	Program	B.Sc., Biotechnology	Code	23U3BTN01
Sem	III	NMEC I - BIOSAFETY, BIOETHICS & IPR		Credits	2
Hrs	30			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To introduce basic concepts of ethics and safety that is essential for Life Science Labs.
2. To understand the procedures involved in protection of Intellectual property.
3. To give an insight into different treaties signed.
4. To gain knowledge about patent filing.

Course Outcomes:

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

CO1	Understand the concepts of basic biosafety and biosafety levels	K1 & K2
CO2	Understand biosafety guidelines and role genetically modified Organisms	K1, K2 & K4
CO3	Understand the basic principles of IPR, its types and patenting Procedures	K4, K5 & K6
CO4	Understand the concepts of ethical, legal considerations on the release of genetically modified organisms	K4, K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit – I	**Introduction to Bio Safety**	**06 Hrs**

Bio safety: Introduction – Bio safety issues in biotechnology - Historical background. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals.

Unit – II	**Biosafety Guidelines and Regulations**	**06 Hrs**

Biosafety Guidelines: Guidelines and regulations (Cartagena Protocol). Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC.

Unit – III	**Introduction to Intellectual Property Rights (IPR)**	**06 Hrs**

Intellectual Property Rights: Introduction to IPR, Types of IPR - Patents, Trademarks, Copyright & Related Rights, Importance of IPR – Patentable and Non-patentable.

Unit– IV	**Patents and Patent Laws in Biotechnology**	**06 Hrs**

Patents and Patent Laws: Objectives of the patent system - Basic, principles 6 and general requirements of patent law. Patentable subjects and protection in Biotechnology. Patent infringement-meaning, scope, litigation, case studies.

Unit – V	**Bioethics and Ethical Decision-Making**	**06 Hrs**

Bioethics: Introduction to ethics and bioethics, Framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy. Ethical implications of human genome project and GM crops, bio piracy and bio warfare.

References

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2019. Biosafety and Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

Year	II	Program	B.Sc., Biotechnology	Code	23U3BTN02
Sem	III	NMEC I – CONCEPTS OF BIOTECHNOLOGY		Credits	2
Hrs	30			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To make non-major life science students understand the basic and applied principles of biotechnology.
2. To understand the technical approach in society in generating value-added, reliable, and reproducible products.

Course Outcomes:

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

CO1	To understand the scope and application of biotechnology	K1
CO2	Use of enzymes in generating basic recombinant DNA concepts.	K2
CO3	Use of plasmid vectors in experimenting and designing cloning Strategies	K3
CO4	Use molecular techniques of the identification of positive recombinantclones.	K4
CO5	To gain knowledge about technologies in biotechnology.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit - I	**Scope of Biotechnology**	**6 Hrs**

History of Biotechnology; Conventional and modern Biotechnology –Biotechindustries. Biotechnology tree. Strategies for gene cloning.

Unit - II	**Tools used in Gene Cloning**	**6 Hrs**

Restriction endonucleases – Types – Features. Ligases – linkers, adaptors and homo polymer tailing. Modifying Enzymes.

Unit - III	**Vectors**	**6 Hrs**

Properties of good vector. Constructed plasmids - pBR322. Cosmidvectors, Animalvectors-SV40.Plant vectors – Tiderivatives.

Unit - IV	**Introduction of Genes**	**6 Hrs**

Vector mode–transformation and transfection. Vectorless mode – Biolistics, Electroporation, Microinjection.

Unit - V	**Selection of Recombinants**	**6 Hrs**

Markers – PCR, RFLP, RAPD and blotting techniques

References

1. Principles of gene manipulations. Old and Primrose (1989), 3rdedition.
2. Biotechnology, Sathyanarayana U (2008), Books and Allied (p) ltd.
3. Biotechnology and genomics, Gupta PK(2004). Rastogi Publications.
4. GenecloningandDNAanalysis.BrownTA.(1996).Blackwellscience,OsneyMead, Oxford.
5. A text book of Biotechnology, Dubey RC(2007).S.Chand & Company Ltd, NewDelhi.
6. Biotechnology, Singh BD(2004). Kalyani 37 Publications. New Delhi.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2022-2023** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER - V									
1	Core -7	22U5BTC07	Immunology	3	4		25	75	100
2	Core -8	22U5BTC08	Bioprocess Technology	3	4		25	75	100
3	Core -9	22U5BTC09	Enzyme Technology	3	4		25	75	100
4	Core PracticalV	22U5BTCP05	Lab in Immunology	2		3	40	60	100
5	Core PracticalVI	22U5BTCP06	Lab in Bioprocess Technology and Enzyme Technology	2		6	40	60	100
6	DSE I	22U5BTE01	Pharmaceutical Biotechnology	2	3		25	75	100
		22U5BTE02	Cancer Biology						
7	DSE II	22U5BTE03	Regenerative Medicine	2	3		25	75	100
		22U5BTE04	Nano Biotechnology						
8	SBECIII	22U5BTS05	Biofarming	2	2		25	75	100
		22U5BTS06	Biosafety, Bioethics & IPR						
9	Internship	22U5BTINT01	Internship	1					
Total				**20**	**20**	**09**	**230**	**570**	**800**

Theory	06
Practical	02
Internship	01

22U5BTCP05	Lab in Immunology	3 Hrs
22U5BTCP06	Lab in Bioprocess Technology and Enzyme Technology	6 Hrs

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTC07
Sem	V	Core – 7 : IMMUNOLOGY		Credits	3
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To provide a thorough understanding of the fundamental principles of immunology, including the components and functions of the immune system, antigen-antibody interactions, and immune cell activation.
2. To explore the applications of immunological concepts in medical research and clinical practice, such as vaccine development, autoimmune disorders, immunodeficiency diseases, and advanced immunological techniques.

Course Outcomes:

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

CO1	Understand the historical development and fundamental scope of immunology, including the structure and function of the immune system.	K1
CO2	Grasp the characteristics and diversity of antigens and antibodies, including their interactions and the production of monoclonal antibodies.	K2
CO3	Explain the mechanisms of antigen processing and presentation and the structure and function of BCR, TCR, and MHC molecules.	K3
CO4	Describe the roles of cytokines, types of hypersensitivity reactions, and the principles of vaccines and the complement system	K4
CO5	Identify the mechanisms and types of autoimmune and immunodeficiencies disorders, and understand advanced immunological techniques.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Scope of Immunology**	**12 Hrs**

Introduction to Immunology. Types of immunity – Innate and acquired. Hematopoiesis. Cells immune system response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen.

Unit –II	**Antigen and Generation of Antibody diversity**	**12 Hrs**

Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Antigen – Antibody interactions Concept of Generation of Antibody Diversity Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.

Unit – III	**Antigen Processing and Presentation**	**12 Hrs**

Structure of BCR, TCR, MHC - Class I and II. Generation and Maturation of B cells and T Cells, Antigen Presenting Cells, Processing of Exogenous and Endogenous Antigens.

Unit – IV	**Cytokines, Immune Cell Activation and Vaccines**	**12 Hrs**

Definition of cytokines, Structure and types of cytokine, Biological functions of cytokines. Reactions and different types of hypersensitivity; Vaccines – Types, Production and application. Complement system– Classical, alternative and Lectin pathway.

Unit – V	**Autoimmune Disorders**	**12 Hrs**

Definition, types of autoimmune disorders. Mechanism of autoimmunity. Immunodeficiency Disorder. Immuno deficiency diseases (HIV). Transplantation immunology – types of grafts. Mechanism of graft rejection, Advanced Immunological Techniques: Blood grouping, Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, and Fluorescent Antibody Techniques.

References

1. "Immunology: Understanding the Immune System" by Klaus D. Elgert, 2nd Edition, Wiley, 2009.
2. "The Immune System" by Peter Parham, 4th Edition, Garland Science, 2014.
3. "Janeway's Immunobiology" by Kenneth Murphy, 9th Edition, Garland Science, 2016.
4. "Cellular and Molecular Immunology" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai, 9th Edition, Elsevier, 2017.
5. "Fundamental Immunology" by William E. Paul, 7th Edition, Lippincott Williams & Wilkins, 2012.
6. "Immunobiology: The Immune System in Health and Disease" by Charles A. Janeway, Jr., Paul Travers, Mark Walport, and Mark J. Shlomchik, 6th Edition, Garland Science, 2005.
7. "Cytokine Storm Syndrome" by Randy Q. Cron and W. Winn Chatham, 1st Edition, Springer, 2019.
8. "Vaccines" by Stanley A. Plotkin, Walter A. Orenstein, and Paul A. Offit, 7th Edition, Elsevier, 2017.
9. "Autoimmune Diseases" by Robert G. Lahita, 5th Edition, Elsevier, 2010.
10. "Essential Clinical Immunology" by John B. Zabriskie, 1st Edition, Cambridge University Press, 2009

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTCP05
Sem	V	Core Practical – V : LAB IN IMMUNOLOGY		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To provide students with practical exposure to immunological techniques, including the handling of laboratory animals and the qualitative and quantitative estimation of antigen-antibody specificity.

Course Outcomes:

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

CO1	To provide students with practical exposure to immunological techniques, including gaining knowledge on handling of laboratory animals.	K1
CO2	To understand the methods of immunization, bleeding, and separation of serum and plasma from blood.	K2
CO3	To analyze qualitative and quantitative estimation of antigen-antibody interaction.	K3
CO4	To learn about the basic principles of blotting techniques in a practical approach.	K4
CO5	To evaluate and create laboratory test analysis kits.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Preparation of serum and plasma.	3
2	ABO Blood grouping (Rh typing) (Agglutination).	3
3	WIDAL test.	3
4	ASO test.	3
5	Pregnancy test (Agglutination).	3
6	Radial immune diffusion test.	3
7	Rocket Immunoelectrophoresis test.	3
8	Ouchterlony double immunodiffusion technique (ODD) (Precipitation test).	3
9	Counter current immunoelectrophoresis (CIE).	3
10	Dot ELISA.	3

References

1. Clinical Laboratory Tests: Values and Implications by Springhouse (Published in 2001).
2. Textbook of Medical Laboratory Technology by Praful B. Godkar (Published in 2014).
3. Clinical Laboratory Diagnostics: Use and Assessment of Clinical Laboratory Results byThomas L. Lehmann and Georg D. Hirsch (Published in 2012).
4. Clinical Laboratory Science Review by Robert R. Harr (Published in 2015).
5. Clinical Laboratory Hematology by Shirlyn B. McKenzie, Lynne Williams, and Turgeon ML (Published in 2014).

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTC08
Sem	V	Core – 8 : BIOPROCESS TECHNOLOGY		Credits	03
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To make the students on understanding basic principles of fermentation techniques and applying them in the production value added products such as antibiotic, vitamins and organic acids.
2. The students also gain added knowledge on the production of agro-based products for human welfare.
3. To provide students with a comprehensive understanding of the principles and practices involved in Bioprocess Technology.
4. To explore the application of bioprocess technology in various industries such as pharmaceuticals, food and biofuels.
5. To highlight recent advancements and emerging trends in bioprocess technology.

Course Outcomes:

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

CO1	To Understanding the Bioprocess Fundamentals.	K1 & K2
CO2	To Mastery of Upstream Processing Techniques.	K2 & K3
CO3	To Competence in Downstream Processing.	K4
CO4	ToIdentify and utilize various types of sensors and instruments for measuring key bioprocess parameters such as pH, temperature, dissolved oxygen, biomass, and substrate concentration.	K4 & K5
CO5	Analyze and evaluate industrial bioprocesses for the production of various bioproducts and understand and apply regulatory standards and ethical principles in bioprocessing.	K4 & K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	Introduction to Bioprocess Technology	12 Hrs

Basics of Bioprocessing Technology - History and overview of bioprocess technology, Interdisciplinary nature: integration of biology and engineering technology; Microbial Growth and Kinetics - Microbial metabolism and growth kinetics, batch, fed-batch, and continuous cultures. Bioreactors - Types of bioreactors: stirred-tank, airlift, packed-bed, and fluidized-bed reactors, Design and operation of bioreactors, Scale-up and scale-down of bioreactors.

Unit – II	Upstream Processing	12 Hrs

Media Formulation - Components of microbial culture media, Sterilization methods: thermal, filtration, and chemical methods, Media optimization techniques; **Inoculum Development** - Preparation and maintenance of inoculum, Scaling up of inoculum, Aseptic transfer techniques; **Fermentation Technology** - Principles of fermentation: aerobic and anaerobic processes, Types of fermentation processes: submerged, solid-state, and photo-fermentation, Fermentation process control and monitoring.

Unit – III	**Downstream Processing**	**12 Hrs**

Cell Disruption Techniques - Mechanical methods: homogenization, bead milling, ultrasonication, Non-mechanical methods: chemical lysis, enzymatic lysis, osmotic shock; **Product Recovery and Purification** - Separation techniques: centrifugation, filtration, and sedimentation, Purification techniques: precipitation, chromatography (ion exchange, Column, affinity, gel filtration), Dialysis and ultrafiltration; **Product Formulation and Stability** - Formulation of bioproducts, Stabilization methods, Quality control and assurance.

Unit– IV	**Quality Control and Instrumentation**	**12 Hrs**

Process Control Basics - Fundamentals of process control: feedback and feedforward control, Control loops: sensors, controllers, and actuators, PID controllers: tuning and applications; **Instrumentation in Bioprocesses** - Measurement of key parameters: pH, temperature, dissolved oxygen, biomass, and substrate concentration, analysis techniques, Data acquisition and process automation; **Computer Applications in Bioprocessing** - Role of computer simulations and modeling, Bioprocess data analysis software, Computational fluid dynamics (CFD) in bioprocessing.

Unit – V	**Applications and Advances in Bioprocess Technology**	**12 Hrs**

Production of bio pharmaceuticles: vaccines and antibiotics. **Production of biofuels**: ethanol and biodiesel. **Production of biochemicals**: organic acids and amino acids. **Environmental and agricultural applications:** Bioremediation and waste treatment. Production of biofertilizer, production of biopesticides. **Advances in Bioprocess Technology** - Recombinant DNA technology and genetic engineering. **Regulatory and Ethical Aspects** - Regulatory frameworks, Ethical considerations in bioprocessing. Future trends and challenges in bioprocess technology.

References

1. "Bioprocess Engineering: Basic Concepts" by Michael L. Shuler and Fikret Kargi
2. "Principles of Fermentation Technology" by Peter F. Stanbury, Allan Whitaker, and Stephen J. Hall
3. "Bioprocess Engineering Principles" by Pauline M. Doran
4. "Fermentation Microbiology and Biotechnology" by E. M. T. El-Mansi, C. F. A. Bryce, Arnold L. Demain, and A.R. Allman
5. "Bioseparations Science and Engineering" by Roger G. Harrison, Paul W. Todd, Scott R. Rudge, and Demetri P. Petrides
6. "Bioprocess Engineering Principles" by Pauline M. Doran (also useful for downstream processing)
7. "Process Dynamics and Control" by Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle
8. "Biochemical Engineering and Biotechnology" by Ghasem Najafpour
9. "Measurement, Monitoring, Modelling and Control of Bioprocesses" edited by Carl-Fredrik Mandenius and David J. McNeil
10. "Industrial Biotechnology: Sustainable Growth and Economic Success" edited by Christoph Wittmann and James C. Liao
11. "Biochemical Engineering" by Douglas S. Clark and Harvey W. Blanch

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTC09
Sem	IV	Core – 9 : ENZYME TECHNOLOGY		Credits	3
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To make students on exposing themselves to know in underlying concepts of enzyme and enzyme technology.
2. In addition the students also know where about the mechanisms enzymes and basic enzyme techniques.

Course Outcomes:

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

CO1	Acquire knowledge in the subject of enzymes and enzyme technology.	K1
CO2	Knowing about the kinetics of enzymes.	K2
CO3	To understand the mechanism of enzyme action.	K3
CO4	Acquire basic concepts about the regulation of enzyme activity.	K4
CO5	Acquire knowledge about the enzyme industries.	K5&K6

K1-Remember;K2-Understand;K3 -Apply; K4-Analyze; K5-Evaluate;K6-Create

Unit – I	**Introduction about Enzymes**	**12 Hrs**

Enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, enzyme activity, specific activity and turnover number, marker enzymes.

Unit – II	**Enzyme Kinetics**	**12 Hrs**

Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, LB plot. Different methods to calculate the Km and Vmax and their significance. Factors affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature.

Unit – III	**Mechanism of Enzyme action and Inhibitors of Enzyme activity**	**12 Hrs**

Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators (competitive, non-competitive, and uncompetitive), coenzymes and cofactors.

Unit– IV	**Regulation of Enzyme activity**	**12 Hrs**

Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes. Multi-enzyme complex.

Unit – V	**Enzymes in Industries**	**12 Hrs**

Paper making, meat processing, bread making, detergent preparation, enactments, regulations, and guidelines in enzyme industries. IPR in enzyme technology (stone wash, bioplastics, corn to plastic).

References

1. Trevor, P. 2004. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry – East West Press.
2. Satyanarayana, U. and Chakrapani, U. 2008. Biochemistry, Books and Allied (P) Ltd, Kolkata.
3. Nicholas, C. and Price, Lewis Stevens, 1998. Fundamentals of Enzymology, 2nd edition, Oxford University Press, New York.
4. David L. Nelson and Michael M. Cox, 2007. Lehninger Principles of Biochemistry, W.H Freeman and Company, New York.
5. Lubert, S. Jeremy M. Berg and John L. Tymoczko, 2001. Biochemistry, V edition, W.H. Freeman & Company, New York.
6. Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, and Christian Larroche, 2005. Enzyme Technology, Asiatech Publishers Inc, New Delhi.

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTCP06
Sem	V	Core Practical – VI: LAB IN BIOPROCESS TECHNOLOGY AND ENZYME TECHNOLOGY		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. The course aims to provide hands-on experience and theoretical knowledge on various microbial fermentation processes and their applications.
2. Students will learn the techniques for fermenter operation, microbial cell immobilization, qualitative analysis of milk, and the production and estimation of bio-products like ethanol, citric acid,and acetic acid.
3. The course also focuses on the isolation and application of beneficial microorganisms in food and beverage fermentation, enhancing the understanding of microbial biotechnology.
4. This course provides comprehensive knowledge and practical skills in isolating and screening amylase-producing bacteria, assessing enzyme activity, and determining key kinetic parameters (Km and Vmax). These skills are crucial for applications in industrial biotechnology and enzyme engineering.

Course Outcomes:

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

CO1	To Gain comprehensive knowledge of the design and function of various fermenter components.	K3
CO2	To learn the technique of immobilizing yeast cells using the sodium alginate method.	K3 & K4
CO3	To perform and interpret the Methylene Blue Reduction Test (MBRT) to assess milk quality.	K4 & K5
CO4	To understand the entire process of wine fermentation, learn the microbial production process of citric acid and understand the microbial process for acetic acid production.	K5 & K6
CO5	To gain proficiency in serial dilution, plating techniques, and the isolation of pure bacterial colonies, perform screening techniques to detect amylase activity in isolated bacterial strains and Gain a thorough understanding of enzyme kinetics, including the concepts of Km and Vmax.	K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
	Bioprocess Technology	
1	Components of a Fermenter – Demonstration	2
2	Immobilization of Yeast Cells Using Sodium Alginate Method	2
3	Qualitative Analysis of Milk a. Methylene Blue Reduction Test (MBRT) b. Resazurin Test	2
4	Wine Production	3
5	Microbial Production and Estimation of Acetic Acid	3
6	Microbial Production and Estimation of Citric Acid	3
	Enzyme Technology	
7	Isolation and Screening of Amylase producing Bacteria from soil.	6
8	Determination of Amylase enzyme activity.	3
9	Determination of specific activity of Amylase enzyme.	3
10	Determination of Enzyme Kinetics (Km and Vmax) of Amylase.	3

References

1. Clinical Laboratory Tests: Values and Implications by Springhouse (Published in 2001).
2. Textbook of Medical Laboratory Technology by Praful B. Godkar (Published in 2014).
3. Clinical Laboratory Diagnostics: Use and Assessment of Clinical Laboratory Results byThomas L. Lehmann and Georg D. Hirsch (Published in 2012).
4. Clinical Laboratory Science Review by Robert R. Harr (Published in 2015).
5. Clinical Laboratory Hematology by Shirlyn B. McKenzie, Lynne Williams, and Turgeon ML (Published in 2014).

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTE01
Sem	V	DSE- I - PHARMACEUTICAL BIOTECHNOLOGY		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. This paper encodes information on pharmacology, drug designing, sources and applications of drugdiscovery.
2. Students also understand the basic and applications of pharmacology and sources of drug.
3. This paper also enables them to understand the concepts of rDNA technology in drug designing.

Course Outcomes:

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

CO1	To understand the principles of pharmacology and its development History	K1 & K2
CO2	To understand principles of action of drugs and mechanism of action towards various diseases	K2 & K3
CO3	To understand the concepts of developing therapeutic agents through genetic engineering principles	K3 & K4
CO4	To explore the applications of pharmaceutical chemistry and its Development	K4 & K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit – I	**Introduction to pharmacology**	**9Hrs**

History & development in pharmacology. Principles of pharmacology. – Pharmacology in the 20th century – Drugs – Sources, dosage forms and routes of administration.

Unit – II	**Drug names and Classification systems**:	**9Hrs**

General Principles of Drug action, Pharmacokinetics, Pharmacodynamics and measurement of drug action.

Unit – III	**Diagnosis and Chemotherapy**	**9Hrs**

Prenatal diagnosis: Invasive Techniques- Amniocentesis, Fetoscopy, Invasive and Non Invasive Techniques – Ultra Sonography. Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics. Therapeutic drugs – Protein synthesis inhibitors, Antibacterial, antifungal, anti protozoal, antiviral, anti helminthic, anticancer, anti-inflammatory drugs.

Unit– IV	**Introduction to r-DNA technology**	**9Hrs**

Production of biological molecules: Human Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII. Synthetic therapy**:** Synthetic DNA, therapeutic ribozymes, synthetic drugs.

Unit – V	**Production and applications**	**9Hrs**

Probiotics, anticancer and anti- inflammatory agents. Biochips, biofilms and biosurfactants. Tissue Engineering, Recombinant vaccines and Cell adhesion based therapy.

References:

1. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.
2. Pharmacology – H.P. Rang, M.M. Pale, J.M. Moore, and Churchill Livingston.
3. Basic Pharmacology – Foxter Cox. Butterworth‟s 1980.
4. Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapure.
5. Pharmaceutical Biotechnology – S.S. Purohit, Kaknani, Saleja.
6. Pharmacology – Mary J. Myuk, Richard A.Hoarey, Pamala Lippinwitt, Williams Edition.
7. Integrated pharmacology – Page, Curtis, Sulter, Walker, Halfman. Mosby Publishing Co.104.

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Year	III	Program	B.Sc., Biotechnology	Code	22U5BTE02
Sem	V	DSE- I - CANCER BIOLOGY		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. Explore the stages and factors influencing multistage cancer progression.
2. Investigate the role of mitogens, carcinogens, oncogenes, and proto-oncogenes in oncogenesis.
3. Analyze the function and significance of tumor suppressor genes such as Rb and p53 in maintaining cellular integrity.
4. Examine programmed cell death (apoptosis) and its implications in cancer biology, including therapeutic strategies.
5. Discuss the clinical implications of cancer biology research for diagnosing, treating, and preventing cancers.

Course Outcomes:

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

CO1	Understand Cancer Biology: Provide students with a comprehensive understanding of the fundamental concepts in cancer biology, including the characteristics, types, and stages of cancer development	K1 & K2
CO2	Explore Molecular Mechanisms: Explain the molecular basis of cancer, including the roles of oncogenes, tumor suppressor genes, and keysignaling pathways involved in cancer progression.	K2 & K3
CO3	Study Cancer Epigenetics and Genomics: Introduce students to cancer genomics and epigenetics, focusing on the techniques used for genomic analysis and the role of epigenetic modifications in cancer.	K1& K4
CO4	Learn Diagnostic Methods: Familiarize students with various cancer diagnostic methods, including imaging techniques, molecular diagnostics, and the importance of screening and early detection.	K2& K5
CO5	Examine Therapeutic Approaches: Provide an overview of conventional and emerging cancer therapies, including targeted therapies, immunotherapy, gene therapy, and precision medicine.	K2& K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit – I	Introduction to Cancer Biology	9Hrs

Characteristics of cancer - benign and malignant tumors- Stages of cancer development: initiation, promotion, progression; Mechanisms of invasion and metastasis- Types of Cancer- Classification based on tissue and cell type- Common types of cancers: Carcinomas, sarcomas, leukemias, lymphomas - Risk factors: Genetic, environmental, lifestyle-related.

Unit – II	**Molecular Basis of Cancer**	**9Hrs**
Oncogenes and tumor suppressor genes - Mutation types and mechanisms - Cell Cycle and Apoptosis - Checkpoints and their role in cancer - Mechanisms of apoptosis and its evasion in cancer cells - Signal Transduction Pathways in Cancer - Growth factor signaling (EGFR & VEGF) - PI3K/AKT/mTOR pathway - MAPK pathway- Therapeutic targets in signaling pathways.		
Unit – III	**Cancer Epigenetics**	**9Hrs**
Cancer Genomics - Techniques for genomic analysis (NGS, microarrays. Epigenetic Changes in Cancer: DNA methylation, histone modification- Role of non-coding RNAs in cancer; Data Analysis - Bioinformatics tools for cancer research- Interpretation of genomic data.		
Unit– IV	**Cancer Diagnostics**	**9Hrs**
Diagnostic Methods- Imaging techniques (MRI, CT, PET) - Molecular diagnostics (biomarkers, liquid biopsy) - Histopathology and immunohistochemistry - Screening and Early Detection - Methods and their importance - Screening programs for common cancers.		
Unit – V	**Cancer Therapeutics**	**9Hrs**
Conventional Therapies - Surgery, radiation therapy, chemotherapy - Targeted Therapies - Monoclonal antibodies, small molecule inhibitors - Examples: HER2 inhibitors, tyrosine kinase inhibitors – Immunotherapy - Checkpoint inhibitors, CAR-T cell therapy - Cancer vaccines - Emerging Therapies - Gene therapy, CRISPR/Cas9 - Nanotechnology in cancer treatment- Precision medicine in oncology.		
References:		

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
3. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications.
4. Ruddon.R.W.,Cancer Biology, Oxford University Press, Oxford, 1995.

Year	III	Program	B.Sc., Biotechnology	Code	22U5NTE03
Sem	V	DSE – II : REGENERATIVE MEDICINE		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. Understand the structure and function of genetic material, focusing on DNA and its role in heredity.
2. Explore the processes of DNA replication, transcription, and the genetic code, elucidating their mechanisms and significance in molecular biology.

Course Outcomes:

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

CO1	Understand the basic principles of regenerative medicine.	K3
CO2	Learn about different types of stem cells and their applications.	K2,K3, K4& K6
CO3	Explore the techniques used in tissue engineering & regenerative therapies.	K3& K6
CO4	Examine the ethical, regulatory, and practical challenges in the field.	K2,K3&K5
CO5	Develop critical thinking skills through analysis of current research.	K2,K3,& K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Foundations of Regenerative Medicine:**	**9 Hrs**

Overview and historical perspective - Stem cells: types, sources, characteristics and properties: Embryonic stem cells(ESCs)-adult stem cells(ASCs)- Induced pluripotent stem cells(iPSCs)-Hematopoietic and mesenchymal stem cells.

Unit – II	**Tissue engineering and Biomaterials**	**9 Hrs**

Principle of tissue engineering-basics of tissue engineering, Scaffolds design and fabrication, bioprinting and organoid technology. Biomaterial of regenerative medicine-types (natural &synthetic), properties and application.

Unit – III	**Techniques and immunity in regenerative medicine:**	**9 Hrs**

Imaging and characterization (imaging cultured cells & tissue, MRI and CT).Analytical techniques-Mechanical testing of biomaterials (spectrophotometry).Types of bioreactors used in tissue engineering . Immune responses to implanted biomaterials and stem cells. Strategies to modulate immune responses & reduce immunogenicity.

Unit– IV	**Regenerative therapies and Applications:**	**9 Hrs**

Cardiovascular regeneration (tissue engineering vascular grafts). Neurological regeneration (treatment for spinal cord injuries).Musculoskeletal regeneration(bone, muscle tissue and cartilage regeneration).

Unit – V	**Ethical, Legal and Future Perspective:**	**9 Hrs**

Ethical issues in regenerative medicine-regulatory frameworks and guidelines. FDA and EMA guidelines for regenerative medicine. Emerging trends and potential impact in regenerative medicine.

References:

1. "Principles of Regenerative Medicine" by Anthony Atala, Robert Lanza, James A. Thomson, Robert Nerem.
2. "Essentials of Stem Cell Biology" by Robert Lanza, Anthony Atala.
3. "Biomaterials Science: An Introduction to Materials in Medicine" by Buddy D. Ratner, Allan.
4. S. Hoffman, Frederick J. Schoen, Jack E. Lemons.
5. "Tissue Engineering" edited by Clemens Van Blitterswijk.
6. "Stem Cells: A Short Course" by Rob Burgess.
7. "Tissue Engineering: Principles and Practices" edited by Joseph D. Bronzino, Donald R. Peterson.
8. "Regenerative Medicine: From Protocol to Patient" edited by Gustav Steinhoff

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTE04
Sem	V	DSE – II : NANO BIOTECHNOLOGY		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. Students will be able to demonstrate a thorough understanding of the fundamental concepts of nanoscience and nanotechnology, including the unique properties of nanomaterials, their historical development, and their applications across various fields such as medicine, electronics, and energy.
2. Students will acquire practical skills in synthesizing and characterizing nanomaterials using various techniques. They will be able to apply this knowledge to real-world problems in medicine, healthcare, environmental remediation, and energy, understanding both the potential benefits and ethical considerations associated with nanotechnology.

Course Outcomes:

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

CO1	Explore the historical development and significance of nanoscience and its applications in medicine, electronics, and energy.	K1
CO2	Gain proficiency in characterization techniques like electron microscopy and spectroscopy to study the properties of nanomaterials.	K2
CO3	Gain proficiency in characterization techniques like electron microscopy and spectroscopy to study the properties of nanomaterials.	K3
CO4	Study nanoscale electronic devices and their applications in information technology, sensors, and consumer electronic	K4
CO5	Explore the use of nanomaterials for energy generation, storage, and conversion, emphasizing sustainable development and clean energy initiatives.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Introduction to Nanoscience**	**09 Hrs**

Overview of nanoscience and nanotechnology, Scale of nanomaterials and their unique properties, Historical development and significance of nanoscience. Applications of nanotechnology in various fields such as medicine, electronics, and energy.

Unit – II	**Nanomaterials Synthesis and Characterization**	**09 Hrs**

Methods for synthesis of nanoparticles and nanomaterials (e.g., bottom-up, top-down approaches). Characterization techniques for nanomaterials (e.g., electron microscopy, spectroscopy). Properties and behavior of nanomaterials at the nanoscale. Applications of different types of nanomaterials (e.g., carbon nanotubes, quantum dots, nanoparticles).

Unit – III	**Nanotechnology in Medicine and Healthcare**	**09 Hrs**
Nanomedicine: Introduction and applications in drug delivery, imaging, and diagnostics. Nanobiotechnology: Role of nanotechnology in understanding biological systems and disease mechanisms. Nanomaterials in tissue engineering and regenerative medicine. Safety and ethical considerations in nanomedicine.		
Unit– IV	**Nanoelectronics and Nanodevices**	**09 Hrs**
Introduction to nanoelectronics and its significance in miniaturization. Nanoscale electronic devices (e.g., nanowires, quantum dots, molecular electronics). Applications of nanoelectronics in information technology, sensors, and consumer electronics. Challenges and future prospects of nanoelectronics.		
Unit – V	**Environmental and Energy Applications of Nanotechnology**	**09 Hrs**
Nanotechnology in environmental remediation and pollution control. Nanomaterials for energy generation, storage, and conversion (e.g., solar cells, batteries, fuel cells). Role of nanotechnology in sustainable development and clean energy initiatives. Environmental and safety implications of nanotechnology in energy and environmental applications.		

References

1. Ferziger, J. H., Numerical Methods for Engineering Applications, 2nd ed., WileyInterscience (1998).
2. Computational Physics, J. M. Thijssen, Cambridge University Press, Cambridge,(1999).
3. Active Metals: Preparation, characterization, applications – A. Furstner, Ed., VCH,New York ,1996.
4. Characterization of Nanophase materials – Z.L Wang (ed), Wiley-VCH, New York,2000.
5. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim, 2004.
6. Nanostructured Silicon – based powders and composites – Andre P Legrand,Christiane Senemaud, Taylor and Francis, London, 2003.
7. Nanocrystalline Materials, A.I. Gusev and A. A. Rempel, Viva Books, New Delhi, 2008.
8. The Physics and Chemistry of Solids, S.R.Elliott, John Wiley & Sons, England, 1998.
9. Properties of Materials, Robert E.Newnham,Oxford University Press, 2005.
10. A. L. Rogach, Semiconductor nanocrystal quantum dots synthesis, assembly, spectroscopyand applications (Springer, Wien; London, 2008).

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTS05
Sem	V	SBEC – III : BIOFARMING		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To make students in understanding the basic concepts of developing entrepreneurship qualit,
2. To produce biologically generated value added products for the development of human welfare.

Course Outcomes:

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

CO1	Understand the principles of conventional cropping systems and natural farming	K1 & K2
CO2	Manipulate integrated pest management for the development of pesticide-free plant products	K2
CO3	Develop the concepts of organic farming	K4
CO4	Understand the concepts of organic agricultural policy and GMOs	K2
CO5	Understand the policies governing organic agriculture and the regulatory challenges posed by genetically modified organisms (GMOs) within organic farming practices.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Agricultural Practices and Systems in TamilNadu**	**6 Hrs**

Agro-ecological zones and geographical distribution of crop plants in Tamil Nadu. Cropping systems - different types and their importance in food production- Package and practices followed for major crops and cropping systems in Tamil Nadu.

Unit – II	**Evolution of Farming Techniques in India**	**6 Hrs**

Green revolution in India - After effects - Definitions of Natural Farming, Traditional farming - Their concepts and scope - Natural Farming - Institutions- their activities and role.

Unit – III	**Integrated Pest Management (IPM) and Agricultural Sustainability**	**6 Hrs**

Pest - Definition - categories of pests-pest control - natural, artificial-pest management IPM. Store grain pest management. Pesticides consumption and hazards. Role of biopesticides and biofertilizers in IPM.

Unit– IV	**Promotion and Implementation of Organic Agriculture**	**6 Hrs**

Organic farming –concept and relevance in the agriculture –problems and remedies -Encouragement and dissemination for effective practicing of organic farming. Production and marketing of Organic products.

Unit – V	**Legal and Ethical Issues in Organic Farming**	**13 Hrs**
Organic agriculture policy, Genetically Modified Organisms as organic regulation.		

References:

1. Basu, D.N., & Guha, G.S. (1996). Agroclimatic regional planning in India. ARPU, Ahmedabad.
2. Krishna, K.R. (2010). Agroecosystems of South India. BrownWalker Press, Florida.
3. Perkins, J.H. (1997). Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War. Oxford University Press.
4. Brown, L.R. (1970). Seeds of Change: The Green Revolution and Development in the 1970s. Praeger Publishers, New York.
5. Kogan, M. (1998). Integrated Pest Management: Historical Perspectives and Contemporary Developments. Annual Review of Entomology, 43, 243-270.
6. Abrol, D.P., & Shankar, U. (Eds.). (2013). Integrated Pest Management: Principles and Practice. Amazon Textbook Store.
7. NPCS Board of Consultants & Engineers. (2008). The Complete Book on Organic Farming and Production of Organic Compost. Asia Pacific Business Press Inc.
8. Suri, S. (2012). Organic Farming. Vedams Books from India, APH.

Year	III	Program	B.Sc., Biotechnology	Code	22U5BTS06
Sem	V	SBEC III: BIOSAFETY, BIOETHICS & IPR		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To introduce basic concepts of ethics and safety that is essential for Life Science Labs.
2. To understand the procedures involved in protection of Intellectual property.
3. To give an insight into different treaties signed.
4. To gain knowledge about patent filing.

Course Outcomes:

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

CO1	Understand the concepts of basic biosafety and biosafety levels	K1 & K2
CO2	Understand biosafety guidelines and role genetically modified Organisms	K1, K2 & K4
CO3	Understand the basic principles of IPR, its types and patenting Procedures	K4, K5 & K6
CO4	Understand the concepts of ethical, legal considerations on the release of genetically modified organisms	K4, K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Unit – I	**Introduction to Bio Safety**	**06 Hrs**

Bio safety: Introduction – Bio safety issues in biotechnology - Historical background. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals.

Unit –II	**Biosafety Guidelines and Regulations**	**06 Hrs**

Biosafety Guidelines: Guidelines and regulations (Cartagena Protocol). Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC.

Unit –III	**Introduction to Intellectual Property Rights (IPR)**	**06 Hrs**

Intellectual Property Rights: Introduction to IPR, Types of IPR - Patents, Trademarks, Copyright & Related Rights, Importance of IPR – Patentable and Non-patentable.

Unit – IV	**Patents and Patent Laws in Biotechnology**	**06 Hrs**

Patents and Patent Laws: Objectives of the patent system - Basic, principles 6 and general requirements of patent law. Patentable subjects and protection in Biotechnology. Patent infringement-meaning, scope, litigation, case studies.

Unit – V	**Bioethics and Ethical Decision-Making**	**06 Hrs**

Bioethics: Introduction to ethics and bioethics, Framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy. Ethical implications of human genome project and GM crops, bio piracy and bio warfare.

References

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2019. Biosafety and Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

Curriculum for B. Sc Biotechnology

Bachelor of Science

B. Sc SYLLABUS

[*For the Candidates admitted under Autonomous, CBCS & OBE pattern*]

(EVEN SEMESTER)

DEPARTMENT OF BIOTECHNOLOGY

VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

[AUTONOMOUS]

An ISO 9001:2015 Certified Institution | Affiliated to Periyar University
Approved by AICTE | Re-accredited with "A" Grade by NAAC|
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

Preamble

Biotechnology is an area of biology that uses living processes, organisms or systems to manufacture products or technology intended to improve the quality of human life. It is an integrated science with interdisciplinary knowledge of biochemistry, Molecular Biology, Microbiology, Genetics, Plant and Animal sciences, Environmental and Pharmaceutical sciences.

Biotechnology has the potential to bring a tremendous change in the socio-economic status of the people by creating a positive impact with food security, Animal husbandry, fisheries, assurance of quality food products to the consumers, environmental protection, health care etc.

The Biotechnology course has the opportunities in health care sector and diagnostics, Research with Institutes, Universities, Animal health, Vaccine industry, Agriculture, Food technology, Pharmaceutical industry, Industrial and Environmental Sciences, Bioinformatics, Biosafety and Education.

The syllabus of Biotechnology is framed in such a way so as to give a fundamental understanding in the different inter disciplinary areas of Cell Biology, Biochemistry, Microbiology, Genetics, Immunology, Animal and Plant Science, Environmental and Pharmaceutical sciences.

The practical syllabus has been designed to enable the students to link and support with their theory background. This also imparts the knowledge of handling instruments and the understanding of interdisciplinary facet of Biotechnology.

The syllabus is also equipped with Entrepreneurial development to help students to start their own enterprises as job providers, which will instill confidence, and to make smarter plans for future development.

Aim of the Programme:

The aim of the programme is to provide students with a wide knowledge in different areas of Biotechnology and to prepare them for employment and research in this rapidly growing field. This programme enables the students with innovative ideas for business creation, creating job opportunities, and the importance of entrepreneurship for facing the challenges and to improve the economy of the nation.

Nature and extent of the Programme:

The field of Biotechnology is an interdisciplinary science and is growing at a tremendous rate with application in medicine, agriculture, environment and nanotechnology. This tremendous growth is because of the integration of new technologies in biological research.

New upcoming thrust areas like Marine Biotechnology, Research Methodology, Bio entrepreneurship and Nanotechnology is introduced in this programme. The programme also offers students the freedom to choose the electives based on their preferences. This will help the students to start, grow their own enterprises and make smarter plans for future development.

Graduate attributes:

The graduate after completing the course becomes a full-fledged Bio entrepreneur with a complete understanding of the various concepts of Biotechnology. This course is designed in such a way as to kindle creative thinking abilities with problem solving capacity and also research attitude. This programme will enable the students to be self-employed, and bring constructive changes to their professional life, work place and to the community at large.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc. BIOTECHNOLOGY
Programme Code:	
Duration:	3 Years [UG]
Programme Outcomes:	**PO1:** Students understand the major concepts in Biologyand understand the fundamental principles.

	PO2: Students will develop scientific outlook not only with Respect to life science, but in all aspects related to life.
	PO3: Students are trained to apply and adapt appropriate techniques, resources, and instrumentation which will help them to pursue higher education or jobs after the programme.
	PO4: Students develop the ability to effectively communicate Scientific information with strong ethics in written and oral formats.
	PO5: Students will understand their roles and responsibilities especially the protection of the people.
	PO6: Students become eligible to pursue higher education in their Respective fields and engage in lifelong learning and enduring Proficient progress.
Programme Specific Outcomes:	**PSO1:** Recall the fundamentals of Biotechnology which would enable them to comprehend the emerging and advanced biotechnology concepts in life sciences.
	PSO2: Inculcate deeper knowledge in practical skills enabling them to work with disciplinary and interdisciplinary aspects of biotechnology.
	PSO3: Enhance students' learning abilities, technological solutions in domains of biotechnology for their applications in industry and research and entrepreneurial skills.
	PSO4: Evaluate the need and impact of scientific techniques on the environment and the society, keeping in view their sustainable development.
	PSO5: Analyze the knowledge gained in Biotechnology for lifelong learning.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2024 – 2025** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER-II									
1	Language –II	23U2LT02	Tamil - II	3	5		25	75	100
		23U2LM02	Malayalam - II						
		23U2LH02	Hindi - II						
2	English –II	23U2CE02	Communicative English - II	3	5		25	75	100
3	Core –III	23U2BTC03	Genetics	4	5		25	75	100
4	Core –II	23U2BTCP02	Lab in Genetics	3		4	40	60	100
5	Allied –II	23U2BCGE02	Biological Chemistry	2	4		25	75	100
6	Allied Practical -II	23U2BCGEP1	Lab in Biochemistry	2		3	40	60	100
7	AECC - II	23U2CSAC02	CS - Office automation	2	2		25	75	100
8		23U2EVS01	EVS	2	2		25	75	100
Total				**21**	**23**	**7**	**230**	**570**	**800**

Theory	06
Practical	02

பொதுத்தமிழ் – 2 (semester-II)

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	Marks		
									CIA	External	Total
23UFTA02	பொதுத்தமிழ் -2	Supportive	Y	-	-	-	3	6	25	75	100

Pre-Requisite	பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்		

Learning Objectives

The Main Objectives of this Course are to :

- சமய இலக்கியங்களையும் சிற்றிலக்கியங்களையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்
- மொழித்திறனையும் சிறுகதை இலக்கிய வடிவத்தையும் மாணவர்க்கு உணர்த்துதல்.

Expected Course Outcomes

On the Sucessful completion of the Course,Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	பக்தி இலக்கியங்களைக் கற்பதன் மூலம் பக்தி நெறியினையும், சமய நல்லிணக்கத்தையும் தெரிந்து பின்பற்றுவர்	K1;K2
CO 2	சிற்றிலக்கியங்களின்வழி இலக்கியச் சுவையினையும் பண்பாட்டுஅறிவினையும்	K2
CO 3	பட்டப் படிப்பினைப் படிக்கும்போதே பெரும்பான்மையான தமிழ் இலக்கியங்கள் குறித்த அறிவினைப் பெறுவர்	K4
CO 4	தமிழ்ச் சமூகப் பண்பாட்டு வரலாற்றினை இலக்கியங்கள் வாயிலாக அறிவர்	K3
CO 5	போட்டித் தேர்வுகளில் வெற்றி பெறுவதற்குத் தமிழ்ப் பாடத்தினைப் பயன்கொள்ளும் வகையில் ஏற்ற பயிற்சி பெறுவர்	K4

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit -I	பக்தி இலக்கியம்	18 hours

திருநாவுக்கரசர் தேவாரம் – நாமார்க்கும் குடியல்லோம் எனத் தொடங்கும் பதிகம் (10 பாடல்கள்)

ஆண்டாள் - திருப்பாவை (முதல் 10 பாசுரம்)

Unit -II		18 hours

வள்ளலார் - அருள் விளக்க மாலை (முதல் 10 பாடல்)

எச்.ஏ.கிருட்டிணப்பிள்ளை - இரட்சணிய மனோகரம் - பால்ய பிரார்த்தனை

குணங்குடி மஸ்தான் சாகிபு - பராபரக்கண்ணி (முதல் 10 கண்ணி)

Unit -III	சிற்றிலக்கியங்கள்	18 hours
தமிழ்விடு தூது (முதல் 20 கண்ணி) திருக்குற்றாலக் குறவஞ்சி - குறத்தி மலைவளம் கூறுதல் முக்கூடல் பள்ளு - நாட்டு வளம்		
Unit -IV	பாடம் தழுவிய இலக்கிய வரலாறு (பல்லவர் காலம், நாயக்கர் காலம்)	**18 hours**
1. பன்னிரு திருமுறைகள் 2. நாலாயிரத் திவ்விய பிரபந்தம் 3. திருமடங்களின் தமிழ்ப்பணி 4. சிற்றிலக்கியங்கள் 5. சைவ சித்தாந்த சாத்திரங்கள்		
Unit -V	மொழித்திறன் / போட்டித்தேர்வுத் திறன்	**18 hours**
1. தொடர் வகைகள் 2. மரபுத்தொடர், பழமொழிகள் 3. பிறமொழிச் சொற்களைக் களைதல் 4. வழுச்சொற்கள் நீக்குதல் 5. இலக்கணக் குறிப்பு அறிதல் (குறிப்பு: அலகு 4, 5 ஆகியன போட்டித் தேர்வு நோக்கில் நடத்தப்பட வேண்டும்).		
Total Lecture Hours		**90 hours**

Reference Books	
•	தமிழ் இலக்கிய வரலாறு – சிற்பி.பாலசுப்பிரமணியன்
•	புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு - தமிழண்ணல்
•	வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு – எஃப்.பாக்கியமேரி

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
Web Sources

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO1	3	2	3	3	3	2	2	2	3	2	3	2
CLO2	3	3	2	2	2	3	2	3	3	2	2	2
CLO3	3	2	3	3	2	2	2	3	2	3	3	2
CLO4		3	3	2	2	2	3	2	3	2	3	3
CLO5	3	3	2	2	2	3	3	2	2	2	3	3

- **Tamil Heritage Foundation- www.tamilheritage.org <http://www.tamilheritage.org>**
- **Tamil virtual University Library- www.tamilvu.org/ library http://www.virtualvu.org/library**
- **Project Madurai - www.projectmadurai.org.**
- **Chennai Library- www.chennailibrary.com <http://www.chennailibrary.com>.**
- **Tamil Universal Digital Library- www.ulib.prg <http://www.ulib.prg>.**
- **Tamil E-Books Downloads- tamilebooksdownloads. blogspot.com**
- **Tamil Books on line- books.tamil cube.com**
- **Catalogue of the Tamil books in the Library of British Congress archive.org**
- **Tamil novels on line - books.tamilcube.com**

Strong-3,Medium-2,Low-1

FIRST YEAR

SEMESTER II - PAPER-II

ENGLISH - II

Learning Objectives

Lo1 : To enable learners to acquire the linguistic competence necessarily required in various life situations.

Lo2 : To help them understand the written text and able to use skimming, scanning skills.

Lo3 : To assist them in creative thinking abilities.

Lo4 : To enable them become better readers and good communication in English writers.

Lo5 : To assist them in developing correct reading habits, silently, extensively and intensively.

Unit - I Poetry

1.1. Very Indian Poem in Indian English - Nissim Ezekiel

1.2. Still I Rise - Maya Angelou

1.3. The Flower - Tennyson

1.4. On Killing a Tree - Gieve Patel

Unit - II Prose

2.1. If You Are Wrong Admit - Dale Carnegie

2.2. Kindly Adjust Please - Shashi Tharoor

2.3. The Spoon - fed Age - W.R. Inge

Unit - III Fiction

3.1. Alchemist - Paulo Coelho

Unit - IV Language Competency

4.1. Homonyms, Homophones, Homographs Portmanteau words

4.2. Verbs and Tenses ,Subject Verb Agreement

4.3. Error Correction

Unit - V English in the Workplace

5.1 Reading for General and Specific information (charts, tables, schedules, graphs etc)

5.2 Reading news and weather reports

5.3 Writing paragraphs

5.4 Taking and making notes

Year	I	Program	B.Sc., Biotechnology	Code	23U2BTC03
Sem	II	Core Paper – III – GENETICS		Credits	4
Hrs	75			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. Students will be knowledge able chromosome alterations.
2. Uponsuccessfulcompletionofthecourse,studentsshouldhaveaclearunderstandingof mendelian genetics.

Course Outcomes:

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

CO1	Acquiring knowledge on mendelian principles.	K1
CO2	Understanding the basic concepts of extensions of mendelian principles.	K2
CO3	To understand the ploidy.	K3
CO4	To gain overall information about population genetics.	K4
CO5	Acquiring knowledge on DNA transfer mechanism.	K5&K6

K1-Remember; K2- Understand; K3-Apply; K4- Analyze; K5-Evaluate; K6- Create

Unit – I	**Mendelian Principles**	**15 Hrs**

Mendels Principles of dominance, Seggregation and Independent Assortment; Punnet Square; Monohybrid cross, Dihybrid cross, Backcross and Testcross, Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles –Blood group inheritance in man.

Unit – II	**Linkage**	**15 Hrs**

Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over-types, mechanism, significance of crossing over. Linkage mapping of Chromosomes Sex – Linked Inheritance and Sex Determination in Drosophila, Birds and Mammals.

Unit – III	**Microbial Genetics**	**15 Hrs**

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction, recombination, Mapping genes by interrupted mating technique, fine structure analysisof genes – Cistron, Recon, Muton.

Uni t – IV	**Genetic Disorders**	**15 Hrs**

Chromosomal aberrations: Deletion, duplication, inversion, translocation, Ploidy and their genetic implications. Pedigree Analysis, QTL mapping. Genetic Disorders Autosomal (dominant, recessive) and X-Linked (dominant, recessive).

Unit – V	**Population Genetics**	**15 Hrs**

Population Genetics – Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Genetic Drift, Bottle neck effect; Concepts of Eugenics, Euphenics and Euthenics.

References:

1. Stickbergerr - Genetics
2. Gardner - Genetics
3. Molecular Genetics of Bacteria (2013) Larry Snyder, Joseph E. Peters, Tina M. Henkin. ASM Press publication.
4. Dobzansky – population genetics
5. Winchister – genetics
6. Hatweell – Genetics from genes to genes
7. Behavioral Genetics – published 2012 – 12th editions by Robert Plomin, John C. DeFries, Gerald E. McClearn
8. Human Biology– Genetics – published 2013 - 2nd editions by CK-12 Foundation.

Year	I	Program	B.Sc., Biotechnology	Code	23U2BTCP02
Sem	II	Core Practical – II: LAB IN GENETICS		Credits	3
Hrs.	40			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. To understand the fundamental principles of Mendelian genetics through monohybrid, dihybrid, and tri hybrid crosses.
2. To explore genetic interactions, including epistasis, linkage, and cross - over analysis, to interpret complex inheritance patterns.
3. To examine sex – linked inheritance in Drosophila and structural models of DNA and RNA, Highlighting molecular genetics concepts.

Course Outcomes:

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

CO1	Apply Mendelian principles to predict and analyze inheritance patterns in monohybrid, dihybrid, and trihybrid crosses.	K1
CO2	Distinguish between test and back crosses and determine their significance in genetic analysis.	K2,K3
CO3	Analyze genetic linkage and calculate cross over frequencies to map gene locations.	K4
CO4	Explain epistatic interactions and their role in altering phenotypic ratios in genetic crosses.	K4,K5
CO5	Demonstrate an understanding of sex linked inheritance, especially in model organisms like Drosophila, and the structural organization of nucleic acids (DNA and RNA).	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

S.No	Experiments	Hours
1	Experiments on monohybrid	4
2	Experiments on dihybrid	4
3	Experiments on trihybrid	4
4	Experiments on test cross and back cross	4
5	Experiments on epistatic interactions	4
6	Determination of linkage analysis	4
7	Determination of cross – over analysis	4
8	Study on sex linked inheritance in Drosophila	4
9	Study of models onDNA	4
10	Study of models on RNA	4

References:

1. BenjaminA.Price.2010.Genetics: A Conceptual Approach. Published by W.H. Freeman
2. Gardner, E. J., Simmons, M. J and Snustad, D.P. 1991. Principles of Genetics. John Wiley & Sons, Inc
3. Mary L. Ledbetter.1993. Cell Biology: Laboratory Manual. Edition:
4. Singh B.D.1990.Fundamentals of Genetics. Kalyani Publishers, New Delhi.
5. Stanfield,W. D. 1991.Theory and Problems of Genetics (3rdEd.) Schaum' soutline series, McGraw Hill, Inc.
6. Strickberger, M. W.1995. Genetics (3rd Ed.). Prentice Hall of India, New Delhi.

Year	I	Program	B.Sc., Biotechnology	Code	23U2BCGE02
Sem	II	Allied – II – BIOLOGICAL CHEMISTRY		Credits	2
Hrs	75			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. Understand the chemical and biological foundations of life, including atomic theory, molecular structures, acids, bases, and buffer systems.
2. Explore biomolecules, their metabolism, and bioenergetics, focusing on carbohydrates, lipids, proteins, nucleic acids, ATP production, and the role of vitamins and hormones.

Course Outcomes:

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

CO1	Comprehend the importance of Chemistry and Biochemistry through the Concept of acids and bases, and chemical bonding.	K1
CO2	Demonstrates the formation of different types of solutions, concentrations of Solutions and preparation of buffer solutions.	K2
CO3	Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain various Biochemical Cycles involved in Carbohydrate Metabolism.	K2
CO4	Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain various Biochemical Cycles involved in Fatty acid And Nucleic acid Metabolism.	K3
CO5	Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific Functions in maintaining health.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Atomic theory and Fundamentals of Organic Chemistry**	**15 Hrs**

Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Types of chemical bonds. Classification of organic compounds - Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles.

Unit – II	**Acids, Bases, and Solution Chemistry**	**15 Hrs**

Acids & Bases properties and differences, Concepts of acids and bases. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson - Hasselbalch equation.

Unit – III	**Carbohydrate Chemistry and Metabolism**	**15 Hrs**

Importance to Biochemistry - the chemical foundation of life - buffering action in biological system. Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.

Unit – IV	**Lipids, Nucleic Acids and their Metabolism**	**15 Hrs**
Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, phospholipids, cholesterol. B - oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA.		
Unit – V	**Proteins, Vitamins, Hormones and Energy production**	**15 Hrs**
Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins.Vitamins (Biological functions, daily requirements, deficiency symptoms and diseases-Structure not required) and Hormones. ATP production. Oxidative phosphorylation, ETC.		

References:

1. P. L. Soni, A Text book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications.
2. Abhilasha Shourie, Shilpa S,Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition.
3. J. L. Jain, 2016, Fundamentals of Biochemistry, S. Chandpublication,7th edition.
4. A. C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies,7th edition.
5. Satyanarayana.U, 2016, Biochemistry, M J publishers 3rd edition (2006).

Year	I	Program	B.Sc., Biotechnology	Code	23U2BCGEP1
Sem	II	Allied Practical – II: LAB IN BIOCHEMISTRY		Credits	2
Hrs.	40			Effect from	2024-2025

Course Objectives:

The main objectives of this course are:

1. To identify and differentiate organic compounds based on their functional groups, saturation, and aromaticity through systematic analysis.
2. To analyze and estimate biomolecules like carbohydrates, amino acids, proteins, and Cholesterol using qualitative, volumetric, and colorimetric methods.

Course Outcomes:

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

CO1	Demonstrate proficiency in detecting functional groups in organic compounds and identifying their elemental composition.	K1
CO2	Differentiate between aliphatic and aromatic compounds, as well as saturated and unsaturated compounds, through systematic tests.	K2,K3
CO3	Performqualitativeanalysisofcarbohydratesandaminoacidstoidentify their presence in given samples.	K4
CO4	Accurately estimate biomolecules such as glucose, cholesterol, and proteins using volumetric and colorimetric methods.	K4,K5
CO5	Applyanalyticaltechniquestosolvereal-worldproblemsinbiochemistryand organic chemistry.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

S.No	Experiments	Hours
	Systematic Analysis of Organic Compounds	
1	Functional Group Tests (Carboxylic acid: Benzoic acid, Phthalic acid, Phenol, Urea, Benzaldehyde).	4
2	Detection of Elements (Nitrogen (N) & Halogens).	4
3	Distinguishing Tests (Differentiate between aliphatic and aromatic compounds & Differentiate between saturated and unsaturated compounds).	4
	Qualitative Analysis	
4	Qualitative Analysis of Carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose, Starch, Glycogen).	4
5	Qualitative Analysis of Amino Acids (Tyrosine, Tryptophan, Arginine, Proline, Cysteine).	4
	Volumetric Analysis	
6	Estimation of Glycine – Formal Titration	4

7	Determination of Ascorbic Acid – DCPIP Method	3
8	Estimation of Ferrous Sulphate – Using Standard Mohr's Salt	3
Colorimetric Analysis		
9	Estimation of Glucose – Anthrone Method	3
10	Estimation of Cholesterol - Zak's Method	3
11	Estimation of Proteins - Bradford's Method And Lowry's Method	4

References:

1. Rageeb, Kiran Patil, M. Bakshi Rahman, Sufiyan Ahmad Raees. A Practical book on Biochemistry Everest publishing house 1st Edition, 2019.
2. Introductory practical Biochemistry – S. K. Sawhney, Randhir Singh, 2nd ed, 2005.
3. Biochemical Tests – Principles and Protocols. Anil Kumar, Sarika Garg and Neha Garg.Vinod Vasishtha Viva Books Pvt Ltd, 2012.
4. Harold Varley, Practical Clinical Biochemistry, CBS.6th edition, 2006.
5. Keith Wilson and John Walker. Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain.1995.

Subject Title	Office Automation	Semester	II
Subject Code	23U2CSAC02	Specialization	NA
Type	Ability Enhancement Compulsory Course (AECC 2) Soft Skill - 2 – Theory	L:T:P:C	2:0:0:2

COURSE OBJECTIVE

- To introduce students with basic concepts of MS – Office application Word, Excel, PowerPoint.

COURSE OUTCOMES

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concept tof MS - Word.	K1
CO2	Explore the concepts of Formatting the Documentation.	K2
CO3	Understanding the basic concept of MS - Excel.	K3
CO4	Apply the concepts of Formula and Functionsin Excel.	K3
CO5	Explore the concepts of Presentation.	K3

MAPPING WITH PROGRAM OUTCOMES

CO/PO	PO1	PO2	PO3	PO4
CO1	3	2	2	1
CO2	2	3	2	1
CO3	3	2	1	1
CO4	3	2	1	1
CO5	3	2	1	1

Unit	Syllabus Contents	Level	Number of Sessions
I	**Introduction to MS - WORD**: Introduction - starting MS - Word - Creating a new word Document - Saving a word Document - Working with Styles - Applying Bulleted and Numbered List - Using Cut, Copy and Paste - Using Find, Replace and GO TO - Opening and Existing Word Document - Closing a Word Document.	K3	6
II	**Working with Tables:** Designing and Reviewing a Word Document: Setting Paragraph Indent and Spacing- Inserting Header and footer – Changing Page Setup Option.	K3	6
III	**Introduction to EXCEL**: Introduction - Creating a New Excel Workbook - Adding Data to Cells - Adding Data using Auto fill - Inserting cells Deleting cells - Wrapping Text - Changing Formats.	K3	6
IV	**Working with Tables and Charts**: Working with Tables – Working with Charts - Changing the Chart Types - Changing the Chart Layout - Formulas and Functions: Working with Formula - Working with Functions.	K4	6

V	**Introduction to PowerPoint**: Creating a Presentation & Saving Presentation - Basics of a Presentation - Setting Up and Running a Slide Show – Slide Show Setup - Building Dynamic PowerPoint Presentation: Adding and Removing Animation Effects - Adding and Removing Transition Effects.	K3	6

Learning Resources	
Text Books	1. Kogent Solutions Inc.Office 2007 in Simple Steps – Dream Tech Press 2008 Edition.
Reference Books	1. Learning MS Office 2007 – Ramesh Bangia. 2. Microsoft Office 2007 Training Guide – Prof. Sathish Jain, M. Geetha, Kratia, BPB Publications.
Web Sites/ Links	1. **https://support.office.com/en-us/article/training-office-basics.** 2. **https://www.ursaminor.in/course/basics-of-microsoft-office.** 3. **https://support.office.com/en-us/article/training-office-basics.**

Pedagogy: Chalk and Talk, ICT……..

SEMESTER II

Course Code	23U2EVS01	Title	Batch	2023-2026
Hours/Week	02	Environmental Studies	Semester	II
			Credits	02

Learning Objectives:

- ❖ To understand the importance of environmental studies to achieve the sustainable development.
- ❖ To create the awareness about pollution, waste management and global warming.

Unit – I **(2 Hours)**

Multidisciplinary nature of environmental studies: Definition, scope and importance. Need for public awareness.

Unit - II **(8 Hours)**

Natural Resources: Renewable and non-renewable resources: a) Forest resources: Use and over – exploitation, deforestation, case studies (Timber extraction, mining, dams and their effects on forest and tribal people). b) Water resources: Use and over - utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit - III **(8 Hours)**

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Hotspots of biodiversity, Threats to biodiversity: habitat loss,

poaching of wildlife, man - wildlife conflicts. Endangered and endemic species of India, Conservation of biodiversity: In - situ and Ex - situ conservation of biodiversity.

Unit - IV **(6 Hours)**

Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit- V **(6 Hours)**

Social issues and the Environment: From Unsustainable to Sustainable development, urban problems related to energy, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies.

Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies, Waste land reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation and, Public awareness.

Course Outcomes (COs)

COs	On completion of this course, the students will be able to	POs
CO1	Familiarize with multidisciplinary nature of environmental studies.	**K1**
CO2	Understand the natural resources and renewable, non renewable resources.	**K2**
CO3	Exposure on biodiversity and conservation at global, national and local levels.	**K3**
CO4	Get an idea about environmental pollution and disaster management.	**K4**
CO5	Get awareness about social issue in the environment and environmental ethics.	**K5**

Text Book:

1. Bharucha, E. 2004.The text book for Environmental Studies, University Grants Commission, New Delhi.

Reference Books:

1. Agarwal, K. C.2001.Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Erach, B. The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India.
3. Clark, R. S.2001. Marine Pollution, Clanderson Press Oxford (TB).
4. Cunningham, W. P. Cooper, T. H. Gorhani, E. and Hepworth, M.T. 2001. Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
5. Gleick, H. P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press.
6. Heywood, V. H. and Waston, R. T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
7. Jadhav, H & Bhosale,V.M.1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi p-284.
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9. Mhaskar, A. K., Matter Hazardous, Techno – Science Publication (TB).
10. Miller,T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1	2	2
CO3	3	3	2	3	1	3	2	3	3	1
CO4	3	2	3	3	2	3	3	1	3	3
CO5	3	3	2	2	1	2	1	3	2	1

S-Strong(3) **M- Medium (2)** **L–Low(1)**

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2023-2024** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER-IV									
1	Language – IV	23U4LT04	Tamil – IV	3	5		25	75	100
		23U4LM04	Malayalam – IV						
		23U4LH04	Hindi - IV						
2	English – IV	21U4CE04	Communicative English - IV	3	5		25	75	100
3	Core – 5	23U4BTC05	Genetic Engineering	4	4		25	75	100
4	Core Practical – 5	23U4BTCP05	Lab in Genetic Engineering	2		4	40	60	100
5	Core – 6	23U4BTC06	Immunology	4	4		25	75	100
5	Core Practical – 6	23U4BTCP06	Lab in Immunology	2		3	40	60	100
7	DSE – II	23U4BTDE03	Marine Biotechnology	3	3		25	75	100
		23U4BTDE04	Poultry Science						
8	NMEC - II	23U4BTN03	Economic Biotechnology	2	2		25	75	100
Total				**23**	**23**	**7**	**230**	**570**	**800**

Theory	06
Practical	02

பொதுத்தமிழ் -4 (semester-IV)

Course Code	Course Name	category	L	T	P	S	Credits	Ins.Hrs	Marks		
									CIA	External	Total
23UFTA04	பொதுத்தமிழ் - 4	Supportive	Y	-	-	-	3	6	25	75	100

Pre-Requisite	பன்னிரெண்டாம் வகுப்பில் தமிழை ஒரு பாடமாகப் பயின்றிருக்க வேண்டும்

Learning Objectives

The Main Objectives of this Course are to :

இலக்கியங்களின் சிறப்பினை உணர்த்துதல்

சங்க இலக்கியத்தின் சிறப்பையும், நாடகம் என்னும் இலக்கிய வகையின் தன்மையையும் அகத்திணை, புறத்திணை இலக்கிணங்களையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.

தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்ப கற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல்

Expected Course Outcomes

On the Sucessful completion of the Course,Students will be able to

இப்பாடத்தைக் கற்பதால் பின்வரும் பயன்களை மாணவர் அடைவர்

CO 1	சங்க இலக்கியத்தில் காணப்பெறும் வாழ்வியல் சிந்தனைகளை அறிந்து கொள்ளுதல்	K1;K2
CO 2	தமிழின் தொன்மையையும், செம்மொழித் தகுதியையும் அறிந்து கொள்ளுதல்	K2
CO 3	நாடக இலக்கியம் மூலம் நடிப்பாற்றலையும், கலைத்தன்மையையும், படைப்பாற்றலையும் வளர்த்தல்	K4
CO 4	தமிழிலிருந்து அலுவலகக் கடிதங்களை மொழிபெயர்க்கும் அறிவைப் பெறுவர்	K3
CO 5	மொழியறிவோடு வேலை வாய்ப்பினைப் பெறுதல்.	K4

K1 - Remember; K2 - Undestand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit -I	எட்டுத்தொகை - 1	18 Condact hours

நற்றிணை (10, 14, 16), குறுந்தொகை (16, 17, 19, 20, 25, 29, 38, 440), கலித்தொகை (38, 51), அகநானூறு (15, 33, 55,) புறநானூறு (37, 86, 112,) பரிபாடல் -55

Unit -II	**பத்துப்பாட்டு**	**18 hours**
நெடுநல்வாடை - நக்கீரர்		
Unit -III	**நாடகம்**	**18 hours**
சபாபதி - பம்மல் சம்பந்த முதலியார்		
Unit -IV	**பாடம் தழுவிய இலக்கிய வரலாறு**	**18 hours**
1. தமிழின் தொன்மையும் சிறப்பும் **2. முச்சங்க வரலாறு** **3. சங்க இலக்கியத்தின் சிறப்பியல்புகள்** **4. எட்டுத்தொகை** **5. பத்துப்பாட்டு** **6. தமிழ் நாடகத்தின் தோற்றமும் வளர்ச்சியும்**		
Unit -V	**மொழித்திறன்**	**18 hours**
1. மொழிபெயர்ப்பு / கலைச்சொற்கள் **2. கொடுக்கப்பட்டுள்ள ஆங்கிலப்பகுதியைத் தமிழில் மொழிபெயர்த்தல்** **3. அலுவலகத் கடிதம் - தமிழில் மொழிபெயர்த்தல்**		
Total Lecture Hours		**90 hours**

Reference Books	
•	தமிழ் இலக்கிய வரலாறு – சிற்பி.பாலசுப்பிரமணியன்
•	புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு - தமிழண்ணல்
•	வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு – எஃப்.பாக்கியமேரி

Web Sources

- **Tamil Heritage Foundation- www.tamilheritage.org <http://www.tamilheritage.org>**
- **Tamil virtual University Library- www.tamilvu.org/ library http://www.virtualvu.org/library**
- **Project Madurai - www.projectmadurai.org.**
- **Chennai Library- www.chennailibrary.com <http://www.chennailibrary.com>.**
- **Tamil Universal Digital Library- www.ulib.prg <http://www.ulib.prg>.**
- **Tamil E-Books Downloads- tamilebooksdownloads. blogspot.com**
- **Tamil Books on line- books.tamil cube.com**
- **Catalogue of the Tamil books in the Library of British Congress archive.org**
- **Tamil novels on line - books.tamilcube.com**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2
CLO1	3	2	3	3	3	2	2	2	3	2	3	2
CLO2	3	3	2	2	2	3	2	3	3	2	2	2
CLO3	3	2	3	3	2	2	2	3	2	3	3	2
CLO4		3	3	2	2	2	3	2	3	2	3	3
CLO5	3	3	2	2	2	3	3	2	2	2	3	3

Strong-3,Medium-2,Low-1

SECOND YEAR - SEMESTER **IV**

PAPER **IV**– GENERAL ENGLISH

Unit – I (Life Writing)

1.1 I am Malala-Malala Yousafzai - Chapter 1 **(Ms.S.Kaviya)**

1.2 My Inventions - Nikola Tesla - Chapter 2 **(Ms.S.Hemalatha)**

Unit – II (One Act Plays)

2.1 The Zoo Story- Edward Albee **(Ms.M.S.Brindha & Mrs.K.Rajalakshmi)**

2.2The Proposal- Anton Chekhov **(Mrs.P.Uma)**

Unit – III (Interviews)

3.1 Nelson Mandela' s Interview with Larry King. **(Mrs.A.Selvi)**

3.2Rakesh Sharma' s Interview with Indira Gandhi from Space **(Mrs.G.Manimekala)**

3.3Lionel Messi with Sid Lowe (Print) **(Ms.Jayarani)**

Unit – IV (Language Competency)

4.1Refuting, Arguing & Debating (**Mr.M.Muthukumar)**

4.2Making Suggestions & Responding to Suggestions, Asking for and Giving Advice orHelp **(Mr.M.Muthukumar)**

4.3Interviews (face to face, telephone and video conferencing) **(Mr.M.Muthukumar)**

Unit – V (English for Workplace)

5.1 Job Applications: Covering letters, CV andResume **(Mr.M.Arulprasath)**

5.2 Creating a digital profile – Linkedin **(Mr.Vignesh)**

5.3 Filling Forms (Online & Manual): creation ofaccount, railway reservation, ATM, Credit/debit card **(Mrs.Tamilelakkiya)**

5.4 Body Language - Practical Skills for Interviews **(Mrs.Tamilelakkiya)**

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTC05
Sem	IV	Core – V: GENETIC ENGINEERING		Credits	4
Hrs	60			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of gene manipulation and its application in the development of novel pharmaceutical and drug products
2. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
3. To expose students to application of recombinant DNA technology in biotechnological research.

Course Outcomes:

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

CO1	To know about DNA manipulating enzymes and its role in rDNA Technology.	K1
CO2	To gain knowledge on different types plasmid vectors and their Usage.	K2
CO3	To acquire knowledge on basic gene cloning strategies.	K3
CO4	To evaluate the usage and applications of gene cloning for the development Value added products.	K4
CO5	To know how on versatile techniques in recombinant DNA technology.	K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	Scope and Milestones of Genetic Engineering	12 Hrs

Bimolecular tools and their applications in genetic engineering: Restriction endonucleases and its types, DNA polymerases, DNA Ligase, Methylase, Taq polymerase, Reverse transcriptase. DNA modifying enzymes (Alkaline phosphatase, Polynucleotide kinase, Terminal deoxy nucleotidyl transferase). S1nuclease, RNAse Hand DNAseI. Ligation (cohesive & blunt end ligation) – linkers & adaptor.

Unit – II	Gene Cloning Vectors	12 Hrs

Plasmids (PBR322, PUC and BAC), Lambda vectors, Phagemids, Cosmids, M13 vectors, Shuttle vectors and artificial chromosomes (YAC and BAC). DNA sequencing (Maxam – Gilbert and Dideoxy) methods. DNA amplification: PCR (Principles & types - RT PCR, Real time PCR and Nested PCR). cDNA synthesis and cloning: mRNA enrichment, reverse transcription.

Unit – III	Cloning Strategies	12 Hrs

Cloning of interacting genes - Yeast two hybrid systems. – Nucleic acid micro arrays and Site directed mutagenesis. Methods to study gene regulation: DNA transfection, Primer extension, S1 mapping, RNase protection assay.

Unit – IV	**Gene Transfer Techniques**	**12 Hrs**

Gene transfer techniques – Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer - Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes.

Unit – V	**Applications of rDNA Technology**	**12 Hrs**

Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); cytoplasmic male ster3i0lity; delay of fruit ripening. Transgenic animals – Pharmaceutical products - insulin. Farm animal production. Recombinant DNA Technology in the production of vaccine. T-DNA tagging and transposon tagging, Transgenic and gene knock out technologies.

References

1. Molecular cloning: A laboratory manual. J. Sambrook, E F. Frischand T. Maniatis, Cold Spring Harbor Laboratory Press, New York.2000.
2. DNA cloning: A practical approach, D M. Glover and B D Hames, IRL Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, P B. Kaufman, W.Wu. D, Kim and L. J Cseke, CRC Press, Florida, 1995.
4. Methods of Enzymology vol.152, Guide to molecular cloning techniques, S L. Berger and A R. Kimmel Academic Press, Inc. An Diego, 1998.
5. Methods in Enzymology. Vol 185, gene expression technology, D V. Goeddel Academic Press, inc. San Deigo, 1990.
6. DNA science. A first Course in Recombinant Technology. D A. Mickloss and G A. Freyer; Cok J Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology.S B. Primrose, Black well Scientific Publishers, Oxford, 1994.
8. Milestones in Biotechnology.Classic papers on Genetic Engineering. J A. Davis and W S. Reznikoff, Butterworth - Heinemann, Boston, 1992.
9. Route maps in Gene technology, M R.Walker and R. Rapley, Blackwel Science Ltd., Oxford, 1997.
10. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, S M. Kingsman and A J. Kingsman, Blackwell Scientific Publications, Oxford, 1998.
11. Molecular Biotechnology - Glick and Pasternak.
12. Principles of gene manipulations – Old & Primrose.

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTCP05
Sem	IV	Core Practical – V – LAB IN GENETIC ENGINEERING		Credits	2
Hrs	40			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles on the usage of genomic and plasmid DNA in the development of microbial recombinant clones.
2. To Learning tools and techniques in rDNA technology.
3. To acquire skills on techniques of construction of recombinant DNA – Cloning vectors and isolation of gene of interest.
4. To Learning techniques for production of pharmaceuticals, growth hormones, vaccines, gene therapy in expression system.

Course Outcomes:

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

CO1	To isolate genomic and plasmid DNA, and to digest them restriction Enzyme	K1
CO2	Shall acquire practical knowledge on vector handling and target DNA	K2
CO3	Shall know about the amplification strategies of cloned vector	K3
CO4	To demonstrate the selection of recombinant clones by using selectable markers	K4
CO5	To conduct gene amplification experiments by PCR analysis	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Isolation of Genomic DNA from *E.coli*.	4
2	Isolation of Plasmid DNA from *E.coli*.	4
3	Gradient Plate Technique.	4
4	Ligation of DNA and plasmid by T4 DNA ligase.	4
5	Replica plate Technique.	4
6	Amplification of ligated plasmid by PCR.	4
7	Transformation of recombinant DNA in Host *E.coli* by CaCl method.	4
8	Selection of recombinant clones by (IPTG – X - gal: Bluewhite selection).	4
9	Agarose Gel Electrophoresis	4
10	Southern Blotting - Demo	4

References

1. Laboratory Manual for Genetic Engineering Paper back – 1 January 2009 by Vennison, S John.
2. BIO2450L Genetics Laboratory Manual Christopher Blair CUNY New York City College of Technology.

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTC06
Sem	IV	Core – VI : IMMUNOLOGY		Credits	4
Hrs	60			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To provide a thorough understanding of the fundamental principles of immunology, including the components and functions of the immune system, antigen – antibody interactions, and immune cell activation.
2. To explore the applications of immunological concepts in medical research and clinical practice, such as vaccine development, autoimmune disorders, immunodeficiency diseases, and advanced immunological techniques.

Course Outcomes:

On the successful completion of the course, student will be ablet o:

CO1	Understand the historical development and fundamental scope of immunology, including the structure and function of the immune system.	K1
CO2	Grasp the characteristics and diversity of antigens and antibodies, including Their interactions and the production of monoclonal antibodies.	K2
CO3	Explain the mechanisms of antigen processing, presentation, Structure and function of BCR, TCR, and MHC molecules.	K3
CO4	Describe the roles of cytokines, types of hypersensitivity reactions, and the Principles of vaccines and the complement system	K4
CO5	Identify the mechanisms and types of autoimmune and immunodeficiencies disorders, and understand advanced immunological techniques.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Scope of Immunology**	**12 Hrs**

Introduction to Immunology. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of Band T lymphocytes. Types of immunity – Innate and acquired.

Unit – II	**Antigen and Generation of Antibody Diversity**	**12 Hrs**

Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Antigen – Antibody interactions Concept of Generation of Antibody Diversity Production of antibodies - Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.

Unit – III	**Antigen Processing and Presentation**	**12 Hrs**

Structure of BCR, TCR, MHC - Class I and II. Generation and Maturation of B cells and T Cells, Antigen Presenting Cells, Processing of Exogenous and Endogenous Antigens. Purification of antibodies.

Unit – IV	**Cytokines, Immune Cell activation and Vaccines**	**12 Hrs**

Definition of cytokines, Structure and types of cytokine, Biological functions of cytokines. Reactions and different types of hypersensitivity; Vaccines – Types, Production and application. Complement system– Classical, alternative and Lectin pathway.

Unit – V	**Autoimmune Disorders**	**12 Hrs**

Definition, types of autoimmune disorders. Mechanism of autoimmunity. Immunodeficiency Disorder. Immuno deficiency diseases (HIV). Transplantation immunology – types of grafts. Mechanism of graft rejection, Advanced Immunological Techniques: Blood grouping, Immunodiffusion, Immunoelectrophoresis, ELISA, RIA, and Fluorescent Antibody Techniques.

References

1. "Immunology: Understanding the Immune System" by Klaus D. Elgert, 2nd Edition, Wiley, 2009.
2. "The Immune System" by Peter Parham, 4th Edition, Garl and Science, 2014.
3. "Janeway's Immunobiology" by Kenneth Murphy, 9th Edition, Garl and Science, 2016.
4. "Cellular and Molecular Immunology" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai, 9th Edition, Elsevier, 2017.
5. "Fundamental Immunology" by William E. Paul, 7th Edition, Lippincott Williams & Wilkins, 2012.
6. "Immunobiology: The Immune System in Health and Disease" by Charles A. Janeway, Jr., Paul Travers, Mark Walport, and Mark J. Shlomchik, 6th Edition, Garland Science, 2005.
7. "Cytokine Storm Syndrome" by Randy Q. Cron and W. Winn Chatham, st Edition, Springer, 2019.
8. "Vaccines" by Stanley A. Plotkin,Walter A. Orenstein, and Paul A.Offit,7thEdition, Elsevier, 2017.
9. "Autoimmune Diseases" by Robert G. Lahita, 5thEdition, Elsevier, 2010.
10. "Essential Clinical Immunology" by John B. Zabriskie, 1st Edition, Cambridge University Press, 2009.

Year	**II**	**Program**	**B.Sc., Biotechnology**	**Code**	**23U4BTCP06**
Sem	**IV**	**Core Practical – VI: LAB IN IMMUNOLOGY**		**Credits**	**2**
Hrs	**30**			**Effect from**	**2023-2024**

Course Objectives:

The main objectives of this course are:

1. To provide students with practical exposure to immunological techniques, including the handling of laboratory animals and the qualitative and quantitative estimation of antigen antibody specificity.

Course Outcomes:

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

CO1	To provide students with practical exposure to immunological techniques, including gaining knowledge on handling of laboratory animals.	K1
CO2	To understand the methods of immunization, bleeding, and separation of serum and plasma from blood.	K2
CO3	To analyze qualitative and quantitative estimation of antigen - antibody interaction.	K3
CO4	To learn about the basic principles of blotting techniques in a practical approach.	K4
CO5	To evaluate and create laboratory test analysis kits.	K5

K1- Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	**Experiments**	**Hours**
1	Preparation of serum and plasma.	3
2	ABO Blood grouping (Rh typing) (Agglutination).	3
3	WIDAL test.	3
4	ASO test.	3
5	Pregnancy test (Agglutination).	3
6	C– Reactive ProteinTest**.**	3
7	Radial immunediffusion test.	3
8	Rocket Immunoelectrophoresis test.	3
9	Ouchterlony double immunodiffusion technique (ODD) (Precipitation test).	3
10	Counter current immuno electrophoresis (CIE).	3

References

1. Clinical Laboratory Tests: Values and Implications by Spring house (Published in 2001).
2. Text book of Medical Laboratory Technology by Praful B. Godkar (Published in 2014).
3. Clinical Laboratory Diagnostics: Use and Assessment of Clinical Laboratory Results by Thomas L. Lehmann and Georg D. Hirsch (Published in 2012).
4. Clinical Laboratory Science Review by Robert R. Harr (Published in 2015).
5. Clinical Laboratory Hematology by Shirlyn B. McKenzie, Lynne Williams, and Turgeon ML (Published in 2014).

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTDE03
Sem	IV	DSE – II : MARINE BIOTECHNOLOGY		Credits	3
Hrs	45			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. Explore marine ecosystems and environmental interactions, focusing on pollution control and the role of biotechnology.
2. Investigate the potential of marine resources for pharmaceuticals, cosmetics, and nutraceuticals.
3. Examine the applications of biotechnology in marine pollution management, including bioremediation and waste treatment.

Course Outcomes:

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

CO1	Understand status and trends of marine major organisms and their habitat.	K1
CO2	Appreciate bio - communication in oceans with reference to food web dynamics and ecological function.	K2
CO3	Accustom with factors influencing biodiversity and the need of conservation.	K3
CO4	Appraise the factors necessitating the preservation of gametes and artificial Insemination for propagation of marine life.	K4
CO5	Acquaint the knowledge in physical, chemical and biological oceanography And their dynamics. Gain knowledge in marine pharmacology.	K5 & K6

K1- Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Introduction to Marine Biotechnology**	**09 Hrs**

The marine ecosystem coastal - intertidal, estuarine, salt marsh, mangrove and coral reef, deep - sea ecosystems; Physical Oceanography – Air - Sea interaction; Chemical Oceanography - composition of sea water, Biological Oceanography - Living organisms of ocean; Green house gases.

Unit – II	**Marine Pollution and Its Control**	**09 Hrs**

Oil pollution - causes and control methods, Thermal and radioactive pollution - causes and control method. Role of biotechnology in marine pollution control; genetically modified microbes for waste water treatment.

Unit – III	**Biofouling and Bio - Deterioration**	**09 Hrs**

Bio-film formation - primary, secondary, tertiary colonizers. Effects of bio-fouling and control measures: manual, mechanical and chemical. Boring organisms – Effects and control measures. Corrosion - definition, reactions, classification. Factors and preventive measure.

Unit – IV	**Biotechnology in Pollution Management**	**09 Hrs**

Bio – augmentation - estimation of microbial load; Methods of Inorganic and Organic waste removal; Bioremediation – Phytoremediation; Biodegradation of natural and synthetic waste materials.

Unit – V	**Marine Pharmacology, Cosmetics and Nutraceuticals**	**09 Hrs**

Principles and mechanisms of drug action; Pharmaceutical compounds from marine flora and fauna – marine toxins, antiviral and antimicrobial agents. Marine Sources as Healthy Foods. Cosmetics from Marine Sources. Green fluorescent protein (GFP) & Red fluorescent protein (RFP) characteristics and their applications; Green mussel adhesive protein; Chatoyant and its applications.

References

1. Carl E. Bond, (2006) Biology of Fishes, 2nd Edition,W. B. Saunders Company, Philadelphia.
2. Levitus, (2000) Warming the World Ocean, Science.
3. Naskar K. and Mandal R., (1999) Ecology and Biodiversity of Indian Mangroves. Daya. pp 361.
4. Jeffrey S. Levinton, C D (2001). Marine Biology: Function, Biodiversity, Ecology (515pp).
5. Artikeya, K., (2005) Biodiversity: Extinction and Conservation, (202pp).
6. Se - kwonKim, (2015) Handbook of Marine Biotechnology, Springer.
7. Felix, S., (2010) Hand book of Marine and Aquaculture Biotechnology, AGROBIOSINDIA.
8. Gautam, N. C., (2007) Aquaculture Biotechnology, Shree Publishers and Distributors.
9. Lakra,W. S.(2008) Fisheries Biotechnology, Narendra Publishing House.

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTDE04
Sem	IV	DSE – II: POULTRY SCIENCE		Credits	3
Hrs	45			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To understand the fundamentals of poultry farming: Gain knowledge about the introduction, breeds, housing systems, and environmental factors affecting poultry production in India.
2. To acquire practical skills in poultry management: Learn effective techniques for chick rearing, brooding, nutrition, and disease control to enhance poultry health and productivity.
3. To develop expertise in poultry health management: Understand the prevention, identification, and control of common poultry diseases, and implement effective vaccination programs and bio security practices.

Course Outcomes:

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

CO1	Understand the importance of poultry farming and production in India, Including breed selection and housing requirements.	K1
CO2	Analyze the poultry industry in India, focusing on breed selection and Housing systems for optimal production.	K2
CO3	Develop practical chick rearing and management skills for broilers, growers, and layers under various conditions.	K3
CO4	Understand poultry nutritional requirements and learn to formulate balanced Feed to support growth and productivity.	K4
CO5	Identify common poultry diseases and implement effective vaccination Programs to maintain flock health.	K5&K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Poultry Farming: Overview and Introduction**	**09 Hrs**

Introduction to poultry farming and poultry production in India. Poultry breeds, varieties and their functions. Poultry housing necessity. Environment and poultry housing-temperature, humidity, air exchange and light. Poultry housing systems - extensive, semi - intensive and intensive.

Unit – II	**Poultry Industry in India**	**09 Hrs**

Poultry industry in India– choosing commercial layers and broilers – Poultry housing – deep litter and cage system - merits and demerits. Shelter engineering concepts as applied to poultry - environment and planning a poultry house. Poultry house construction-design/layout and common material.

Unit – III	**Chick Rearing Management**	**09 Hrs**

Practical aspects of chick rearing – brooding management – grower and layers – management of broilers - lighting, summer and winter management – debunking.

Unit – IV	**Poultry Nutrition**	**09 Hrs**

Poultry Nutrition: Energy – protein and amino acids – Vitamins – essential organic elements – Non – nutrition feed additives – feed stuffs for poultry – feed formation.

Unit – V	**Poultry Diseases and Vaccination**	**09 Hrs**

Diseases: Overview of viral, bacterial, fungal, and parasitic diseases affecting poultry, including symptoms, transmission, and impact on poultry health. Vaccines and vaccination programmes. Principles of bio security, hygiene practices, and preventive measures to reduce the risk of disease outbreaks in poultry farms.

References

1. Komlósi, I. K. (Ed.) (2022). Poultry: Breeding, Health, Nutrition, and Management (1st ed.). MDPI. This book offers comprehensive coverage of advancements in poultry breeding, health, and management techniques, especially in relation to environmental impacts and bio security measures.
2. Gonzalez, J. M., & Owens, C. M. (2024). Current Advances in Poultry Research (1st ed.). MDPI. This collection provides insights into global trends in poultry production, focusing on management practices, nutrition, and disease prevention.
3. Squires, R. W., & Byerly, D. (2023). Poultry Science: Advances in Genetics, Nutrition, and Welfare (2nd ed.). CRC Press. The second edition addresses the latest developments in genetics, nutritional needs, and welfare in poultry science.
4. Miller, M. R., & Hunt, C. (2021). Poultry Nutrition and Feeding Techniques (3rd ed.). Wiley-Blackwell. This textbook provides a comprehensive guide on poultry nutrition, covering feed ingredients, supplementation, and feeding strategies.
5. Bain, M., & Walsh, M. (2023). Poultry Health and Disease Management (1st ed.). Elsevier. This book highlights key aspects of poultry disease management, including viral, bacterial, and parasitic diseases, as well as vaccination strategies.

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTN03
Sem	IV	NMEC-II : ECONOMIC BIOTECHNOLOGY		Credits	2
Hrs	45			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. To make students on understanding the applied part of biotechnology to non-major and non life science back ground students.
2. To understand technical approach in society in generating value added, reliable and reproducible products.

Course Outcomes:

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

CO1	To understand basic knowledge of silkworm, earth worm cultivation and its applications	K1
CO2	To understand the concepts of biofertilizers, bio plastics and Bioweapons.	K2
CO3	To understand the basic concepts of biodegradation of xenobiotic Compounds.	K3
CO4	To understand the concepts of generating genetically modified transgenic organisms	K4
CO5	To understand the concepts of Transgenic animals	K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Trends in Economic Biotechnology**	**09 Hrs**

Sericulture, Aquaculture, Apiculture, Vermiculture and Mushroom Technology.

Unit – II	**Regulations in Biotechnology**	**09 Hrs**

Biofertilizers, Biopesticides, Biorepellents, Pest control and management, Biomass (SCP), Bioplastics, Bioweapons.

Unit – III	**Biofuels**	**09 Hrs**

Biodyes, Biofuels – Biodiesel & Biogas, Bioindicators, Biodegradation – Role of genetically modifies organisms.

Unit – IV	**rDNA Technology**	**09 Hrs**

Production of penicillin, Recombinant Vaccines (HBV), Recombinant Insulin, Plantibodies, Vaccines in animal cells, Gene therapy.

Unit – V	**Application of Biotechnology**	**09 Hrs**

Transgenic animals and their applications. Mice, Sheep and Fish. Transgenic plants and their applications – BT cotton, Flavr - Savr tomato and golden rice.

References

1. Animal Biotechnology, Ranga M M (2000). Agrobios.
2. Introduction to Plant Biotechnology. Chawla (2003). 2nd edition. Oxford and IBH publications.
3. Biotechnology, Sathyanarayana U (2008), Books and Allied (P) Ltd.
4. Industrial Microbiology, Patel A H (2005). MacMillan Publishers.
5. A text book of Biotechnology, Dubey R C (2007). S. Chand & Company Ltd, New Delhi.
6. Environmental Biotechnology, Chatterji A K, 3rd edition, PHI Learning Pvt Ltd, New Delhi

Year	II	Program	B.Sc., Biotechnology	Code	23U4BTGE01
Sem	IV	ALLIED: MODERN BIOTECHNOLOGY		Credits	2
Hrs	60			Effect from	2023-2024

Course Objectives:

The main objectives of this course are:

1. Understand the principles and techniques of plant tissue culture.
2. Understand the principles behind animal cell culture techniques.
3. Understand the basics of stem cell technology and its medical applications.
4. Understand the industrial applications of microbial fermentation.
5. Understand the use of genetically modified microorganisms for environmental applications.

Course Outcomes:

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

CO1	To evaluate the applications of plant growth hormones and secondary metabolites.	K3
CO2	To students will acquire skills in cell culture techniques used in medical and Pharmaceutical industries.	K2
CO3	To gain proficiency in the techniques used for gene therapy, monoclonal antibody production, and DNA finger printing.	K3
CO4	To understand how biotechnology contributes to the production of essential Industrial products.	K2
CO5	To understand the environmental impact of genetically modified organisms and learn about the renewable energy production using biogas and biomass.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Plant Biotechnology**	**12Hrs**

Basic principles and techniques in plant tissue culture, Secondary metabolites in plants, Plant growth Hormones, Plant based vectors for gene transfer in plants, transgenic production in plants.

Unit – II	**Animal Biotechnology**	**12Hrs**

Animal cell culture techniques: Basic principles and applications. Animal as a bioreactor, Animal viral vectors, Cloning strategies and production of transgenic mice and sheep. In-vitro fertilization, embryo transfer and Cryopreservation.

Unit – III	**Medical Biotechnology**	**12Hrs**

Stem cell technology, Gene therapy, DNA finger printing, Production and applications of Monoclonal antibodies. DNA Vaccine, Tissue engineering, Molecular diagnosis.

Unit – IV	**Industrial Biotechnology**	**12Hrs**

Production of microbial products, Production of Antibiotics, Citric acid and Vinegar, Industrial uses of enzymes in detergents, leather, food, beverages and pharmaceutical industries.

Unit – V	**Environmental Biotechnology**	**12Hrs**

Genetically modified Microorganisms, Microbial and Phyto bioremediation of xenobiotics, Biological weapons, Biogas, Biomass and Single cell proteins.

References

1. "Plant Biotechnology and Genetics" by C. G. Norkin.
2. "Plant Biotechnology: The Genetic Manipulation of Plants" by S. B. Gelvin.
3. "Introduction to Plant Biotechnology" by H. S. Chawla.
4. "Animal Cell Culture and Technology" by S. N. Sharma.
5. "Animal Biotechnology" by R. E. Hamer.
6. "Principles of Animal Biotechnology" by B. B. Mundy.
7. "Medical Biotechnology" by H. R. Rees.
8. "Principles of Gene Therapy" by A. D. Riggs.
9. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" by B. R. Glick & J. J. Pasternak.
10. "Industrial Biotechnology: Sustainable Production and Use of Bio – based Products" by C. P. Kaul.
11. "Biotechnology for Biofuels" by M. R. S. P. Anwar.
12. "Fermentation Microbiology and Biotechnology" by E. M. T. El -Mansi.
13. "Environmental Biotechnology" by M. P. P. P. Srivastava.
14. "Biotechnology and Environmental Sustainability" by R. A. Ghosh.
15. "Bioremediation: Principles and Applications" by P. P. Sharma.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

B.Sc., Biotechnology Curriculum

(Autonomous, CBCS & OBE pattern)

(For the Candidates admitted during the academic year **2022 – 2023** onwards)

SCHEME OF EXAMINATION

S.No	Course Component	Course Code	Course	Credits	Hours		Maximum Marks		
					T	P	Int	Ext	Total
SEMESTER-VI									
1	Core - 10	22U6BTC10	Plant Biotechnology	3	4		25	75	100
2	Core -11	22U6BTC11	Animal Biotechnology	3	4		25	75	100
3	Core - 12	22U6BTC12	Environmental Biotechnology	2	4		25	75	100
4	Core -13	22U6BTC13	Bioinformatics	2	4		25	75	100
5	Core Practical - 7	22U6BTCP07	Lab in Plant and Animal Biotechnology	2		5	40	60	100
6	Core Practical - 8	22U6BTCP08	Lab in Bioinformatics	2		3	40	60	100
7	DSE - III	23U6BTE05	Genomics and Proteomics	2	2		25	75	100
		23U6BTE06	Biophysics and Bioinstrumentation						
8	Research Activity	22U6BTPR01	Mini Project	1		4	40	60	100
Total				**17**	**18**	**12**	**245**	**555**	**800**

Theory	05
Practical	02
Project	01

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTC10
Sem	VI	Core – 10: PLANT BIOTECHNOLOGY		Credits	3
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

To make students on exposing plants technically, so as manipulate them for the production of disease free, nutritive elite plant varieties. In addition candidates are exposed to the use of vector based engineering of plant genome for the generation of genetically modified plants and food products.

Course Outcomes:

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

CO1	Know about the historical development of plant tissue culture and basic tissue culture techniques and their principles.	K1 & K2
CO2	Gaining knowledge on plant secondary metabolites and their role in defense mechanisms.	K1 & K2
CO3	To acquire knowledge on the generation novel plant varieties by genetic manipulation strategies.	K3, K4 & K5
CO4	Exposing towards the application of secondary metabolites in drug development and value added products.	K2, K4 & K5
CO5	To acquire knowledge on applications of plant secondary metabolites	K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Introduction**	**12 Hrs**

Plant tissue culture history, Laboratory organization sterilization methods ,types of media, media preparation, plant growth regulators. Applications of crop improvement in agriculture, horticulture and forestry.

Unit – II	**Plant Tissue Culture Techniques**	**12 Hrs**

Micro propagation, Callus induction. Cell culture techniques, Protoplast culture and fusion. Organogenesis and somatic embryogenesis. Haploid production of plants (Anther, Pollen and embryo cultures).

Unit – III	**Plant secondary Metabolites**	**12 Hrs**

Basic biosynthesis pathway of auxins and cytokinins. Role of secondary metabolites in plant defense. Plant genome organization (Chloroplast and mitochondria), Agrobacterium mediated genetransfer (Ti plasmid and Ri plasmids) methods in plants.

Unit – IV	**Genetic Engineering in Plants**	**12 Hrs**

Selectable markers, Reporter genes and promoters used in plant vectors Genetic engineering & crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Production of antibodies.

Unit – V	**Applications of Plant Secondary Metabolites**	**12 Hrs**

Isolation and characterization – drug development. Production of Biopesticides and Biofertilizers. Development of value added plant products (Saline tolerance & Delayed fruit ripening).Organic food Production, types and Identification of organic foods. Edible vaccine – Banana andWatermelon.

References

1. Plant Biotechnology: An introduction to genetic engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University, Press, 2008.
2. Biochemistry and Molecular Biology of Plants. Bod Buchananm Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.
3. Molecular Biotechnology by Glick, B. R. and J. J. Pasternak. Scond Edition, ASM press, Washington, 1998.
4. Plant propagation by tissue culture: volume 1 & 2. E. F George. Exegetics Limited, 1999.
5. Natural products: A laboratory Guide by Raphael Ikan, Academic press, 1991.
6. Chemistry of Natural products by Sujatha V. Bhat, Bhimsen A. Nagasampagi, Meenakshi Sivakumar. Birkhausr, 2005.
7. An introduction to plant tissue culture by M K R azdan. M. K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTC11
Sem	VI	Core – 11 : ANIMAL BIOTECHNOLOGY		Credits	3
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To provide foundational knowledge of animal cell culture and its applications in biotechnology.
2. To explore the various techniques involved in maintaining, analyzing, and manipulating animal cells in vitro.
3. To examine the creation and applications of transgenic animals in medicine and agriculture.
4. To address ethical, bio safety, and regulatory considerations in animal biotechnology.
5. To prepare students for advanced research or industry roles in animal biotechnology by integrating theoretical knowledge with practical skills.

Course Outcomes:

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

CO1	Understand and apply the principles of animal cell culture and its significance in biotechnology.	K2 & K3
CO2	Perform sterile techniques, prepare media, and use appropriate culture vessels for various types of animal cell cultures.	K3
CO3	Analyze cell growth, perform sub – culturing and cryopreservation, and monitor cell viability effectively.	K4
CO4	Explain the methodologies for creating transgenic animals and their applications in healthcare, agriculture, and research.	K4 & K6
CO5	Evaluate ethical, safety, and regulatory aspects involved in animal biotechnology, including the implications of genetically modified cells	K5 & K6

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	Introduction to Animal Biotechnology	12 Hrs

Overview of Animal Biotechnology and its scope and history of animal Biotechnology, Applications of Animal Biotechnology in Medicine, Agriculture and Industry. Principles of animal Cell Culture, Growth characteristics of animal cells, Cellular requirements for growth (nutrients, gases, pH, temperature, etc.)

Unit – II	Techniques in Animal Cell Culture	12 Hrs

Sterile Techniques and Aseptic Handling in animal cell culture, Common sources of contamination and how to avoid them. Preparation of Culture Media - Types of media (DMEM. basal media, enriched media, serum – free media) and Supplements and growth factors. Culture Vessels - Flasks, Petri dishes, multi - well plates, bioreactors.

Unit – III	**Cell Growth, Maintenance and Analysis**	**12 Hrs**
Principles of Animal Cell Culture. Types of Animal Cell Cultures (Primary, secondary and cell lines). Sub culturing and Passaging. Cryopreservation and cell storage techniques. Growth Phases of Cells - Lag, log, stationary and death phases, Factors influencing cell growth. Monitoring Cell Growth and Viability – Methods for counting cells (Hemocytometer, automated counters), Assays for cell viability (trypanblue and MTT). Cell Synchronization and Differentiation.		
Unit – IV	**Transgenic Animals and Biotechnology Applications**	**12 Hrs**
Principles of Transgenics in Animals – Methods of Transgenic (Physical, Chemical and Biological). Applications of Transgenic Animals. Vaccine Production - Use of cell cultures in the development and production of vaccines Cell - based and egg - based vaccine production.		
Unit – V	**Ethical and Safety considerations in Animal Cell Culture**	**12 Hrs**
Ethical Issues in Animal Cell Culture - Use of animals in research and biotechnology, Alternatives to animal testing (3R's: Reduction, Refinement, Replacement), Ethical guidelines and regulations in animal cell culture. Biosecurity and Biosafety in Cell Culture. Regulatory and Legal Framework – International guidelines (WHO, FDA and EMA) for animal cell culture applications, Legal issues in cellline patenting.		

References

1. Freshney, R. I. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley - Blackwell, 2016.
2. Butler, M. Animal Cell Culture and Technology. Taylor & Francis, 2004.
3. Masters, J. R. W., and Stacey, G. N. Animal Cell Culture: A Practical Approach.Oxford University Press, 2000.
4. Portner, R. Animal Cell Biotechnology: Methods and Protocols. Humana Press, 2007.
5. Glick, B. R., Pasternak, J. J., and Patten, C. L. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, 2010.

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTC12
Sem	VI	Core –12: ENVIRONMENTAL BIOTECHNOLOGY		Credits	2
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

This paper provides insight into environmental issues, relevant biotechnological concepts for facing environmental issues, available biotechnological applications in environmental issues, relevant policies.Thecoursealsotriestoimpartknowledgeandskillinenvironmentalbiotechnologyfor sustainable development.

Course Outcomes:

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

CO1	To provide knowledge in environmental impacts in biotechnology	K2
CO2	To understand the concepts in various bioremediation techniques related environmental aspects.	K2
CO3	To impart new thoughts about biotechnological applicationson environmental issues.	K3
CO4	To create awareness regarding the environmental policies for the improvement of environmental safety.	K3
CO5	Evaluate environmental significant.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Basic Concept of Environment**	**12 Hrs**

Basic concepts of Environment and Environmental components. Status, Scope and Role of Biotechnology in Environmental protection. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics - need for public awareness.

Unit – II	**Measurements of Pollution**	**12 Hrs**

Environmental pollution and its types: Definition – causes, effects, control measures and Biotechnological methods for management of: (a). Air pollution, (b). Water pollution, (c). Soil pollution, (d). Noise pollution, (e). Thermal pollution and (f). Nuclear hazards.

Unit – III	**Sewage and Waste Water Treatment**	**12 Hrs**

Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment. Recent approaches to biological waste water treatment, composting process and techniques – Vermicomposting, use of composted materials.

Unit – IV	**Bioremediation**	**12 Hrs**

Concept of bioremediation (in-situ, ex-situ, intrinsic & engineered bioremediation). Bioremediation of toxicmetalions biosorption and bioaccumulation principles. Concepts of phytoremediation. Microbial Leaching mechanism. Mining: use of microbial technology for mining.

Unit – V	**Environmental Ecosystem**	**12 Hrs**
Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids - types, biogeochemical cycles, ecological succession, Ecad sand ecotypes.		

References

1. Waste water engineering - treatment, disposal and reuse, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
2. Environmental Chemistry, A K. De, Wiley Eastern Ltd, New Delhi.
3. Introduction to Biodeterioration, D. Allsopp and K. J. Seal, ELBS/Edward Arnold.
4. Bioremidation, Baaker, K H and Herson D.S., 1994. Mc. GrawHill Inc, New York.
5. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and ObaidY.Khan, 2006. Horizon Press.
6. Environmental Molecular Biology, Paul. A, Rochelle, 2001. Horizon Press.

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTC13
Sem	VI	Core – 13: BIOINFORMATICS		Credits	2
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To gain basic knowledge in the concept to essential of bioinformatics.
2. To understand the usage of prediction tools that is used to predict the biological system.
3. To understand basic concepts of drug designing.

Course Outcomes:

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

CO1	Understand the structure of various biological databases, nucleic acid sequence (GenBank / NCBI, EMBL, DDBJ) and protein sequence databases (UniprotKB, PIR).	K1
CO2	Develop skills in sequence alignment; including both Pairwise sequence alignment (local and global alignments) and multiple sequence alignment.	K2
CO3	Learn to use gene prediction methods (ORF Finder), and RNA / protein secondary structure prediction methods (GOR).	K3
CO4	Understand the principles of molecular mechanics, including force fields, bond length, torsion angle, non - bonded interactions (van der Waals interactions).	K2
CO5	Learn the concepts and techniques of drug designing, including computer - aided drug design, Ligand - based approaches, and target - based approaches.	K3 & K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Biological Databases**	**12 Hrs**

Biological Databases, Nucleic acid sequence databases – GenBank / NCBI, EMBL, and DDBJ. Protein Sequence databases – Uniprot KB and PIR, Structure databases – PDB, CATH and SCOP.

Unit – II	**Sequences Analysis**	**12 Hrs**

Sequence alignment, Pairwise Sequence alignment – Local alignment and Global alignments, Dynamic programming algorithm, Scoring matrices, gap penalties.

Unit – III	**Sequences similarity and Analysis tools**	**12 Hrs**

Multiple Sequence alignment, Phylogenetic analysis – tree construction methods - Maximum Likelihood and maximum parsimony – distance methods. Database similarity search – BLAST and types.

Unit – IV	**Gene prediction methods**	**12 Hrs**

Gene Prediction methods – ORF Finder, Protein Secondary Structure Methods - GOR IV. Molecular Mechanics – force fields; Bond length, Torsion angle, and VanderWaals interactions and analyzing Ramachandran plots.

Unit – V	**Drug Designing**	**12 Hrs**
Drug Discovery. History. Steps in drug discovery. Target identification. Target validation. ADME. Drug designing – Computer aided drug design. Ligand based approach. Target based approach.		

References

1. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount, 2nd Edition (2004).
2. "Bioinformatics: Principles and Applications" by Zhumur Ghosh and Bibekan and Mallick, 1st Edition, (2008).
3. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount, 2nd Edition, (2004).
4. "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins" by Andreas D. Baxevanis and B. F. Francis Ouellette, 3rd Edition, (2004).
5. "Molecular Modelling: Principles and Applications" by Andrew R. Leach, 2nd Edition, (2001).
6. "Drug Design: Methodology, Concepts, and Mode of Action" by Thierry Langer and Rolf W. Hartmann, 1st Edition, (2006).
7. "The Organic Chemistry of Drug Design and Drug Action" by Richard B. Silverman and Mark W. Holladay, 3rd Edition, (2014).

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTCP07
Sem	VI	Core Practical – 7: LAB IN PLANT AND ANIMAL BIOTECHNOLOGY		Credits	2
Hrs	60			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To understand and apply aseptic techniques essential for both plant and animal tissue culture, including media preparation and culture handling.
2. To explore various tissue culture techniques, such as callus culture, shoot/root induction, and micropropagation in plant biotechnology.
3. To gain knowledge of essential procedures for establishing primary animal cell cultures, including disaggregation, media preparation, and counting methods.

Course Outcomes:

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

CO1	Understand and apply aseptic techniques and media preparation for plant and animal cultures.	K2 & K3
CO2	Demonstrate proficiency in plant tissue culture techniques, including explant surface sterilization, synthetic seed preparation, callus culture, and micropropagation.	K3
CO3	Perform animal tissue culture techniques, including embryo isolation, virus inoculation, and cell counting using a hemocytometer.	K2 & K3
CO4	Isolate and analyze DNA from animal tissues for genetic studies, gaining practical experience in molecular techniques.	K4
CO5	Demonstrate ethical laboratory practices and understand biosecurity considerations relevant to plant and animal biotechnology.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Aseptic technique and media preparation (MS medium).	5
2	Surface sterilization of plant explants.	5
3	Synthetic seed preparation.	5
4	Shoot induction from Callus.	5
5	Establishing a Callus culture	5
6	Root induction from Shoots	5
7	Micropropagation of Nodes & Axillary Buds	5
8	Aseptic technique and media preparation (DMEM & BSS medium)	5

9	Virus inoculation and remove embryo aseptically and transfer to dish	4
10	Disaggregation of animal tissue by warm trypsinisation method	4
11	Primary culture of chick embryo fibroblasts	4
12	Determination of cell number using haemocytometer	4
13	Isolation of DNA from goat liver	4

References

1. Plant Tissue Culture: Theory and Practice by S. S. Bhojwani and M. K. Razdan - Comprehensive coverage of plant tissue culture techniques and applications.
2. Animal Cell Culture: A Practical Approach by John R. W. Masters – A practical guide for basic and advanced animal cell culture methods.
3. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker - Covers essential biotechnological methods, including DNA isolation and cell counting.
4. Introduction to Plant Biotechnology by H. S. Chawla – Introduces plant tissue culture and genetic manipulation techniques.
5. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by R. Ian Freshney - A detailed resource for animal cell culture techniques.
6. Molecular Biology of the Cell by Bruce Albertsetal. – An in-depth text that provides foundational knowledge in cellular and molecular biology techniques.

Year	III	Program	B.Sc., Biotechnology	Code	22U6BTCP08
Sem	VI	Core Practical – 8: LAB IN BIOINFORMATICS		Credits	2
Hrs	30			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. Equip students with comprehensive bioinformatics skills for analyzing and interpreting biological data, including sequence similarity searching, multiple sequence alignment, phylogenetic analysis, and structural modeling using various databases and tools such as NCBI, BLAST, and Modeller.
2. Develop students' proficiency in utilizing specialized software and servers for advanced bioinformatics applications, including predicting secondary structures, drug - like properties, and conducting docking analyses with tools like NPSA, Mol inspiration, AutoDock Vina, and Protein Plus.

Course Outcomes:

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

CO1	Understand and navigate NCBI, PDB and Pubchem databases for retrieving and analyzing biological data and sequence alignment and similarity searching.	K2
CO2	Conduct multiple sequence alignments and phylogenetic analysis to infer evolutionary relationships. Gain proficiency in performing both local and global pairwise alignments, understanding their applications.	K2
CO3	Protein secondary structures and interprets the results using the NPSA server.	K3
CO4	Gain expertise in performing comparative modeling of protein structures using Modeller and validating these models with the SAVES server and assessing drug like properties of molecules using Mol inspiration.	K3
CO5	Master the techniques of docking analysis using AutoDock Vina and the Protein Plus server to predict and evaluate protein ligand interactions.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

S.No	Experiments	Hours
1	Biological database with reference on NCBI, PDB and Pubchem.	3
2	Open Reading Frame (ORF).	3
3	Sequence similarity searching using BLAST.	3
4	Pairwise alignment – Local and Global alignment.	3
5	Multiple sequence and Phylogenetic analysis.	3

6	Predicting protein secondary structure using NPSA server (GORIV).	3
7	Comparative Modeling using Modeller and Validation using SAVES server.	3
8	Program to convert DNA to RNA / Protein.	3
9	Determine Drug like properties using Mol inspiration.	3
10	Docking analysis using Autodock Vina and Protein plus server.	3

References

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount, 2004.
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette, 2005.
3. Introduction to Protein Structure by Carl - Ivar Brandén and John Tooze, 1999.
4. Structural Bioinformatics edited by Philip E. Bourne and Helge Weissig, 2003.
5. Molecular Modelling: Principles and Applications by Andrew R. Leach, 2001.
6. Computational Drug Design: A Guide for Computational and Medicinal Chemists by David C. Young, 2009.
7. Essential Bioinformatics by Jin Xiong, 2006.
8. Protein Structure Prediction: A Practical Approach edited by Michael J. E. Sternberg, 1997.

Year	III	Program	B.Sc., Biotechnology	Code	23U6BTE05
Sem	VI	DSE - III: GENOMICS AND PROTEOMICS		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

1. To make students on understanding basic principles of genome and its manipulating strategies end up with the development of novel candidate gene.

Course Outcomes:

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

CO1	Understand the basic structure of genome map in prokaryotic and eukaryotic organisms.	K2
CO2	To understand the mapping of different regions of DNA and its amplification protocols.	K2
CO3	To acquire knowledge on different tools used in the fields of Proteomics.	K3
CO4	To explore with the different application of proteomics in terms of protein mapping.	K3 & K4
CO5	Evaluate and create applications in proteomics.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Genomics**	**9 Hrs**

Overview of Genome anatomies. Prokaryotic Genome Organization: operons. Eukaryotic Genomes, Nuclear Genomes and gene families, Organelle genomes: origin, Repetitive DNA contents, Tandem repeats, Transposons and transposable elements.

Unit – II	**DNA Sequencing Methods**	**9 Hrs**

Shot gun sequencing – Contigassembly. Techniques for gene location: ORF findings, Northern Hybridization, RT- PCR, RACE, S1nuclease mapping, exontrapping. Transcriptome analysis: SAGE And Microarray technology.

Unit – III	**Genome Mapping**	**9 Hrs**

Genetic Mapping: RFLP, SSLP, SNP - Physical. Mapping, Restriction site Mapping: FISH, STS mapping. Human genome organization. Gene therapy for inherited disorders and infectious diseases and ethics.

Unit – IV	**Tools of Proteomics**	**9 Hrs**

Theproteome – the lifecycle of protein – analytical techniques. Protein separation: 1D PAGE, 2D PAGE, RPHPLC, Protein digestion techniques: peptide analysis - MALDI-TOF-ESI, Tandem Mass analyzers, Peptide Massfinger printing.

Unit – V	**Applications of Proteomics**	**9 Hrs**

Protein mining, SALSA algorithm for mining specific features. Protein expression profiling. Identifying protein – protein interactions. Mapping of protein modifications

References

1. Terence A Brown. (2002). Genomes, 2nd Edition, Bios Scientific Publishers.
2. Tom Strachan and Andrew P Read. (1999). Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.
3. Daniel C. Liebler. (2002). Introduction to Proteomics, tools for the New Biology - Humana press. Totowa, N J. 59
4. Pennington. S, M. Dunn. (2001). Proteomics: From Protein Sequence to Function 1st Edition Bios Scientific Publishers.

Year	III	Program	B.Sc., Biotechnology	Code	23U6BTE06
Sem	VI	DSE - III: BIOPHYSICS AND BIOINSTRUMENTATION		Credits	2
Hrs	45			Effect from	2022-2023

Course Objectives:

The main objectives of this course are:

To make students to deals with the basic instrumental principles leading to biological research outputs. It also describes the biophysical concepts of different biomolecular.

Course Outcomes:

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

CO1	Explores student towards the biophysical properties of nucleic acids Proteins.	K1
CO2	Acquiring knowledge with the basic concepts of chromatographic techniques.	K2
CO3	Acquiring knowledge with the basic concepts of spectroscopic techniques.	K2
CO4	Exploring towards the use of radiation principles in the field of biomedical Science.	K3
CO5	Evaluate and measure radioactive compounds.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Unit – I	**Scope and Methods of Biophysics**	**09 Hrs**

Scope and methods of Biophysics. Various bonding: structure and properties of water. Understanding various structure of proteins, globular and fibrous protein; protein stability; protein folding. The physicsofnucleicacids:Forcesstabilizingstructures;Doublehelicalstructures;properties;helix–coil; transitions.

Unit – II	**Biophysics of Proteins**	**9 Hrs**

Amino acids – Conformations. Phi and Psi angles. Ramachandran plot. Peptide bond isomerisation. Disulphide bonds, electrostatic forces, vanderwaals interaction and hydrogen bond.

Unit – III	**Analytical Techniques**	**9 Hrs**

Principles and applications of Chromatography (Paper, thin-layer, column, GC-MS, GLC, Ion exchange chromatography, HPLC). Principles and applications of spectroscopy. (UV-Vis, NMR, Ramanspectroscopy, AAS and X-ray crystallography).

Unit – IV	**Separation Techniques**	**9 Hrs**

Introduction to electrophoresis. Starch-gel, poly acrylamide gel (native and SDS-PAGE), Agarose – gel electrophoresis, pulse field gel electrophoresis, immuno - electrophoresis, isoelectricfocusing, Western blotting.

Unit – V	**Radiation Biophysics**	**9 Hrs**

Basic concepts of radiography. Measurement of radioactivity: GM counter, Liquid and solid Scintillation counter. Advantage and disadvantage of radioactive compounds.

References

1. Narayanan, P. (2000). Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Roy R. N. (1999). A Text Book of Biophysics, New Central Book Agency.
3. Biophyscial chemistry – Principles and Techniques - Upadhyay, Upadhyay Nath.1997.
4. Biophysical chemistry – Cantor and Schinmel. 2002.
5. Biophysical Chemistry – Principles and Technique, Biophysics – Arora, 1st, Himalaya Publications, New Delhi.
6. Palanivelu, P. (2001). Analytical Biochemistry, and separation techniques, Tulsi Book Centre. Madurai.