GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^{++} Grade

CURRICULUM AND SYLLABUS

of

UBTSC03 B.Sc. Biotechnology

(w.e.f. 2021-22 admitted batch)

(Updated upto May 2024)

Academic Regulations

Applicable for the Undergraduate programmes in the Faculties of
Engineering, Humanities, Management and the Sciences

https://www.gitam.edu/academic-regulations

VISION AND MISSION OF THE UNIVERSITY

VISION

To become a global leader in higher education.

MISSION

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

GITAM SCHOOL OF SCIENCE
GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)

Vision

To nurture outstanding science education and to build a vibrant, world class research & innovation ecosystem.

Mission

I. To provide a flexible and adaptive curriculum that emphasizes experiential learning to allow students to realize their full potential.

II. Develop high impact research knowledge and solutions to improve communities in which we live.

III. To promote a culture of healthy curiosity, enterprising mindset, and keen desire to contribute to society.

IV. To inculcate empathy, integrity, trust with a strong commitment towards society and environment among the GITAM fraternity.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

1. To update and enhance the knowledge of students in Biotechnology
2. To help the students explore their academic and other forms of their talent with exposing them wide areas of interdisciplinary subjects that relate to Biotechnology
3. To enrich the students with the comprehensive knowledge on frontier research areas of Biotechnology
4. To make the students as highly valuable human resources for medical, pharma and other industrial sectors by enhancing and fine tuning their skills.

Mapping of the Mission of the School with the PEOs

	PEO1	**PEO2**	**PEO3**	**PEO4**
M1	**3**			
M2		**2**		
M3			**2**	
M4				**2**

Programme Objectives	
1	To acquire the knowledge on biological macromolecules, enzymes, metabolic processes and cell interactions and various bioanalytical techniques.
2	To gain theoretical and practical knowledge and understanding Microbiology and understand the role of microbes in infections and industrial applications of microbes
3	To understand, analyze and comprehend immunological and other physiological processes
4	To understand the basics of genetics, molecular biology and advances in rDNA technology and its implications in in the fields of plant, animal, fermentation, marine and industrial biotechnology.
5	To enhance the understanding nature of environment and itsimpact on natural processes that sustain life.
6	To identify various marine resources and understand methodologies to apply in different methods for exploring marine resources for various therapeutic and other purposes.
7	To identify and understand various industrial processes involved in the product development and scaling up methods.
8	To gain fundamental knowledge on computers and other information technology tools and their application in biological sciences.

Program Specific Objectives (PSOs)	
1	To conceptualize and apply the basic principles of biological sciences and chemical sciences to provides an essential platform to understand the modern biotechnological processes designed according to the current needs of the society
2	To understand and evaluate the various cellular processes and underlyingmechanisms along with development of a diverse technologies
3	To provide a platform for encompassing research with proficient and ethicalresponsibilities towards meeting societal needs
4	To Acquaint with various biological processes and explore their therapeutic, agriculture and industrial applications

CURRICULUM STRUCTURE OF B.Sc. BIOTECHNOLOGY

(2021-22 ADMITTED BATCH)

University Core (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Softskills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Softskills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Softskills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Softskills 4)	0	0	2	0	0	1
VEDC1001	1	Venture Development	0	0	0	2	0	2
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
MFST1001	1	Health and Welbeing#	0	0	2	0	0	1*
CLAD20XX	2	Softskills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Softskills 6A/6B/6C	0	0	2	0	0	1
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*

* Pass/Fail courses

Opt any three courses among the five

^ Online/Swayam/NPTEL Courses

Softskills courses 5 and 6

Course code	Level	Course title	L	T	P	S	J	C
CLAD2001	2	Preparation for Campus Placement - 1 (Softskills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation For Higher Education (GRE/ GMAT) - 1 (Softskills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT - 1 (Softskills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation For Campus Placement - 2 (Softskills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation For Higher Education (GRE/ GMAT) - 2 (Softskills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT - 2 (Softskills 6C)	0	0	2	0	0	1

Sports courses

Course code	Level	Course title	L	T	P	S	J	C
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club Activity courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1001	1	Club Activity (participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of CLub)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

Community Service courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1041	1	Community Services - Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services - Mobilizer	0	0	0	0	2	2

Faculty Core (FC)

Course code	Level	Course title	L	T	P	S	J	C
CHEM1011	1	Chemistry-I	3	0	0	0	0	3
CHEM1031	1	Chemistry-II	3	0	0	0	0	3
CSCI1001	1	Basics of Information Technology	3	0	0	0	0	3
CHEM1021	1	Chemistry -I Lab	0	0	2	0	0	1
CHEM1051	1	Chemistry-III	3	0	0	0	0	3
PHYS1091	1	Biophysics	3	0	0	0	0	3
CHEM1041	1	Chemistry - II Lab	0	0	2	0	0	1
PHYS1101	1	Biophysics Lab	0	0	2	0	0	1

Programme Core/ Major Core (PC/MaC)

Course code	Level	Course title	L	T	P	S	J	C
BTSC1001	1	Molecules of Life	3	0	0	0	0	3
BTSC1011	1	Molecules of Life Lab	0	0	2	0	0	1
BTSC1021	1	Cell Biology	3	0	0	0	0	3
BTSC1031	1	Cell Biology Lab	0	0	2	0	0	1
BTSC2001	2	Enzymology & Metabolism	3	0	0	0	0	3
BTSC2011	2	Bioanalytical Techniques	3	0	0	0	0	3
BTSC2021	2	Enzymology & Metabolism Lab	0	0	2	0	0	1
BTSC2031	2	Bioanalytical Techniques Lab	0	0	2	0	0	1
BTSC2041	2	Molecular Biology & rDNA Technology	3	0	0	0	0	3
BTSC2051	2	Molecular Biology & rDNA Technology Lab	0	0	2	0	0	1
BTSC3001	3	Plant and Animal Biotechnology	3	0	0	0	0	3
BTSC3011	3	General Immunology	3	0	0	0	0	3
BTSC3021	3	Plant and Animal Biotechnology Lab	0	0	2	0	0	1
BTSC3031	3	General Immunology Lab	0	0	2	0	0	1
BTSC3041	3	Industrial Biotechnology	3	0	0	0	0	3
BTSC3051	3	Industrial Biotechnology Lab	0	0	2	0	0	1

Programme Elective (PE)*

Course code	Level	Course title	L	T	P	S	J	C
BTSC2071	2	General Microbiology	3	0	0	0	0	3
BTSC2081	2	Classical Genetics	3	0	0	0	0	3
BTSC2091	2	General Microbiology Lab	0	0	2	0	0	1
BTSC2101	2	Classical Genetics Lab	0	0	2	0	0	1
BTSC2061	2	Plant and Animal Physiology	3	0	0	0	0	3
BTSC2111	2	Marine Biotechnology	3	0	0	0	0	3
BTSC2121	2	Medical Biotechnology	3	0	0	0	0	3
BTSC3101	3	Stem Cell Biology	3	0	0	0	0	3
BTSC3061	3	Bioinformatics	3	0	0	0	0	3
BTSC3071	3	Fundamentals of Virology	3	0	0	0	0	3
BTSC3081	3	Molecular Diagnostics	3	0	0	0	0	3
BTSC3091	3	Food Biotechnology	3	0	0	0	0	3
Note 1: *Students should acquire a minimum of 16 credits from the program elective courses*								
Note 2: *Theory and corresponding lab course are co-requisites (For example if a student opts to study BTSC2071 then he/she has to study BTSC2091 in the same semester)*								

Open Elective (OE)*

* Opt eligible Programme Elective (PE) courses from other programmes as an open elective courses and earn 18credits

Eligible MINOR courses to be offered to the students of B.Sc Biotehcnology Program

Stream	Major course	Minor course (Select one)
Life sciences	Biotech	Biochemistry
		Bioinformatics
		Microbiology
		Food Science & Technology
		Environmental Science

Minor courses in Biotechnology								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
BTSC1021	1	Cell Biology	3	0	0	0	0	3
BTSC1031	1	Cell Biology Lab	0	0	2	0	0	1
BTSC2011	2	Bioanalytical Techniques	3	0	0	0	0	3
BTSC2001	2	Enzymology & Metabolism	3	0	0	0	0	3
BTSC3011	3	General Immunology	3	0	0	0	0	3
BTSC2041	3	Molecular Biology & rDNA technology	3	0	0	0	0	3
BTSC2031	3	Molecular Biology & rDNA technology Lab	0	0	2	0	0	1
BTSC3001	3	Plant & Animal Biotechnology	3	0	0	0	0	3
BTSC3021	3	Plant & Animal Biotechnology Lab	0	0	2	0	0	1
BTSC3041	3	Industrial Biotechnology	3	0	0	0	0	3

Minor Courses in Biochemistry*								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
BCBI1021	1	Protein Chemistry and Enzymology	3	0	0	0	0	3
BCBI1031	1	Protein Chemistry and Enzymology Lab	0	0	2	0	0	1
BCBI2001	2	Metabolism and Bioenergetics	3	0	0	0	0	3
BCBI2021	2	Biochemical Techniques	3	0	0	0	0	3
BCBI2041	2	Molecular Biology	3	0	0	0	0	3
BCBI2051	2	Molecular Biology Lab	0	0	2	0	0	1
BCBI3001	3	Genetic Engineering	3	0	0	0	0	3
BCBI3021	3	Clinical Biochemistry	3	0	0	0	0	3
BCBI3031	3	Clinical Biochemistry Lab	0	0	2	0	0	1
BCBI3041	3	Immunology	3	0	0	0	0	3
*** Offered to other than BSc Biochemistry**								

Minor Courses in Bioinformatics

Course code	Level	Course title	L	T	P	S	J	C
BCBI1081	1	Computational Biology	3	0	0	0	0	3
BCBI1091	1	Computational Biology Lab	0	0	2	0	0	1
CSCI1261	1	Basics of Python Programming	3	0	0	0	0	3
BCBI2241	2	Immunology and Immunoinformatics	3	0	0	0	0	3
CSCI2341	2	Fundamentals of Database Management System	3	0	0	0	0	3
BCBI2251	2	Genomics and Proteomics	3	0	0	0	0	3
BCBI2261	2	Genomics and Proteomics Lab	0	0	2	0	0	1
BCBI3151	3	Molecular Modeling and Structural Bioinformatics	3	0	0	0	0	3
BCBI3161	3	Molecular Modeling and Structural Bioinformatics Lab	0	0	2	0	0	1
BCBI3171	3	Drug Designing	3	0	0	0	0	3

Minor Courses in Microbiology

Course code	Level	Course title	L	T	P	S	J	C
MFST1051	1	Introductory Microbiology	3	0	0	0	0	3
MFST1061	1	Introductory Microbiology Practical	0	0	2	0	0	1
MFST1071	2	Microbial Genetics	3	0	0	0	0	3
MFST2061	2	Cell and Molecular Biology	3	0	0	0	0	3
MFST2071	2	Microbial Physiology and Biochemistry	3	0	0	0	0	3
MFST2081	2	Microbial Physiology and Biochemistry Practical	0	0	2	0	0	1
MFST3061	2	Immunology	3	0	0	0	0	3
MFST3071	3	Industrial Microbiology	3	0	0	0	0	3
MFST3091	3	Industrial Microbiology lab	0	0	2	0	0	1
MFST3101	3	Medical Microbiology	3	0	0	0	0	3
* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Biotechnology/Food Science & Tech/Environmental Science/Chemistry								

Minor Courses in Food Science and Technology*

Course code	Level	Course title	L	T	P	S	J	C
MFST1001	1	Principles of Food Science	3	0	0	0	0	3
MFST1011	1	Principles of Food Science Practical	0	0	2	0	0	1
MFST1021	1	Fundamentals of Food Technology	3	0	0	0	0	3
MFST2001	2	Technology of Plantation Crops	3	0	0	0	0	3
MFST2011	2	Food Processing and Preservation Technology	3	0	0	0	0	3
MFST2031	2	Food Processing and Preservation Technology Practical	0	0	2	0	0	1
MFST2041	2	Food Microbiology	3	0	0	0	0	3
MFST3001	3	Technology of Animal Foods	3	0	0	0	0	3
MFST3021	3	Technology of Animal Foods Practical	3	0	0	0	0	3
MFST3011	3	Food Biochemistry	3	0	0	0	0	3

* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Microbiology/ Biotechnology/ Environmental Science/Chemistry

Minor courses in Environmental Science

Course code	Level	Course title	L	T	P	S	J	C
ENVS1011	1	Understanding Environment & Ecology	3	0	0	0	0	3
ENVS1021	1	Understanding Environment & Ecology Lab	0	0	2	0	0	1
ENVS1031	1	Environmental Chemistry	3	0	0	0	0	3
ENVS2021	2	Geological Sciences and its resources	3	0	0	0	0	3
ENVS2001	2	Air Pollution and Control	3	0	0	0	0	3
ENVS2041	2	Environmental Microbiology	3	0	0	0	0	3
ENVS2011	2	Air Pollution and Control Lab	0	0	2	0	0	1
ENVS3001	3	Solid Waste Management and Soil Pollution	3	0	0	0	0	3
ENVS3011	3	Solid Waste Management and Soil Pollution Lab	0	0	2	0	0	1
ENVS3041	3	Industrial Safety	3	0	0	0	0	3

* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Microbiology/Food Science & Tech/Biotechnology/Chemistry

Students pursuing 4th year of the B.Sc. Biotechnology programme need to choose either Honours or Honours with Research courses from the following tables respectively.

Honours Courses

Minimum number of credits to be earned is 40, out of which 8 credits must be earned through Minor Enhancement courses.

Minor Enhancement course to be chosen in the specialization the student has studied the Minor.

Course code	Level	Course Title	L	T	P	J	S	C
BTSC4161	400	Genomes and Genomics	4	0	0	0	0	4
BTSC4221	400	Computational Genomics Lab	0	0	4	0	0	2
BTSC4171	400	Applied Immunology	4	0	0	0	0	4
BTSC4231	400	Fundamentals of Nanobiotechnology	4	0	0	0	0	4
BTSC4241	400	Fundamentals of Nanobiotechnology Lab	0	0	4	0	0	2
BTSC4211	400	Proteins and Proteomics	4	0	0	0	0	4
BTSC4251	400	Proteins and Proteomics Lab	0	0	4	0	0	2
BTSC4261	400	Concepts in Human Physiology	4	0	0	0	0	4
BTSC4271	400	Concepts in Human Physiology Lab	0	0	4	0	0	2
BTSC4191	400	Concepts in Biostatistics	4	0	0	0	0	4
		Total						**32**

Honours with Research Courses

Minimum number of credits to be earned is 40 out of which 20 credits must be earned through Research Project / Dissertation and 8 credit must be earned through Minor Enhancement course.

Minor Enhancement course to be chosen in the specialization the student has studied the Minor.

Course code	Level	Course Title	L	T	P	J	S	C
BTSC4161	400	Genomes and Genomics	4	0	0	0	0	4
BTSC4171	400	Applied Immunology	4	0	0	0	0	4
DIST4666	400	Dissertation - I	0	0	0	16	0	8
BTSC4181	400	# Microbial Physiology	4	0	0	0	0	4
BTSC4191	400	# Concepts in Biostatistics	4	0	0	0	0	4
BTSC4201	400	# Ecology and Biodiversity	4	0	0	0	0	4
DIST4777	400	Dissertation - II	0	0	0	24	0	12
		Total						**32**

Opt any ONE course

Minor Enhancement Courses

Bioinformatics								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
BCBI4241	400	Statistics for Biology	4	0	0	0	0	4
BCBI4281	400	Omics Technologies	4	0	0	0	0	4

Biotechnology								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
BTSC4161	400	Genomes and Genomics	4	0	0	0	0	4
BTSC4211	400	Proteins and Proteomics	4	0	0	0	0	4

Chemistry (Opt Any Two Courses)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
CHEM4001	400	Advanced Inorganic Chemistry-1	3	0	2	0	0	4
CHEM4011	400	Advanced Organic Chemistry -1	3	0	2	0	0	4
CHEM4021	400	Advanced Physical Chemistry -1	3	0	2	0	0	4
CHEM4031	400	Advanced Analytical Chemistry -1	3	0	2	0	0	4
CHEM4041	400	Advanced Inorganic Chemistry-2	3	0	2	0	0	4
CHEM4051	400	Advanced Organic Chemistry-2	3	0	2	0	0	4
CHEM4061	400	Advanced Physical Chemistry-2	3	0	2	0	0	4
CHEM4071	400	Advanced Analytical Chemistry-2	3	0	2	0	0	4
CHEM4081	400	Medicinal Chemistry	3	0	2	0	0	4
CHEM4131	400	Regulatory affairs and Quality assurance	3	1	0	0	0	4

Mathematics								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH4521	400	General Operations Research	4	0	0	0	0	4
MATH4421	400	Optimization Techniques and Decision Modelling	4	0	0	0	0	4

Statistics								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH4431	400	Advanced AI Techniques	4	0	0	0	0	4
MATH4451	400	Visual Analytics and Dashboard Design	4	0	0	0	0	4

Microbiology & FST								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
MFST4441	400	Microbial Products and Applications	4	0	0	0	0	4
MFST4451	400	Air and Waterborne Diseases	4	0	0	0	0	4

Allocation of credits for 3-year and 4-year B.Sc. Program

Type of Course	Credits	% of Program (in credits)	Credits	% of Program (in credits)	Credits	% of Program (in credits)
	3-year B.Sc. Program		4-year B.Sc. Program (Honours)		4-year B.Sc. Program (Honours with Research)	
University Core	12	10	12	7.5	12	7.5
Faculty Core	18	15	18	11.25	38	23.75
Major Core	32	27	64	40	40	25
Major Electives	16	13	16	10	20	12.50
Program Minor	24	20	32	20	32	20
Open elective	18	15	18	11.25	18	11.25
Total	**120**	**100**	**160**	**100**	**160**	**100**

Course PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
BTSC1001 Molecules of Life	3								3			
BTSC1011 Molecules of Life Lab	3								3			
BTSC1021 Cell Biology	2								3			
BTSC1031 Cell Biology Lab	3								3			
BTSC2001 Enzymology & Metabolism	2								3			
BTSC2011 Bioanalytical Techniques	3								3			
BTSC2021 Enzymology & Metabolism Lab	2								3			
BTSC2031 Bioanalytical Techniques Lab	3								3			
BTSC2041 Molecular Biology & rDNA Technology				1						3		
BTSC2051 Molecular Biology & rDNA Technology Lab				2						3		

BTSC3001 Plant and Animal Biotechnology				2						3		
BTSC3011 General Immunology			1							3		
BTSC3021 Plant and Animal Biotechnology Lab				2						3		
BTSC3031 General Immunology Lab			1							3		
BTSC3041 Industrial Biotechnology							2				3	
BTSC3051 Industrial Biotechnology Lab							2				2	
BTSC2071 General Microbiology		3								1		
BTSC2081 Classical Genetics								3	3			
BTSC2091 General Microbiology Lab		1								3		
BTSC2101 Classical Genetics Lab								3	3			
BTSC2061 Plant and Animal Physiology					2				2			
BTSC2111 Marine Biotechnology						3					3	
BTSC2121 Medical Biotechnology				1								2
BTSC3101 Stem Cell Biology					3							1
BTSC3061 Bioinformatics								1				3
Fundamentals of Virology		1									2	
BTSC3081 Molecular Diagnostics				1								1
BTSC3091 Food Biotechnology							2					2

	Course Code	Course Title	L	T	P	J	S	C
	BTSC1001	Molecules of Life	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	Biology and Chemistry Knowledge at Intermediate level	Contact hour				60	
	Course Co-requisite(s)	None	Date Approved					
	Alternate Exposure	None						

This course has been designed to enrich the students' knowledge about the macromolecules of life like carbohydrates, amino acids, fatty acids, nucleic acids. The course shall make the students' aware of the classification of all macromolecules and the structure, physical and chemical properties and biological roles of complex carbohydrates, amino acids, proteins, eicosanoids and nucleic acids.

Course Objectives:

1. To enlighten about properties and interactions of water.
2. To build up the knowledge about the macromolecules of life.
3. To familiarize the classification of all macromolecules.
4. To impart knowledge on structures of complex carbohydrates, proteins and structures of nucleic acids.
5. To reveal the biological role of macromolecules.

UNIT- I Title: Water: The medium of life No. of Hours: 8

Structure and Properties of water, intra and intermolecular forces, non-covalent interactions, electrostatic, hydrogen bonding, Vander Waals interactions, hydrophobic and hydrophilic interactions. Disulphide bridges.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain why water's solvent properties are important in undertaking events taking place inside cells.
- Describe how hydrogen bonding in water effects its capacity, melting, evaporation and cohesion.
- Distinguish between hydrophyllic and hydrophobic interactions using examples.
- Identify instances in which van der Wall's forces are important.
- Distinguish between intra & inter disulfide bridges using examples.

Pedagogy tools: Blended learning, self-reading.

UNIT- II Title: Carbohydrates No. of Hours: 8

Classification and biological functions of carbohydrates, structure and properties of monosaccharaides (Glucose and Fructose). Disaccharides (sucrose, maltose, lactose), polysaccharides (starch, cellulose and chitin). Glycosaminoglycans (chondroitin sulfate and Hyaluronic acid)

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the concept of carbohydrates.
- Understand the structures and properties of monosaccharides, disaccharides, polysaccharides and glycosaminoglycans.
- Understand the biological importance of monosaccharides, disaccharides, polysaccharides and glycosaminoglycans.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- III Title: Amino acids & Proteins No. of Hours: 8

Classification, structure and properties of amino acids, Primary structure of protein- determination of amino acid composition and sequence. Secondary structure-α-helix, β-pleated sheet, collagen triple helix. Tertiary and quaternary structures. Solid phase peptide synthesis. Glycoproteins.

Learning Outcomes:

After completion of this unit, the student will be able to

- Sketch the chemical structures of standard amino acids
- Describe how amino acids differ in their side chains
- Describe how amino acids are joined to form a peptide bond
- Biological importance of amino acids and proteins.
- Distinguish primary, secondary, tertiary, quarternary structures and predict how a protein's structure will be affected by a change in an amino acid and its primary structure.
- Understand the chemical synthesis of proteins
- Biological importance of glycoproteins.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- IV Title: Lipids, Eicosanoids & Vitamins No. of Hours: 8

Classification, structure, properties and functions of fatty acids, triglycerides, phospholipids, sphingolipids. Cholesterol, Eicosanoids. Structure and functions of vitamins (A, D, E, K, B complex and C).

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the structure, properties and functions of fatty acids and triglycerides.
- Describe the structure, properties and functions of phospholipids, sphingolipids and cholesterol
- Understand the structure and functions of Eicosanoids.
- Understand the structure and functions of fat-soluble vitamins
- Understand the structure and functions of water-soluble vitamins

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- V Title: Nucleic acids No. of Hours: 8

Purine and pyrimidine nitrogen bases, Nucleosides and nucleotides, Structure and properties of DNA. Alternative forms of DNA - A, B, Z. Structure and properties of RNA, different types of RNA: mRNA and non-coding RNA – tRNA, rRNA, siRNA, miRNA.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the concepts of Nitrogen bases, structural differences between Nucleosides and nucleotides.
- Explain the structure and properties of DNA and different types of DNA (A, B, and Z).
- Explain the structure and properties of RNA and different types of RNA (mRNA and non-coding RNA).
- Distinguish between DNA and RNA.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

Textbook(s):

1. Lehninger Principles of Biochemistry by Nelson D & Cox D, 7th Edition, McMillan Pub.
2. Biochemistry A short course by John L Tymoczko, 3rd Edition (Freeman-Tappan).
3. Harper's Biochemistry by Robert K Murray et.al., 30th Edition (Langeman).

Reference Book(s):

1. Biochemistry by Garrett & Grisham, 6th Edition (Cengage Learning).
2. Biochemistry Concepts and Connections by Mathews et.al., Global Edition.
3. Principles of Biochemistry by David Rawn et.al., 5th Edition (Pearson)
4. Essentials of Glycobiology, 3rd Edition (CSHL press).
5. Biochemistry by L Stryer, 8th Edition (Freeman-Tappan).
6. Biochemistry by D Voet & JG Voet, 4th Edition (John weily).

Journals(s):

1. Annual Review of Biochemistry, eISSN: 1545-4509

2. The Journal of Biochemistry, ISSN: 1756-2651
3. Biochemistry & Molecular Biology Journal, ISSN: 2471-8084
4. Biochemistry & Analytical Biochemistry, ISSN: 2161-1009

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3		1			2		1	1			
CO2	3					3				2	3	
CO3	3									3	2	
CO4	3									2		
CO5	3				1	3	1	1		2	2	

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC1011	Molecules of Life Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus Version				1.0	
	Course Pre-requisite(s)	Biology and Chemistry Knowledge at Intermediate level	Contact Hours				40	
	Course Co-requisite(s)	BTSC 1001 Molecules of life	Date Approved					
	Alternate Exposure	None						

The main objective of this course is to train students in the practical aspects of macromolecules so that they can perform different experiments targeted towards qualitative and quantitative assays of the biomolecules.

Course Objectives

1. To prepare various buffers and determine the pH of solutions
2. To familiarize the students with qualitative assay of the different macromolecules.
3. To help the students gain expertise in quantitative estimation of different macromolecules.
4. To train the students on the use of UV-Vis Spectrophotometer and other relevant lab equipments.
5. To train the students on the basic concept of chromatography with special reference to paper chromatography.

SPECIFIC INSTRUCTIONAL OBJECTIVES

The overall instructional objective is to gain hands-on experience in conducting different assays related to the qualitative and quantitative analysis of the different macromolecules.

1. To become familiar with handling of the different instruments related to the laboratory course.
2. To understand the concept of UV-Vis spectrophotometry and absorbance maxima.
3. To understand the concepts of different units of concentration of solutions and their inter-conversion.
4. To learn the preparation of different reagents having different strengths.
5. To learn precise pipetting techniques.
6. To understand the concept of isoelectric point and the application of this concept.
7. To understand the concept of paper chromatography and apply the same towards separation of amino acids.
8. To conduct qualitative assay and quantitative estimation of different biomacromolecules.

List of Experiments

1. Qualitative analysis of amino acids
2. Qualitative analysis of carbohydrates
3. Determination of isoelectric point of glycine
4. Estimation of proteins by Lowry method
5. Separation of amino acids by paper chromatography
6. Ultra violet absorption spectra of proteins and nucleic acids

Text Books

1. Biochemical Methods by Sadasivam & Manickam (New Age International Pvt. Ltd)
2. Laboratory Manual in Biochemistry by J. Jayaraman (Wiley Eastern Limited)
3. Introductory practical Biochemistry by S.K.Sawhney & Randhir Singh – 2nd Edition (Narosa)

Additional Reading

1. An introduction to Practical Biochemistry by D. T. Plummer, 3rd Edition (McGraw-Hill)
2. Biochemistry – A Laboratory Course by J. M. Beckar, 2nd Edition (Academic Press)

Reference Book(s):

	Program Objectives (POs)								**PSOs**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**
CO1	1					3		2	2			
CO2	2					3		2		1		
CO3	1					3		2		2	3	
CO4	1					3		2		3		
CO5	2					3		2		2		

1-Low, 2- Medium, and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2071	Cell Biology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology	Contact hour				60	
	Course Co-requisite(s)	BTSC1021 Cell Biology	Date Approved					
	Alternate Exposure	None						

This course is designed to introduce the students to the basics and core concepts in cell biology understanding the organisms based on cell structure, function, cell division, and the consequences of altered cell division.

During this course, the students are taught about the life, life forms- cells, understand and appreciate "reason for cell being called as structural functional unit of life", the cell evolution, and the entire evolution tree of life. Students are taught about the structure of prokaryotic and eukaryotic cells-chemical composition and major cell organelles in detail. They will also be taught about the ultra-structure of plasma membrane and membrane transport. Besides they are taught about the cell in social context – extracellular matrix, cell skeleton, cell life cycle – division and the regulation of its cycle and its altered cycle.

Course Objectives:

1. To familiarize with the historical aspects and the important discoveries in the cell biology, cell evolution, and to make them understand organelle biogenesis, organization of prokaryotic and eukaryotic cells, and ultra-structure mitochondrial, and Golgi apparatus. To make them to complete understand the cell wall (bacteria and plants) and other important organelles in the cells.
2. To make the students to understand the chemical composition of plasma membrane and ultrastructure of chloroplast, lysosomes and peroxisomes.
3. To impart the students with complete knowledge on extracellular matrix, cytoskeleton, different types of cell junctions and transport by vesicular means (exocytosis and endocytosis).
4. To make the students to understand detailed structure of plasma membrane and membrane transport.
5. To understand cell cycle, cell division, cell cycle regulation its importance and consequences of altered regulation and genes involved in this process leading to cancer. They are made to understand about the apoptosis and role in cancer.

UNIT-I - History and the Evolution of Cell **Hours: 15**

History of cell biology, Evolution of the cell: endosymbiotic theory, tree of life**.** Structural organization of prokaryotic and eukaryotic cell. Ultra-structure of nucleus, mitochondria, endoplasmic reticulum, golgi complex.

UNIT-II – Chemical composition of Cell Wall, Plasmodesmata, and ultrastructure of Lysosomes and peroxisomes **Hours: 8**

Chemical composition, structure and functions of cell wall and plasmodesmata. Biochemistry and significance of vacuoles. Ultra structure of chloroplast. Lysosomes and Peroxisomes

UNIT-III – Cell in social context- Extracellular matrix, Cytoskeleton, Cell junctions and vesicular mediated membrane transport **Hours: 15**

Extracellular matrix – Collagen, Elastin, Fibrillin, Fibronectin, Laminin, Proteoglycans, Integrins. Cytoskeleton – microtubules and microfilaments. Cell-cell interactions - Gap junction, Tight Junction, Desmosomes. Exocytosis and Endocytosis.

UNIT-IV – Membrane ultrastructure and transport **Hours: 12**

Different membrane models, Ultra structure of plasma membrane. Membrane asymmetry. Fluidity of membranes. Membrane biogenesis. Membrane channels and pumps. Membrane transport mechanisms.

UNIT-V – Cell cycle- its regulation and cancer **Hours: 10**

Cell division by mitosis/meiosis. Cell cycle and its regulation. Abnormal cell division: cancer - hallmarks of cancer and role of oncogenes and tumour suppressor genes in cancer development - Programmed cell death (Apoptosis).

RECOMMEDED BOOKS:

1. Molecular Biology of the Cell by B Alberts *et.al.*, 5th Edition, Garland publications incorporation.

2. Principles of Development by Lewis Wolpert, 4th Edition, Oxford University press.
3. Molecular Cell Biology by Harvey Lodish*et.al.*, 7th Edition, W.H. Freeman and Co.,
4. Cell and Molecular Biology by DeRoberties&DeRoberties, 8th Edition, S Chand & Co.
5. The Cell: A molecular approach by GM Cooper & RE Hausman, 6th Edition, Ingram Publishers

6. Molecular Cell Biology by J Darnell, 4th Edition, Scientific American Books.
7. Harper's Biochemistry by RK Murray *et.al.*, 30th Edition, McGraw-Hill Lange Publishers.

8. Biochemistry of Signal Transduction and Regulation by G Krauss, 5th Revised Edition, Wiley-VCH publishers.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	1									1		
CO2	2											
CO3	1									2		
CO4	1									2		
CO5	2									3		

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC1031	Cell Biology Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1031 Cell Biology	Contact hours				40	
	Course Co-requisite(s)	BTSC2031 Cell Biology	Date Approved					
	Alternate Exposure	None						

This course enables the students to gain knowledge on various cellular processes and mechanisms, methods in cell and cytogenetics. In this course, students will be performing the practical experiments to understand, appreciate the visual as well practical aspects of cell division, making permanent mounts, cell fractionation, understand and visualize movement of water in and outside the cell by keeping cell in hypo or hypertonic solutions. Students would also be performing the karyotyping and understand polyploidy by treating the cells with colchicine drug.

Course Objectives

1. To familiarize with microscopy observation of biological specimens and to identify them.
2. To familiarize with microscopy observation of biological specimens and to identify them based on anatomical structures.
3. To impart the students with practical knowledge the cell division and hands on experience of making specimen and identifying different stages of mitosis.
4. To impart the students with practical knowledge the cell division and hands on experience of making specimen and identifying different stages of meiosis.
5. To familiarize with the differential centrifugation techniques and the isolate different organelles by centrifugation and give hands on experience in isolating sub cellular organelles.

List of Experiments

1. Microscopic examination of thallus in Algae.
2. Microscopic examination of fruiting bodies of Fungi.
3. Identification of different stages of mitosis (onion root tips) by squash method.
4. Identification of different Meiotic stages by smear method (in onion flower buds).
5. Isolation of subcellular organelles by centrifugal techniques (Nucleus / Mitochondria / Chloroplast)
6. Microscopic examination of nucleus by Feulgen staining method.

Course outcomes:

After completion of this unit, the student will be able to

- Identify different types of thalli in Algae.
- Identify different types of fruiting bodies of fungi based on their anatomical structures.
- Perform make specimen preparation from onion flower buds and identify different stages of meiosis based on the images under microscopy.
- Isolate subcellular organelles from plant material and stain them and identify under microscope.

Text Books

1. Handbook of Microbiological Media by Atlas RL.
2. Manual of Clinical Microbiology by Lennettee EH.
3. Manual of Clinical Microbiology by Murray PR.
4. A Laboratory manual of Microbiology: Microbes in action.
5. Molecular Biology of the Cell by B Albert*set.al.*
6. Handling of Chromosomes by Darlington & Lacor.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1		2								2		
CO2		2								2		
CO3		2								2		
CO4		2								2		
CO5		1								2		

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2001	Enzymology and Metabolism	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1001 Molecules of Life	Contact hour				60	
	Course Co-requisite(s)	BTSC2021 Enzymology and Metabolism Lab	Date Approved					
	Alternate Exposure	None						

This course is designed to introduce the students to the core concepts in Enzymology, in-depth understanding of metabolism. In this course students will be learning about the enzymes, properties and learn about the method of classifying the enzymes, and study about enzyme kinetics. They also learn about the classification of metal containing enzymes, metalloenzymes-classification, and mechanism of their enzymatic actions. In the second part of this course, they will learn about the different metabolic pathways that occur in the cells and the enzymatic reactions of those pathways and their regulation

Course Objectives:

6. To familiarize students about the fundamental concepts enzymes and enhance the basic knowledge and to understand about the enzyme kinetics.
7. To enhance the basic knowledge and to understand about the enzyme inhibition and regulation processes.
8. To acquaint the students to the metabolism of carbohydrates in terms of synthesis and degradation, and diseases pertaining to the glycogen storage.
9. To enhance the knowledge and to understand about the secondary source of energy to the cell and the important structural components of cells, fatty acids and their metabolism etc.
10. To familiarize the students to the concepts metabolism of nitrogen based biomolecules and related inborn errors of metabolism.

UNIT- I Title: Basic Concepts of Enzymes and Kinetics No. of Hours: 8

Nomenclature and classification of enzymes, Factors effecting enzyme activity: enzyme concentration, substrate concentration, pH, temperature and metal ions. Enzyme assay, units of enzyme activity and specific activity. Michaelis - Menten equation, significance of Km, Vmax.

UNIT- II Title: Enzyme Inhibition and Regulation No. of Hours: 9

Cofactors, coenzymes, metalloenzymes. Enzyme inhibition: Irreversible inhibition and Reversible inhibition - competitive, non- competitive and uncompetitive. Enzyme regulation: allosteric enzymes, zymogen activation, covalent modification and isoenzymes. Overview of Abzyme, ribozyme and enzyme immobilization.

UNIT- III Title: Carbohydrate metabolism and storage disorders No. of Hours: 8

Glycolysis and its regulation. TCA cycle and its regulation. Electron transport chain and oxidative phosphorylation. gluconeogenesis, HMP shunt and glyoxylate cycle and their significance. Glycogen synthesis and degradation, Glycogen storage diseases.

UNIT- IV Title: Fatty acid Metabolism No. of Hours: 7

Synthesis and degradation of Saturated and Unsaturated Fatty acids, Ketone bodies, Synthesis of Triacylglycerides, Phospholipids and Cholesterol.

UNIT- V Title: Amino acid and Nitrogen base Metabolism No. of Hours: 8

Transamination and oxidative deamination and Urea cycle. Biosynthesis and degradation of phenylalanine and valine. Inborn errors of amino acid metabolism. Synthesis and degradation of purine and pyrimidine nucleotides. Formation of deoxyribonucleotides.

Learning Outcomes:

After completion of this unit, the student will be able to

- Learn and gain knowledge about basic fundamental features and kinetics of the enzymes.
- Understand the enzyme inhibition process in the presence of various types of inhibitors and also about the fine-tuning of metabolism by means of enzyme regulation.
- Learn the basic features of the carbohydrate metabolism and storage disorders.
- Understand the fatty acid metabolism and be familiar with harmful effects of ketone bodies etc.
- Gain knowledge on urea cycle, nitrogen base metabolism and inborn errors of amino acid metabolism

Textbook(s):

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Palmer, 2nd edition, East West publishers.
2. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. –7th Edition. Mcmillan Pub.
3. Biochemistry by L.Stryer– 8th Edition. (Freeman-Tappan).
4. Biochemistry by U.Satyanarayana—6thEdition, Reed Elsevier India Pvt. Ltd.

Reference Book(s):

1. Biochemistry by D.Voet and J.G.Voet– 4th Edition. (John weily).
2. Biochemistry by Garrett and Grisham 6th Edition. (Cengage Learning).
3. Biochemistry Concepts and Connections by Mathews et. al.,Global Edition.
4. Principles of Biochemistry by David Rawn etal., 5th Edition (Pearson).
5. Essentials of Glycobiology. 3rd Edition. (CSHL press).
6. Harper's Biochemistry by Robert K. Murray et al., – 30thEdition. (Langeman).

Journals(s):

1. Journal of Biological Chemistry, Elsevier Publishers, ISSN: 0021-9258.
2. PLOS ONE, PLOS corporation, USA. eISSN: 1932-6203.
3. Metabolism-Clinical and Experimental, Elsevier Publishers, ISSN: 0026-0495.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3			1	2				2	3		2
CO2	3				2				1	2		2
CO3	3			1					1	2		3
CO4	3			1	1				1	2		3
CO5	3			1	1				1	2		3

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2011	BIOANALYTICAL TECHNIQUES	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1001 Molecules of Life	Contact hour				60	
	Course Co-requisite(s)	None	Date Approved					
	Alternate Exposure	None						

Preamble: The biochemical techniques predominately embrace a broad cross-section of modern analytical techniques and latest sophisticated instruments like HPLC, XRD, NMR, GC-MS, ORD…etc. The course will help to build the knowledge about the bioanalytical techniques used to analyze various biomolecules and also the use of radio tracer techniques in biology.

Course objectives:

The bioanalytical methods predominately embrace a broad area of basic and advanced analytical techniques used in biology.
1. To learn the fundamentals of many techniques used regularly for the analysis of the biological molecules. Throughout the course different broad classes of techniques for the separation of DNA, RNA, and protein are discussed.
2. To make the students understand of the principle of various techniques used to analyse biomolecules.

3. To make the students aware of the different components of the equipment that are used and methodology to analyse biomolecules.

UNIT-I (Chromatography Techniques)
Principles and applications of chromatographic techniques- Paper chromatography, thin layer chromatography, gel filtration, ion-exchange chromatography, affinity chromatography, GC, HPLC and GC-MS.

UNIT-II (Electrophoresis Techniques)
Principles and concepts of electrophoretic techniques- native PAGE, SDS-PAGE, Agarose gelelectrophoresis, capillary electrophoresis, isoelectric focusing (IEF), two dimensional, pulse field and diagonal electrophoresis.

UNIT-III (Spectroscopic Techniques)
Principles and applications of Optical Rotatory Dispersion (ORD), Circular Dichroism (CD),Nuclear

Magnetic Resonance spectroscopy (NMR), Electron Spin Resonance spectroscopy (ESR),Fluorescence spectroscopy. X-ray diffraction.

UNIT-IV (Centrifugation Techniques)
Principles and applications of preparative centrifugation: Differential centrifugation, density gradient centrifugation, rate zonal centrifugation and isopycnic centrifugation. Types of rotors. Analytical centrifugation: sedimentation coefficient, boundary sedimentation, band sedimentation.

UNIT-V (Tracer and Biosensor Techniques)
Radioactive and non-radioactive tracer techniques and their applications in biological sciences. Detection and measurement of radioactivity. Principles of electrochemical techniques-operation and applications of pH, oxygen, ion-selective and gas sensing electrodes. Biosensors- principle, design and applications.

COURSE OUTCOMES:

1. The students will be able to comprehend the applications of different techniques used to analysebiomolecules.
2. The students will be informed of the limitations of various techniques so that they will know whichtechnique to apply for different kinds of analyses of the biomolecules.
3. The course will also guide them to develop new techniques or in the direction of improving theexisting techniques.

Recommended Books:

1. Practical Biochemistry by Keith Wilson & Walker, 5th edition, Cambridge University Press.
2. A Biologists guide to Principles and techniques of practical Biochemistry by BD Williams (EdwardArnold).
3. Principles and Techniques of Biochemistry and Molecular Biology by K Wilson & J Walker, 7thEdition, Cambridge University Press.
4. Biophysical chemistry principles and techniques by Upadyay& Nath, Himalaya publishing House.
5. Instrumental methods of chemical analysis by Chatwal & Anand, 5th edition, HimalayaPublishers.
6. Modern Experimental Biochemistry by Rodney F Boyer, 3rd Edition.
7. Fundamentals of Biostatistics by Khan & Khanum, Ukaaz publications.
8. Biostatistics by Daniel, 10th edition, Wiley Publishers.
9. Physical Chemistry: Science of Biology by Atkins, Freeman & Company

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3									1		
CO2	3									1		
CO3	3									1		
CO4	3											
CO5	3											

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2021	Enzymology and Metabolism Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	Biology and Chemistry Knowledge at Intermediate level	Contact hours				32	
	Course Co-requisite(s)	BTSC2001 Enzymology and Metabolism	Date Approved					
	Alternate Exposure	None						

This course enables the learner to be acquainted with laboratory skills in assaying, quantifying
various enzymes. Further, enhances the ability to understand the kinetics aspects of enzymes.

Course Objectives

1. To train the students in the practical aspects of enzymology and metabolism.
2. To demonstrate the qualitative and quantitative assay procedures.
3. To evaluate the enzyme acid phosphatase through assay.
4. To demonstrate the kinetic behaviour of enzymes by evaluating the kinetic parameters.
5. To make understand the effect of various factors on enzyme activity.

List of Experiments

1. Assay of salivary amylase
2. Assay of potato acid-phosphatase
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Effect of incubation time on enzyme activity
6. Effect of substrate concentration on enzyme activity

Course outcomes:

By the end of this practical course, the student will be able to

- Gain hands-on experience in conducting various enzyme assays and analysis.
- Perform experiments related to various factors influence the enzyme and the enzyme activity.

Text Books:

1. Modern experimental Biochemistry by Rodney Boyer – 3 rd Edition (Benjamin Cummings).
2. Biochemical methods by Sadasivam and Manikam – 3 nd Edition (New Age International Pvt. Ltd. Publishers).
3. An introduction to practical biochemistry by D.T.Plummer – 2nd Edition (McGraw Hill).
4. Laboratory manual in Biochemistry by J. Jayaraman (Wilety Eastern limited).
5. Biochemistry - a laboratory courses by J. M.Beckar – 2 nd Edition (Academic Press).
6. Introductory practical Biochemistry by S. K.Sawhney and Randhir Singh – 2 nd Edition (Narosa).

	Programme Objectives (POs)								PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**
CO1	3			1	2				2	3		2
CO2	3				2				1	2		2
CO3	3			1					1	2		2
CO4	3			1	1				1	2		2
CO5	3			1	1				1	2		2

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2031	BIOANALYTICAL TECHNIQUES Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	Biology and Chemistry knowledge at Intermediate	Contact hours				40	
	Course Co-requisite(s)	BTSC2011 Bioanalytical techniques theory	Date Approved					
	Alternate Exposure	None						

The bioanalytical techniques predominately embrace a broad cross-section of modern analytical techniques and principle and usage of instruments like HPLC, XRD, NMR, GC-MS, ORD…etc. The course will help to build the knowledge about the bioanalytical techniques used to analyze various biomolecules.

Course objectives:

1. To train students in the different separation techniques of biomolecules.
2. To make students understand the importance of different techniques in characterization of biomolecules.

Experiments:

1. Separation of biomolecules by paper chromatography
2. Separation of biomolecules by thin layer chromatography
3. Separation of amino acids/proteins by ion exchange chromatography
4. Purification of enzyme by affinity chromatography
5. Separation of proteins by SDS PAGE and determination of molecular weight.
6. Centrifugation technique for separation of cell organelles.

Course Outcomes:

By the end of this practical course, the student will be able to
• Learn the techniques of qualitative and quantitative analysis of biomolecules
• Learn the usage of lab equipment like centrifuge, colorimeter and spectrophotometer.

Recommended Books:

1. Modern experimental Biochemistry by Rodney Boyer, 3rd Edition, Benjamin Cummings.
2. Biochemical methods by Sadasivam and Manikam, 2nd Edition, Wiley Eastern limited.
3. An introduction to practical biochemistry by DT Plummer, 2nd Edition, Mc Graw Hill.
4. Laboratory manual in Biochemistry by J Jayaraman, 2nd Edition, Wiley Eastern limited.
5. Biochemistry - A laboratory courses by JM Beckar, 2nd Edition, Academic Press.
6. Introductory practical Biochemistry by SK Sawhney &Randhir Singh, 2nd Edition, Narosa Publishing House Ltd.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3			1	2				2	3		
CO2	3				2				1	2		
CO3	3			1					1	2		
CO4	3			1	1				1	2		
CO5	3			1	1				1	2		

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2041	Molecular biology and rDNA technology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	Classical genetics	Contact hour				60	
	Course Co-requisite(s)	BTSC2051 Molecular biology and rDNA technology lab	Date Approved					
	Alternate Exposure	None						

Studying structure function and interactions of macromolecules essential to life defines molecular biology. Manipulating such biomolecules by copying or expressing them in bacteria is recombinant DNA technology. Based on the fact that all molecular machinery involved in life organization is invisible to naked eye, understanding their interactions and function is even more challenging. For example, cracking the genetic code and its further implications in translation is considered as one of the toughest challenges encountered and addressed by the scientific world. Molecular biology has marvellous theoretical and practical applications in genetic engineering, biotechnology and many more. Molecular biology and genetic engineering can be effortless to students, if they are delt in logical and application-oriented manner.

Course Objectives:

The objectives of this course are

1. To make students understand how molecular machines are constructed and regulated so that they can accurately copy, repair and interpret genomic information in prokaryotes and eukaryotic cells; To appreciate the subject of molecular biology as a dynamic and ever-changing experimental science.
2. Explain about different enzymes and vectors used in genetic engineering
3. To help students understand manipulation of DNA by various genetic engineering tools
4. To understand hybridization and sequencing techniques of nucleic acids
5. To understand implementing rDNA technology in plant and animal genetic transformation.

UNIT-I **No. of Hours: 8**

Features of DNA Replication, mechanism of DNA replication in prokaryotes and eukaryotes, enzymes and proteins involved in DNA replication, DNA damage and repair

Learning Outcomes:

By the end of this Unit, students will be able to:

- Acquire basic knowledge on mechanism of DNA replication.

UNIT-II **No. of Hours: 8**

Transcription mechanism in prokaryotes and eukaryotes, Types of RNA polymerases and promoter-polymerase interactions, DNA-dependent RNA polymerase, RNA transport and editing, inhibitors of transcription and applications of antibiotics.

Learning Outcomes:

By the end of this Unit, students will be able to:

- Comprehend the basic mechanism and methods to measure rate of gene expression.

UNIT-III **No. of Hours: 8**

Mechanism of translation in prokaryotes and euakryotes, Co-and post translational modifications, protein targeting, regulation of gene expression-operon concept, cis-trans elements, DNA methylation, RNAi and gene silencing

Learning Outcomes:

By the end of this Unit, students will be able to:

6. Understand molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes.

UNIT-IV **No. of Hours: 8**

Genetic engineering molecular tools: Restriction enzymes, DNA ligases, Polymerases, Alkaline phosphatase, Poly nucleotide kinase, Terminal deoxy nucleotide transferase.Cloning vectors: Plasmids, Bacteriophage-derived vectors and artificial chromosomes. Gene Recombination and Gene transfer: Transformation and screening of recombinants.

Learning Outcomes:

By the end of this Unit, students will be able to:

7. Explain about different enzymes and vectors used in genetic engineering

UNIT-V **No. of Hours: 8**

Hybridization techniques: Southern and Northern hybridization. Principle and applications of Polymerase Chain Reaction (PCR) and Reverse transcription (RT) PCR. Preparation of Genomic and cDNA libraries, DNA sequencing by chemical, enzymatic and Next Generation Sequencing (NGS) methods, DNA fingerprinting.

Learning Outcomes:

By the end of this Unit, students will be able to:

8. Describe different nucleic acid hybridization and sequencing techniques

RECOMMENDED BOOKS:

1. Recombinant DNA: Genes and Genomes - a Short Course by James D. Watson, (2006) WH Freeman & Co; 3rd edition

2. Lewin's Genes-XII by Jocelyn E. Krebs et al., (2017) Jones and Bartlett Publishers, Inc; 12th edition

3. Principles of Gene Manipulation and Genomics by Primrose & Twyman (2006) 7thed (Oxford).

4. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Glick et al., (2017) 5th ed ASM Press.

5. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown (2016) 7thed (Wiley-Blackwell).

6. Molecular Biology of the Cell by Bruce Alberts (2014), 6th edition, Garland Science

7. Genomes by T.A. Brown (2017) 4th ed Garland Science Publishers.

8. Molecular Biology of the Gene by Watson et al., (2013) Person Publishers

9. Molecular Cell Biology by Lodish et al., (2016) 8th Edition, WH Freeman publishers

10. Karp's Cell and Molecular Biology: Concepts and Experiments by Janet Iwasa (2016), John Wiley & Sons Inc; 8 edition

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	1			2						3		
CO2				3							3	
CO3				3							3	
CO4				3							3	
CO5				3							3	

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

SEMESTER-IV

MOLECULAR BIOLOGY AND rDNA TECHNOLOGY LAB

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2051	Molecular biology and rDNA technology Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	Classical genetics	Contact hours				40	
	Course Co-requisite(s)	BTSC2041 Molecular biology and rDNA technology	Date Approved					
	Alternate Exposure	None						

The experiments are designed to make students gain hands on experience to isolate DNA and RNA from prokaryote and eukaryotes; to quantify and amplify nucleic acids.

Course Objectives

1. To understand organization and nature of prokaryotic / eukaryotic genetic material
2. To familiarize differences between organization of eukaryotic and prokaryotic genetic material.
3. To understand how to isolate, analyse purity and quantify the nucleic acids.
4. To familiarize restriction enzymes as molecular scissors and ligases as molecular glue.
5. To understand the power of PCR in amplification of DNA.

1. Isolation of DNA from Eukaryotic cells.

2. Isolation of Plasmid DNA by alkaline Lysis method

3. Separation of DNA by Agarose gel electrophoresis

4. Purity of isolated DNA by A260/A280 Ratio

5. Isolation of RNA by Trizol method

6. DNA denaturation and Hyperchromic effect

7. Estimation of DNA by DPA method

8. Estimation of RNA by Orcinol method

9. Restriction digestion of DNA

10. Ligation of DNA

11. Polymerase Chain Reaction (PCR)

RECOMMENDED BOOKS:

1. Biotechnology: A laboratory course by Becker J.M.

2. Molecular Cloning: A laboratory manual Vals. 1-3, Sambrook, J.

3. Biochemistry - a lab course by J.M.Becker (Academic Press).

4. Molecular Cloning: A laboratory manual Vals. 1-3, Sambrook, J.

Outcome of Learning:

The students will be able to:

1. isolate DNA and RNA from prokaryote and eukaryotes

2. know the extraordinary power of restriction and other enzymes in molecular cloning and genetic manipulations.

3. gain hands-on training in various molecular techniques for gene manipulation

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	1			2						3		
CO2				3						3		
CO3				3						3		
CO4				3						3		
CO5				3						3		

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3001	PLANT AND ANIMAL BIOTECHNOLOGY	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology BTSC2001 Enzymology & Metabolism	Contact hour				60	
	Course Co-requisite(s)	BTSC3021 Plant and Animal Biotechnology Lab	Date Approved					
	Alternate Exposure	None						

Course Description:

This course deals with basic methodology associated with animal and plant cell culture methods and therole played by the culture media and kinetics of cell growth. This paper deals with phytohormones and plant cell hybridazation techniques. This paper also explains the properties of animal stem cells and induced pluripotency. This course gives a detailed view on human reproductive systems and transgenic techniques.

Course Educational Objectives:

- Explain the principles, practices and applications of plant tissue culture and thereby, describe clear procedures for the maintenance of sterile condition and maintenance of plant tissue cultures. Apply and demonstrate the diverse purposes and practices of molecular breeding in plants.
- Introduce the techniques of cell, tissue and organ culture, stem cells and induced pluripotency.
- Learn about basics and advanced developments in reproductive biology.
- Different practices employed in the productionof transgenic animals and gene therapy.

UNIT-I **No. of Hours:10**

Phytohormones, types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropropagation: advantages and disadvantages. Organogenesis and somatic embryogenesis. In vitro haploid production: Androgenic and Gynogenic methods. Transgenic plants: Production methods and its applications.

UNIT-II **No. of Hours:10**

Protoplast Isolation and fusion methods somatic hybridization, identification and selection of hybridcells and its limitations. Cybrids, Somaclonal variations. Plant growth promoting bacteria, Nitrogenfixation.

UNIT-III **No. of Hours:12**

Basic techniques of animal cell and tissue culture. Different types of animal cell culture media Natural, synthetic media, cryopreservation of cells, applications of cell culture. Stem cells: Properties, types and applications.

UNIT-IV **No. of Hours:10**

Causes of infertility in male and females. super ovulation, embryo transfer. In vitro Fertilization methodology, Artificial insemination, Immuno contraception.

UNIT-V **No. of Hours:8**

Production of transgenic animals -by microinjection, retroviral, vector method and embryonic stem cellmethod. Animal cloning – methodologies and its applications. Gene Therapy-Ex vivo and In vivo genetherapy.

Recommended Books:

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by R. IanFreshney
2. Molecular Biotechnology by Glick.
3. Gene cloning and DNA analysis an introduction by T.A. Brown (Blackwell).
4. Biotechnology by U.Satyanarayana.
5. Biotechnology by B.D.Singh (Kalyani).
6. Plant Tissue Culture and Practice.by Bhojwani, S.S. and Razdan
7. Plant Biotechnology: The Genetic Manipulation of Plants, by Slater, A., Scott, N.W. & Fowler,M.R.
8. In Vitro Fertilization: The A.R.T. of Making Babies (Assisted Reproductive Technology)(2013) by Geoffrey Sher, Virginia Marriage Davis, Jean Stoess
9. In-Vitro Fertilization 3rd Edition (2011), by Kay Elder, Yves Ménézo, Joyce Harper, JohnHuntriss

Course Outcomes:

On successful completion of this course, students will be able to:

- The process of production of transgenic animals
- The mechanism of animal cloning
- Gene knockdown and knockout methods

CO-PO Mapping:

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3											2
CO2	3											3
CO3	3											2
CO4	3											3
CO5	3											3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3011	General Immunology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	None	Contact hour				60	
	Course Co-requisite(s)	BTSC3031 General Immunology Lab	Date Approved					
	Alternate Exposure	None						

This course has been designed to introduce the field of immunology by understanding the basic immunological concepts. The course will offer a general idea of different types of immunity in human body, structure and functions of immune organs, basics of different immune cells, their development, structure, and functions under regular condition. Upon completion of this course students will be able to apply these ideas to new problems related to immunological disorders.

Course Objectives:

1. An understanding of basic immunological concepts
2. An appreciation of how the experiments are designed and interpreted to test scientific hypothesis
3. Intellectual skills to read critically the current immunologic literature
4. In depth knowledge on the biological functions and regulation of a type of immune response
5. An understanding of the immune response against immunogenic disorders

UNIT- I **No. of Hours: 8**

Innate immunity and Adaptive immunity. Immunological barriers. Pattern recognition receptors. Toll like receptors. Cells of the immune system - lymphocytes, macrophages, neutrophils, NK, NKT cells and Innate lymphoid cells. Structure and functions of lymphoid organs. Antigens, Immunogens, Adjuvants, Haptens. Factors contributing to antigenicity. Superantigens. Epitopes.

UNIT- II **No. of Hours: 8**

B cell development, maturation, activation, and memory. BCR. Types of B cells Classification, Structure, and functions of antibodies. Antigenic determinants-isotypes, allotypes and idiotypes. The generation of antibody diversity. Recognition of antigen by B-Cell receptors Effector cell mechanisms of humoral response.

UNIT- III **No. of Hours: 8**

T cells-development, maturation, activation, and memory. TCR and Types of T cells. MHC restriction. Recognition of antigen by T-Cell receptor. MHC & HLA-Types, structure, and properties. Organization of MHC genes. Antigen processing and presentation. Cell mediated immune responses. Regulation of immune response.

UNIT- IV **No. of Hours: 8**

Complement system -Classical, alternate and MBL pathways, biological functions and regulation. Cytokines and receptors-Properties, biological functions and signalling pathways. Inflammasomes. Inflammation.

UNIT- V **No. of Hours: 8**

Tolerance and factors involved in maintaining tolerance. Autoimmune diseases - Organ specific and Systemic. Hypersensitivity - Mechanism and pathophysiology of different types of hypersensitivity.

Course outcomes: After completion of this unit, the student will be able to
• Distinguish between innate immunity and acquired immunity
• Describe the basic structural and functional components of the immune system
• Understand the development processes of T cells and B cells
• Factors that contribute to the development of autoimmunity
• Distinguish between different types of Delayed type hypersensitivity

Recommended Books:

1. Immunology: A Short Course (2021). by Richard Coico. Wiley-Blackwell
2. Cellular and Molecular Immunology (2021). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Elsevier – Health Sciences
3. Kuby Immunology (2019). J Punt., S Stranford., P Jones., & J. A. Owen. New York: W.H. Freeman.
4. Roitt's Essential Immunology (2017). Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. Wiley- Blackwell
5. Janeway's Immunobiology (2016). Murphy, K., Weaver, C. New York: W. W. Norton & Company.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1			3						3	2		1
CO2			3						3	2		1
CO3			3						3	2		1
CO4			3						3	2		1
CO5			3						3	2		1

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3021	PLANT AND ANIMAL BIOTECHNOLOGY LAB	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology BTSC2001 Enzymology & Metabolism	Contact hour				40	
	Course Co-requisite(s)	BTSC3001 Plant and Animal Biotechnology	Date Approved					
	Alternate Exposure	None						

Course Description: This course provides hands-on training in basic experiments of plant and animal biotechnology.

Course objectives: Learn good laboratory practices in Plant and Animal tissue culture laboratories. Acquire skills and hands on experience in basic plant tissue culture using various explants. Perform basic experiments in cell viability and growth. Gain knowledge in preparation of glycerol stocks.

List of Experiments:

1. Preparation of simple growth nutrient (Knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige& Skoog's medium)
3. Sterilization and preparation of various explants for plant tissue culture.
4. To demonstrate various steps of Micropropagation.
5. Isolation of protoplasts from Leaf.
6. Preparation of animal cell culture media
7. Preparation of single cell suspension cultures from spleen
8. Enumeration of cells in culture by haemocytometer
9. Preparation of glycerol stocks

Recommended Books:

1. Plant cell culture - A practical approach by Dixion RA.
2. Plant tissue culture - Theory and practice by Bhojwani, S.S.
3. Biotechnology: A laboratory course by Becker, J.M.
4. Animal cell culture - A practical approach Ed. By John R.W. Masters (IRL Press).
5. Animal cell culture techniques, Ed. Martin Clyenes (Springer).
6. Culture of Animal cells; A manual of Basic techniques by R. Ian Freshney

Course outcomes:

On completion of this course, students will be able to perform basic experiments on plant and animal biotechnology and help them to take up plant and animal biological research as well as placement in relevant biotech industry.

CO-PO Mapping:

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3											2
CO2	3											3
CO3	3											2
CO4	3											3
CO5	2											3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3031	General Immunology Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	None	Contact hours				40	
	Course Co-requisite(s)	BTSC3011 General Immunology	Date Approved					
	Alternate Exposure	None						

This course enables the students to gain knowledge on various basic techniques of immunology and get a hands-on exposure to the basic components of immunology involving processing of immune cells and antigen-antibody interaction. It enables the students to learn about the qualitative and quantitative determination of different immune reactions.

Course objective

1 To learn how to prepare blood smears
2 To learn and peripheral blood mononuclear cells using a density-interface centrifugation
3 technique, from defibrinated or anticoagulated human blood.
4 To identify human blood group
5 To learn and familiarize with the techniques in the quantitation of antibodies present in the serum
6 by precipitation methods
7 To learn quantitative estimation the antibody using enzyme conjugates

Experiments:

1. Preparation and examination of peripheral blood smears
2. Isolation of peripheral blood mononuclear cells by density gradient centrifugation
3. Cell Lysis and Protein Extraction
4. Blood grouping
5. Double Immuno diffusion
6. Radial Immunodiffusion
7. ELISA

Course outcomes:

On completion of this course, students will be able to perform experiments of separation of mononuclear cells, human blood group identification, Quantitative and qualitative estimation of antibodies.

Recommended books:

1. Biotechnology: A laboratory course by JM Becker, 2nd Edition, Wiley publishers.
2. Molecular Cloning: A laboratory manual by Gren & Sambrook, 4thEdition, CSHL Press
3. Laboratory manual in Biochemistry by JJayaraman, 2ndEdition, Wiley Eastern limited.
4. Biochemistry - a laboratory courses by JMBeckar, 2nd Edition, Academic Press.
5. Immunology methods manual - The comprehensive source book by I Lefkovits.
6. Manual of clinical laboratory immunology by NR Rose.
7. The experimental foundations of modern immunology by WR Clark.
8. Laboratory Immunology by Bradshaw U.

	Programme Objectives (POs)												PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**					**1**	**2**	**3**	4
CO1			3										3	2		
CO2			3										3	2		
CO3			3										3	2		
CO4			3										3	3		
CO5			3										3	3	1	
CO6			3										3	3	2	
CO7			3										3	3	2	

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	***Course Title***	*L*	*T*	*P*	*J*	*S*	*C*
	BTSC3041	Industrial Biotechnology	*3*					*3*
	Course Owner	Department of Biotechnology	***Syllabus Version***				*1.0*	
	Course Pre-requisite(s)	BTSC 2041 Molecular Biology & rDNA Technology	***Contact Hours***				*60*	
	Course Co-requisite(s)	BTSC 3051 Industrial Biotechnology Lab	***Date Approved***					
	Alternate Exposure	None						

Preamble:

The significance of this course is to provide students with effective theoretical knowledge and principles relevant to Industrial Biotechnology. As per the course content, one can understand the diversity of microorganisms and search for strains from the natural environment, which are able to produce novel or unusual products of high commercial value. The main task of the industrial biotechnologist is to develop procedures for obtaining new microbial metabolites by rapid and reliable isolation and screening procedures and metabolic engineering. Understanding various principles of reactor designs, scale-up and downstream processing is primary and essential in large-scale production of various biologically active principles or products. This course also provides the knowledge about the importance of immobilization of enzymes/ cells and their applications.

COURSE OBJECTIVES

1. To educate students about the fundamental concepts of industrial biotechnology and its related applications, thus preparing them to meet the challenges of the new and emerging areas of biotechnology industry.
2. To develop skills about the screening and maintenance of industrially useful microorganisms, the sterilization kinetics, fermentation processes, reactor design, product development and recovery.
3. To improve the base knowledge and to bring awareness on various industrial processes.

UNIT- I **Number of Hours: 8**

Title: Screening, Isolation of Cultures and Strain Improvement

Screening, isolation and maintenance of microbes, preservation of isolated pure cultures. Sterilization of media: Batch and Continuous sterilization. Strain selection, Strain improvement: physical and chemical methods

UNIT – II **Number of Hours: 8**

Title: Bioreactors, Fermentation and Mass Transfer

Bioreactor: design and parts of bioreactor, types of bioreactor, Batch reactor, Continuous reactor, fixed bed reactor, fluidized bed reactor, trickle fermenter. single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up.

UNIT – III **Number of Hours: 8**

Title: Downstream Processing

Downstream processing: solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Isolation and Purification of proteins.

UNIT- IV **Number of Hours: 8**

Title: Production of industrial chemicals, biochemicals and chemotherapeutic products

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Ethanol, hydrogen, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; anti-cancer agents.

UNIT – V **Number of Hours: 8**

Title: Microbial Products of Industrial Interest and Application

Microbial products of pharmacological interest, steroid fermentations and transformations. Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing. Application of immobilized enzymes in medicine and industry.

Course Outcomes or Learning Outcomes:

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

- isolate and screen the microorganisms from the soil, air or water and preserve the selected strains.
- understand mass transfer and scale up processes.
- gain knowledge about the design parameters and operations of the bioreactors.
- be acquainted with the protein purification process.
- understand the important microbial / industrial processes in industrial chemicals, solvents, insecticides etc.
- understand the transformations and metabolic engineering of biologically active molecules.
- know the immobilization techniques.

Recommended Books:

1. Modern Industrial Microbiology and Biotechnology, Second Edition 2nd Edition (2017). by Nduka Okafor,Benedict C. Okeke.
2. Casida LE. (2016). Industrial Microbiology.2nd edition. New Age International Private Limited.
3. Crueger W and Crueger A. (2017). Cruegers Biotechnology: A Textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Patel AH. (2015). Industrial Microbiology.2nd edition, Laxmi Publications-New Delhi.
5. Stanbury PF, Whitaker A and Hall SJ (2016). Principles of Fermentation Technology.3rded, Butterworth-Heinemann Ltd.

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1		2										2
CO2		2										2
CO3		2										2
CO4		2										2
CO5		2										2

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3051	Industrial Biotechnology Lab			2			1
	Course Owner	Department of Biotechnology	**Syllabus Version**				1.0	
	Course Pre-requisite(s)	Biology and Chemistry Knowledge at Intermediate level	**Contact Hours**				40	
	Course Co-requisite(s)	BTSC 3041 Industrial Biotechnology	**Date Approved**					
	Alternate Exposure	*None*						

COURSE OBJECTIVES

1. *To train the students in isolation and screening of useful microorganisms from their native habitats.*
2. *To make students gain expertise in industrial methods such as batch fermentation, production and estimation of enzymes and alcoholic beverages.*
3. *To improve the base knowledge and to bring awareness on various industrial processes.*

List of Experiments

1. Selective isolation of actinomycetes and fungi from soil samples.
2. Microbiological assay of an antibiotic including the construction of standard curve.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Fermentative production of protease by shake flask method.
5. Fermentative production of amylase by shake flask method.
6. Immobilization of an enzyme by gel entrapment.
7. Immobilization of whole cells for enzyme production by gel entrapment.
8. Production of alcohol by *Saccharomyces cerevisiae* and its estimation.
9. Production of citric acid by *Aspergillus niger*.
10. Production of red wine from grapes.
11. Production of Glutamic acid by *Corynebacterium glutamicum*.

Course Outcomes or Learning Outcomes:

By the end of this practical course, the student will be able to :-

• Gain knowledge to investigate, design and conduct experiments, analyse and interpret data, and apply the laboratory skills to isolate a potent production strain.

• Be acquainted with immobilization skills to produce enzymes and able to demonstrate there usability of enzymes under in vitro conditions.

• Gain knowledge on the downstream processing of metabolites.

• Gain hands on experience in fermentation of industrially important enzymes, organic acids, alcohol and wine.

Recommended Books:

1. A Manual of Industrial Microbiology and Biotechnology by AL Demain et al., 3rd Edition, ASM

Press.
2. Immobilization of Enzymes and Cells: Methods in Biotechnology by GF Bickerstaff, Volume I, Springer Publishers.
3.Principle of fermentation technology by Stanbury by PF Stanbury, A Whitakar, and SJ Hall, 2nd Edition, Elsevier.
4. Biotechnology: A Laboratory Course by JM Becker, Academic Press.
5. Lab Manual in Biochemistry by Jayaraman, Wiley Eastern Limited.

	Programme Objectives (POs)								**PSOs**			
	1	2	3	4	5	6	**7**	**8**	1	**2**	**3**	**4**
CO1		2					2					2
CO2		2					2					2
CO3		2					2					2

1-Low Correlation; 2- Medium Correlation; and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2071	General Microbiology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology	Contact hour				60	
	Course Co-requisite(s)	BTSC2091 General Microbiology Lab	Date Approved					
	Alternate Exposure	None						

This course has been designed to introduce the field of microbiology by studying different kinds of microorganisms with special emphasis on microbial diversity. By studying this course, the student develops knowledge on the techniques used to isolate and identify the microorganisms from natural habitats. Moreover, this course imparts knowledge about the morphological, and physiological features among diverse microbial species and also different kinds of methods to control microbes. Furthermore the general microbiology course inculcates the student's about the virus classification, structure, and cultivation of viruses in laboratory.

Course Objectives:

1. To familiarize with the historical foundations in the field of microbiology and to understand the classification system of bacteria and archaea.
2. To impart knowledge on microscopy techniques and to gain knowledge on the sterilizing agents.
3. and concepts of culture dependent and independent techniques
4. To familiarize with the polyphasic approaches employed to characterize the microorganisms and bacterial growth kinetics
5. To impart knowledge about vegetative thalli structures and reproductive structures of algae and fungi.
6. To understand the clinical manifestations of protozoans and to know about the viral structures

UNIT-I **Title: Introduction to microbiology** **No. of Hours: 8**

Historical Foundations of Microbiology; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Beijerinck, Winogradsky, Edward Jenner, Ivanowski; Golden era of microbiology. Whittaker's and Carl Woese's three kingdom classification systems, Bergey's classification of bacteria & Achaea

UNIT-II **Title: Microscopy** **No. of Hours:8**

Microscopy - Principles and applications of light, phase, fluorescent and electron microscopy, confocal microscopy; Ultra structure of microorganisms (bacteria, algae, fungi and protozoa) and Acellular microorganisms (Viruses, Viroids, Prions); Preparation and staining of specimens; Fixation, Dyes, simple and differential staining; Sterilization - physical, chemical and radiation methods.

UNIT-III **Title: Isolation of pure cultures** **No. of Hours:8**

Isolation of pure cultures- Culture dependent techniques (spread plate, streak plate and pour plate methods) Characterization and Identification of bacteria based on morphology, biochemical

characteristics, Phage typing and ribotyping; culture independent technique; Types of nutrient media for bacterial growth, microbial growth – principles & kinetics.

UNIT-IV **Title: General features of algae and fungi** **No. of Hours:8**

General characteristics of algae and blue green algae, thallus organization, pigments, flagella, eyespot food reserves; General characteristics of fungi, fungal cells and vegetative growth, multihyphal systems, Types of culture media for cultivation of algae and fungi, Economic importance of algae & fungi.

UNIT- V **Title: Viruses** **No. of Hours:8**

General characteristics with special reference to *Plasmodium*, *Entamoeba*, *Leishmania*; Virus taxonomy, ICTV regulations, Baltimore system of virus classification, virus structure, and cultivation of virus-Embryonated egg, animal cell culture methods; TMV, lytic and lysogenic cycle (T4 and λ phages).

Learning Outcomes:

After completion of this unit, the student will be able to

- Learn about the features, clinical manifestations of *Plasmodium*, *Entamoeba*, *Leishmania*
- Learn the regulations issued and nomenclature system followed by ICTV.
- Learn the characteristics used to classify the viruses and virus structures
- Lear about the multiplicity of infection in phage particles.

Textbook(s):

1. Microbiology – An Introduction (2020) by Tortora, Funk & Case, 13th Edition, Pearson education.
2. Microbiology by Pelczar, TATA McGraw Hill Press
3. Textbook of Microbiology by Ananthanarayan & Paniker's, 10th Edition

Reference Book(s):

7. Brock Biology of Microorganisms (2018) by Michael T Madigan & Kelly S Bender, 15th Edition,
   Pearson education
8. Microbiology: Principles and Explorations (2018) by JG Black, 10th Edition, John Wiley & Sons.
9. Prescott's Microbiology, (2019) 11th Edition, McGraw-Hill Publishers
10. Microbiology: An Evolving Science (2020) by Joan L. Slonczewski, 5th Edition, Norton & Company
11. Microbiology with Diseases by Body System, (2017) by Bauman Robert W, Pearson education

Journals(s):

1. Nature Microbiology, Nature Publishing Group, ISSN: 20585276
2. Nature Reviews Microbiology, Nature Publishing Group, ISSN: 17401526, 17401534;
3. Annual review of microbiology, Annual Reviews Inc., ISSN: 00664227, 15453251;

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1						1			1			
CO2						1	2		1	2		
CO3						2	3			1	2	
CO4						3	2			1	2	3
CO5							3			2	3	

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2081	**Classical Genetics**						
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology	Contact hours				60	
	Course Co-requisite(s)	None	Date Approved					
	Alternate Exposure	None						

Hours per week: 04 **Credits: 04**

Course Objectives

1. To introduce the concepts of Mendelian genetics and Chromosome Theory of Heredity.
2. To familiarize students with deviation from Mendelian Genetics.
3. To impart knowledge concerning linkage and crossing over and utilize the information to perform gene mapping.
4. To describe different types of chromosomal aberrations and explain their role in evolution.
5. To introduce the concepts of pedigree analysis and statistical tool for testing genetic hypothesis.

UNIT - I **Title: Patterns of Inheritance** **No of Hours: 9**

Mendelism & Chromosome Theory – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the significance and history of Mendelian genetics.
- Understand the Chromosome Theory of Heredity
- Understand the concept of various inheritance patterns

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II **Title: Extension of Mendelism** **No of Hours: 9**

Extension of Mendelism – Sex-linked, Autosomal and cytoplasmic inheritance, extranuclear inheritance Mitochondrial and chloroplast inheritance. Deviation from Mendel's Dihybrid phenotype,. Allelic Variation & Gene function – Multiple allele, Genetic interaction, Epiststic interactions, Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand different types of deviation from Mendelian Genetics
- Understand the concept of Penetrance and expressivity

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - III **Title: Crossing over and linkage** **No of Hours: 9**

Linkage & Crossing over - Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson & Punnet's Coupling & Repulsion hypothesis Chromosome theory of Linkage, kinds of linkage, linkage groups. Determination of linkage groups, determination of map distance, determination of gene order, cytological mapping. Types of Crossing over, mechanism of Meiotic Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the principle crossing over and linkages.
- To perform gene mapping using the crossing over data.

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - IV **Title: Chromosomal aberrations** **No of Hours: 9**

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants, Aneuploidy in Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand different types of structural and numerical chromosomal aberrations.
- To understand the role of chromosomal aberrations in evolution.

UNIT - V **Title: Pedigree analysis and testing genetic hypothesis** **No of Hours: 9**

Pedigree analysis –Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance. Formulating & Testing Genetic Hypothesis –problems of Sex-linkage, problems of genes with Multiple alleles, problems of gene interactions, Chi-square, t-test.

Learning Outcomes:

After completion of this unit, the student will be able to

- Perform the pedigree analysis for different genetic disorders.
- Perform statistical analysis such as t test and Chi-square test.

RECOMMENDED BOOKS:

1. Medical Biotechnology by Bernard Glick, Terry L delovitch, Cheryl L Patten
2. Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
4. An introduction to Human Molecular Genetics by Pasternak et al., Wiley Pubs
5. Human Chromosomes by Miller & Tharman, Springer Publishing Company
6. Genes XII, by Lewin B, Pearson India
7. Elements of medical Genetics by Turnpenny and Ellard, Churchill Livingstone

	Programme Objectives (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	13	2	3
CO1									3				2		
CO2									3				2		
CO3									3				2		
CO4									3				2		
CO5									3				2		

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2091	General Microbiology Lab	0	0	2	0	0	1
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology	Contact hours				40	
	Course Co-requisite(s)	BTSC2071 General Microbiology	Date Approved					
	Alternate Exposure	None						

This course enables the students to gain knowledge on various basic techniques of microbiology and to understand, identify and to characterise microbes by staining and biochemical studies. It enables the students to learn about the growth of microorganisms and sensitivity of the microbes towards antimicrobials, and metals etc.

Course Objectives

1. To familiarize with good laboratory practices and biosafety levels.
2. To demonstrate the methods for isolation of bacteria from soil by various isolation procedures.
3. To identify the morphology of bacteria by microscopic observation and enumeration of bacterial growth.
4. To determine the sensitivity of the microorganisms towards chemicals.
5. To familiarize with the morphological features of microorganisms by microscopic observations.

List of Experiments

1. Culture media preparation methods
2. Techniques for isolation of pure cultures
3. Staining methods: - Simple, Gram, & spore
4. Enumeration of bacterial growth curve
5. Detection of motility by hanging drop method
6. Antibiotic sensitivity test by disc / well diffusion methods
7. Observation of permanent slides of protozoa, fungi and algae

Course outcomes: After completion of this unit, the student will be able to

- Learn basic microbiology laboratory safety methods and aseptic techniques.
- Perform the streak-plate and/or the spread plate inoculation procedure to separate the cells of a mixed culture so that discrete colonies can be isolated.
- Perform biological staining by smear preparation for simple, gram and spore staining
- Conduct an experiment for generating a bacterial growth curve.
- Perform the disc–agar diffusion technique for determination of antimicrobial activity of chemotherapeutic agents
- Identify morphological features of fungi, protozoa and algae

Text Books

1. Microbiology: A Laboratory Manual (2020) by James G. Cappuccino 12th Edition Pearson Publishers
2. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education
3. Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe, Morton Publishing Company
4. Benson's Microbiological Applications Laboratory Manual in General Microbiology

(2012)by Alfred Brown & Heidi Smith 13th edition, McGraw-Hill Publishers.

1-

	Programme Objectives (POs)								PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**
CO1						1			1			
CO2							2			1		2
CO3						2	3			2	3	
CO4						3	3		3		2	
CO5						3				2		

Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2101	**Classical Genetics Lab**						
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC 2081 Classical Genetics	Contact hours				40	
	Course Co-requisite(s)	BTSC1021 Cell Biology	Date Approved					
	Alternate Exposure	None						

To make the students learn how cells divide, types of cell division and different stages in each type of cell division.

Course Objectives:

1. To make the students aware of the dihybrid cross, and the variations of it.
2. To make the students understand the arrangement of chromosomes, the distinctive features of human chromosomes, and how the silencing of chromosomes occurs in buccal smears.
3. To make students learn to grow cells, arrest them during cell division and check the ploidy level of chromosomes.

Experiments:

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body - Rhoeo translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

Course outcomes:

After completion of this unit, the student will be able to

- Get acquainted in laboratory techniques of genetics
- Learn and identify different cell cycle stages
- Prepare Pedigree charts
- Understand the concept of polyploidy

Recommended Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. 8th edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. 5th edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. 9th edition, Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. 3rd edition, Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. 9th edition

	Program Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1					3							
CO2					3				2			
CO3					3				2			
CO4					3				2			
CO5					3				2			

Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC 2061	Plant and Animal Physiology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)		Contact hours				60	
	Course Co-requisite(s)		Date Approved					
	Alternate Exposure							

Preamble: This course aims at understanding how the living world is classified, along withgaining knowledge about flow of energy in and out of the biological systems. Main purpose of this course is to enlighten the student about red-ox reactions occur in eukaryotic and vertebrate systemsin fixing as well as dissipating the free energy. Animal physiology, on the other hand, discusses machinery evolved in animals, including digestive, circulatory and nervous systems, in utilizing thefood produced by plants.

Course Objectives: 1.To understand basic principles of important physiological processes like water relations & photosynthesis in plants
2.To understand the concept of photorespiration and phytohormone regulation and applications
3.To understand the mechanism of gas, nutrient transport and respiration, pH balance and their role in homeostasis.
4.Students will be familiar with membrane potential, membrane transport, resting potential, transmission of information through neuron and the role of action potential and graded potential
5.To learn the organization of digestive and excretory system, its control mechanism. pH balance by renal system. Mechanism of food digestion and assimilation. Transport and distribution of nutrients in the body.

UNIT-I

Water relations: Cell water potential, soil plant atmosphere continuum. Photosynthesis: Light absorption, emission, energy transfer, Z-scheme of photosynthesis, electron transfer, photophosphorylation, CO_2 fixation in C3, C4, CAM plants, environment and its impact on photosynthesis.

UNIT-II

Photorespiration: Respiration complexes, structure, function and regulation; cyanide resistantrespiration. Plant hormones: Biosynthesis, transport, regulation and applications.

UNIT-III

Composition of blood, coagulation of blood and fibrinolysis. Circulatory systems: general plan, electrical and mechanical properties of myogenic and neurogenic hearts. Heart - cycle including electrocardiogram, Hemodynamics. Cardiovascular response to extreme conditions like exercise, diving and hemorrhage. Neural control of cardiovascular system. Respiratory system: respiratory pigments, transport of gases in blood, regulation of body pH, respiratory response to extreme conditions like hypoxia, diving and exercise. Physiology of respiration and neural control ofbreathing.

UNIT-IV

Structure of nerve cell, Origin of membrane potential, Mechanism of propagation of nerve impulse in unmyelinated and myelinated nerve fibres. Neuro transmitters. Structure and organization of muscle cells. Biochemical changes associated with muscle contraction and relaxation.

UNIT-V

Gastrointestinal system: Functional structure of digestive glands - salivary glands, pancreas, liver, gastric and intestinal wall glands- neural and hormonal regulation of secretion of digestive juices. Digestion of food nutrients in different parts of the alimentary canal in animals. Absorption of food- the molecular structure of the absorptive surface. Assimilation of food, egestion. The peristaltic movements, their regulation and significance.

Excretory system: Functional anatomy of kidney - the nephron and its functions, the mechanism of urine formation and its concentration - the countercurrent theory, electrolyte balance, acid-base balance. The feedback and hormonal control of renal functions. Micturition

Course outcomes:

After completion of this course, the student will be able to

1. Importance of pigments in harvesting sun's energy; cyclic and non-cyclic photo-phosphorylations in generating useful form of energy
2. Explain how ion channels work and differentiate voltage gated and ligand gated channels
3. Mechanisms of producing action potential in nerve cells and its progression from CNS to theorgan
4. How actin and myosin fibres organized in muscle cells and bring about muscle contractionand relaxation
5. Understand about the importance of different glands and their secretions in food digestion

Recommended Books:

1. Introductory Plant Physiology by GR Noggle & GJ Fritz, 2nd Edition, PHI learning Pvt.Ltd.,New Delhi.
2. Text book of Medical Physiology by AG Guyton & JE Hall, 11th Edition, Harcourt, Asia.
3. Medical Physiology by Sembulingam. Human Physiology by Ross & Wilson.
4. Text book of Medical Biochemistry by Chaterjee, Jaypee.
5. Harper's Biochemistry by RK Murray *et al.,* 30th Edition, McGraw Hill-Lange Publishers.

	Program Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1					3		1					3
CO2					3		1		2			3
CO3	2				3					3	2	
CO4	1				3					3		
CO5	2				3					1	3	1

Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC 2111	Marine Biotechnology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC2061 Plant and Animal Physiology	Contact hour				40	
	Course Co-requisite(s)	BTSC3001 Plant and Animal Biotechnology	Date Approved					
	Alternate Exposure	Culture ponds visit						

This course aims at understanding how the living world can meet the food requirements. This course provides knowledge about ocean profile and rotation of required nutrients between ocean and its surrounding atmosphere. Management of aqua ponds, preservation of the crop after harvesting, gaining quality assurance during preservation for exports and to know about the measures being implemented by different Govt. agencies for the upliftment of fisher folk becomes possible with the present study.

Course Objectives:

1. To gain fundamental knowledge of biotic and abiotic features of marine habitat.
2. An understanding of basic concepts about aquaculture practices.
3. General understanding about the maintenance of economically important aquatic animals to meet the food requirements of the living world
4. To gain intellectual skills for the management of aqua ponds.
5. Gain knowledge about the sustainability of marine environment and an emphasis towards entrepreneurship of fisher folk.

UNIT- I **Title: Marine Environment:** **No. of Hours: 8**

Chemical Composition of sea water.Biological features of the marine environment, Estuaries, Tropical shores and brackish water.Biogeo chemical cycles in marine ecosystem.

Learning Outcomes:

After completion of this unit, the student will be able to

- Gain knowledge about physicochemical and biological features of different aquatic habitats.
- Know about the cyclic movements of nutrients between oceanic water and its surrounding atmosphere.

Pedagogy tools: Blended learning, Case lectures, video lectures, self-reading

UNIT- II **Title: Aquaculture Methods and Practices:** **No. of Hours: 8**

General aquaculture practices - fish, shrimp and crab culture practices, induced breeding techniques - Hypophysation and Eyestalk oblation. Management of aquaculture farms – Feeding schedules, feed formulations, wet feeds and dry feeds.Fish byproducts.Economically important aquatic resources.

Learning Outcomes:

After completion of this unit, the student will be able to

- Know about the maintenance of economically important aquaculture ponds.
- Understand to produce aqua products to meet the food requirements.

Pedagogy tools: Blended learning, Case lectures, video lectures, self-reading

UNIT- III **Title:Mariculture**: **No. of Hours:8**

Culture of Lobsters, Mussel, Pearls, Oysters and Sea-weeds. Biology of estuaries – Estuarine adaptations, Coral reef communities and conservation methods.

Learning Outcomes:

After completion of this unit, the student will be able to

- Know the culture of different economically important sea products.
- Understand how sea creatures are adapted for estuarine habitats.
- Know about the importance of coral reefs in providing shelter to various sea animals.

Pedagogy tools: Blended learning, Case lectures, video lectures, self-reading

UNIT- IV **Title: Post harvesting and preservation technologies:** **No. of Hours:8**

On board handling, drying and dehydration, salt curing, smoking, marinades, freezing, freeze drying, modified atmosphere packaging. Quality assurance.

Learning Outcomes:

After completion of this unit, the student will be able to

- Get aware of the preservative technologies of sea food after harvesting.
- Know about acquiring quality assurance of sea food during packaging.

Pedagogy tools: Blended learning, Case lectures, video lectures, self-reading

UNIT- V **Title: Coastal Zone Management:** **No. of Hours:8**

Marine pollution- Causes and preventive measures, Role of government agencies – Role of NABARD and other central government agencies in the upliftment of fisher folk. The Marine Products Exports Development Authority (MPEDA), Integrated coastal zone management, ocean policy and Coastal regulatory zone (CRZ)

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the causes and preventive measures of marine pollution.
- Gain Knowledge about different Govt. agencies involved in upliftment of fisher folk.

Pedagogy tools: Blended learning, Case lectures, video lectures, self-reading

RECOMMENDED BOOKS:

1. Elements of Marine Ecology Fourth Edition R.V. Tait F. A. Dipper 1998

2. Marine fisheries ecology by Simon Jennings, Michel J. Kaiser, 2001 by Blackwell Science Ltd, a Blackwell Publishing company

3. Aquaculture: Farming Aquatic Animals and Plants edited by John S. Lucas, Paul C. Southgate (2012), second edition; (Wiley Blackwell)

4. Post-harvest Technology of Fish and Fish Products by K. K. Balachandran, Dayapublishinghouse.

5. Marine Fish Culture (1998) By John W. Tucker Jr. Springer publishers

6. Fish and Fisheries (2006) by By B. N. Yadav, DAYA publishing house

7. Induced Fish Breeding: A Practical Guide for Hatcheries (2017) By Nihar Ranjan Chattopadhyay, Acdemic Press.

	POs								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1					5				1			
CO2					3				2			
CO3						6					3	4
CO4							7				3	4
CO5				4		6		8	1			

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

BTSC 2121: MEDICAL BIOTECHNOLOGY

	Course Code	Course Title	L	T	P	J	S	C
	BTSC2121	Medical Biotechnology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC2041 Molecular Biology & rDNA Technology	Contact hour				60	
	Course Co-requisite(s)	None	Date Approved					
	Alternate Exposure	None						

Preamble: This course deals about different methodologies involved in the production of various health care products and helps us to understand about the process of tissue engineering. This course enlightens on hybridoma technology and basic and new generation strategies to design vaccines and specific attempts to prepare vaccines against some of the diseases challenging mankind and discusses the application of various molecular probes.

Course objectives:

1. This course helps us to understand about the production and applications of health care products and Hybridomas.
2. Gives a view on the design of vaccines and problems associated with the development of vaccines against some of the diseases.
3. This course critically examines the production of health care products and the mechanism of gene therapy
4. Gives an overview of physiology of reproductive systems and various methodologies developed for *in vitro* fertilization

UNIT – I

Vaccines: Active and Passive Immunization, Designing Vaccines for Active Immunization, Whole-Organism Vaccines, Purified Macromolecule Vaccines, Recombinant-Vector Vaccines, DNA Vaccines, Multivalent Subunit Vaccines. Edible vaccine, RNA vaccine, Strategies for development of vaccines against HIV and Malaria.

UNIT – II

Hybridoma technology - Production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies. DNA in the diagnosis of diseases, Disease diagnosis using Enzyme probes. DNA fingerprinting and DNA profiling and application in forensic medicine.

UNIT –III

Production of recombinant health care products- Insulin, growth hormone, factor VIII, tissue plasminogen activator, Urokinase, interferons, lymphokines and Hepatitis-B vaccine. Nanomedicine - Preparation of Nano particles for target based drug delivery.

UNIT –IV

Gene Therapy: Ex vivo gene therapy- vectors in gene therapy, Therapy for Adenosine deaminase deficiency , Lesch-nyhan syndrome, hemophilia. In vivo gene therapy, gene delivery by viral and non viral vectors, Gene therapy for Cancer, AIDS. Antigene and antisense therapy.

UNIT –V

In vitro fertilization in humans and Cattle- Types and causes of male and female infertility. Sperm collection and Cryopreservation. Artificial insemination, superovulation and Oocyte recovery. In vitro oocyte maturation. Embryo culture and transfer. Amniocentesis, Immunocontraception.

Course outcomes:

On completion of this course, students should be able to:

1. Understand basics of Research and Development in the fields of medical biotechnology
2. Apply knowledge gained on various gene therapies in respective fields of pharmaceutical industry
3. Describe basic science behind the physiology of reproductive systems with special emphasis on IVF process

Recommended Books:

4. Molecular Biotechnology by Glick.
5. Gene cloning and DNA analysis an introduction by T.A. Brown (Blackwell).
6. Biotechnology by U. Satyanarayana.
7. Biotechnology and genomics by P.K. Gupta.
8. Biotechnology by B.D. Singh (Kalyani).

	Programme Objectives (POs)											PSOs
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	1	2							1			3
CO2			2						2			3
CO3				1						1	3	
CO4											3	
CO5												

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3101	Stem Cell Biology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1021 Cell Biology	Contact hour				60	
	Course Co-requisite(s)	BTSC3001 Animal Biotechnology	Date Approved					
	Alternate Exposure	None						

This course offers an opportunity to the students to understand the basics of stem cells, genetic manipulation of stem cells and their applications to various diseases affecting mankind.

Course Objectives:

1. To provide students with basic understanding of Stem Cell biology and their applications
2. Study characteristics of Stem Cells
3. To introduce students to regenerative medicine and tissue engineering.
4. To understand preservation techniques
5. To analyze clinical applicatoins

UNIT- I Title: Introduction to Stem Cells No. of Hours: 8

Introduction to stem cells. Types-Embryonic, adult stem cells. Properties, potency, Differences and similarities in adult and embryonic stem cells. Stem cell niches. Stem cells localized in different tissues-Hematopoietic and Umbilical cord blood stem cells.

UNIT- II Title: Characteristics of Stem Cells No. of Hours:8

Isolation and characterization of stem cells. Stem cell markers. Mechanisms of self-renewal. Epigenetics in stem cells development. Transcriptional control of gene expression in ESC: role of miRNAs, Linc RNAs and RNA binding proteins. Cell cycle regulation in stem cells.

UNIT- III Title: Induced Pluripotent Stem Cells No. of Hours:8

Tissue derivation from different germ layers. Induced pluripotency of stem cells, Markers and factors involved in induced pluripotency. Production of induced pluripotent stem cells-earlier attempts and recent advancements. Applications of iPSCs.

UNIT- IV Title: Applications of Stem Cells No. of Hours:8

Tissue engineering. Autologous and Allogenic Stem Cell Transplantation, Stem cells in gene therapy. Applications of stem cells in regenerative medicine-neurodegenerative diseases, stroke, cardiac disorders, cancer, and diabetes.

UNIT- V Title: Issues with Stem cell Research No. of Hours: 8

Cryopreservation of stem cells. Stem cell banking. Clinical trials in stem cell research. Challenges and promises of stem cell applications in medicine and research. Ethical and regulatory issues

Learning Outcomes:

After completion of this unit, the student will be able to

- Comprehend the concept of stem cells, different types of stem cells
- Describe the concept of stem cell renewal, markers, and cell cycle regulation
- Explain how somatic cells can be made pluripotent and their uses
- Recognize treatment of human diseases connected to stem cell therapy
- Understand the ethical, political and religious issues related to stem cell research

Textbook(s):

1. Stem Cells: From Mechanisms to Technologies by MK Stachowiak & E Tzanakaki, World Scientific publishers
2. Essentials of Stem Cell Biology by R Lanza & A Atala, 3rd Edition, Academic Press
3. Stem Cells: Basics and Applications by KK Deb & SM Totey, Reprint 2009, Tata McGraw-Hill Education.

Journals(s):

1. Cell Stem Cell, Cell Press ISSN: 20585276
2. Stem Cell Research and Therapy, Biomed Central, ISSN:1757-6512

	`Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	3								3			
CO2	3								1	2		
CO3				3						1		
CO4					1					1		3
CO5					2						3	

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

BTSC 3061: BIOINFORMATICS

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3061	Bioinformatics	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC1001 Molecules of Life	Contact hour				60	
	Course Co-requisite(s)	BTSC20712 General Microbiology	Date Approved					
	Alternate Exposure	None						

Preamble:

Bioinformatics is an information technology applied to the management and analysis of biological data with the aid of computers. It is the science of using information to understand biology. It is a field in which biological information collected, compared, studied and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies.

Course objectives:

• The objective of this course is to provide theoretical and practical knowledge of the usage of Computational tools and databases
• This course enables investigation of molecular biology and evolution-related ideas by using various tools and databases.

UNIT –I Title: Introduction to Bioinformatics **No. of Hours: 8**

Scope of computers in biological research. Anatomy of computers and its accessories, types of computers. Introduction to networks (internet) and its applications. Introduction to Bioinformatics, history of Bioinformatics, branches of Bioinformatics, scope and research areas of Bioinformatics

UNIT -II Title: Introduction to Biological databases **No. of Hours: 7**

Introduction to Biological Databases, Classification of Biological Databases, National Center for Biotechnology Information (NCBI), EMBL Nucleotide Sequence Database (EMBL-Bank), DNA DataBank of Japan (DDBJ). Protein Information Resource (PIR), UniProt, TREMBL, Protein Data Bank (PDB), Human genome data base.

UNIT -III Title: Sequence Alignment **No. of Hours: 8**

Concept of Alignment, Pairwise Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Point Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

UNIT -IV Title: Introduction to phylogeny **No. of Hours: 9**

Methods of Phylogeny- Distance based and character-based methods. Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

UNIT -V Title: Searching databases and gene annotation **No. of Hours: 8**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Introduction to genomics, Genome Annotation: Pattern and repeat finding, Gene identification tools. Introduction to proteomics.

Course outcomes:

By the end of this course, the student will be able to

1. Acquire basic knowledge about the bioinformatics and its scope in biology and allied fields that are useful in biological research
2. Gain knowledge of various biological databases and their uses in research.
3. Be acquainted with the sequence alignment and its variants and its role in constructing phylogenetic trees.
4. Be acquainted with the genome annotation and gene identification using dry-lab techniques
5. Comprehend various methods in phylogenetic tree construction and their importance

Recommended Books:

1. Essential Bioinformatics by Jin Xiong, Reprint 2011(Cambridge University Press).
2. Biological Sequence Analysis by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Indian Reprint (Cambridge University Press).
3. An Introduction to Bioinformatics by T. K. Attwood and D. J. Parry-Smith Addison, Reprint 2011 (Wesley Longman, Harlow).
4. Introduction to Bioinformatics by Arthur M. Lesk, 3rd Edition (Oxford University Press).
5. Bioinformatics: Sequence and Genome Analysis by David W. Mount, 2nd Edition (Cold Spring Harbor Laboratory Press).

Co-Po Mapping:

	Programme Objectives (POs)								PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**
CO1								3	2			3
CO2								3		3		
CO3	1							2	2			2
CO4				2				3			2	3
CO5		1		2				2		1		2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC 3071	Fundamentals of Virology	3	0	0	0	0	3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC 2071 Gen Microbiology	Contact hour				60	
	Course Co-requisite(s)		Date Approved					
	Alternate Exposure	None						

This course has been designed to introduce the field of Virology and help students to acquire sufficient level of knowledge, skills and aptitude in all aspects of the epidemiology, prevention, diagnosis and management of infections and communicable diseases related to Viruses. Moreover, this course imparts knowledge about the morphological, and physiological features among diverse plant and animal viruses and also different kinds of control methods .Furthermore, the course inculcates the student's about various techniques to purify, inactivate and diagnostic methods, and cultivation of viruses in laboratory.

Course objectives:

1. The objectives of this course is to introduce field of Virology with special emphasis on history, structure and classification of viruses.
2. To impart knowledge on interaction of virus and host, pathogenesis of various viral infections.
3. To familiarize with the methods to culture viruses, purify and inactivation of viruses
4. To impart knowledge on epidemiology and emerging and remerging of viruses and diagnostic methods for their early detection.
5. To understand the life cycle of clinically important viruses and prions.

Unit - I Introduction and classification of viruses **No. of Hours : 8**

History and development of viruses; Nature, origin of viruses; ICTV; Nomenclature, and Baltimore classification of viruses; Virus structure; capsid symmetry types; quasci equivalence; characteristics of viruses.

Unit - II Isolation and purification of viruses **No. of Hours : 8**

Isolation, cultivation and quantification of viruses; Purification and inactivation of viruses - physical and chemical methods. Animal viruses and their interactions with hosts; Host resistance and viral evasion mechanisms.

Unit - III Molecular mechanism and pathogenesis of viruses **No. of Hours : 8**

Molecular mechanisms of viral pathogenesis with respect to poliovirus, influenza, rotavirus, herpes virus, Hepatitis B Virus and HIV; laboratory diagnosis of viral diseases; new and emerging viruses (Ebola, Zika, Corona), Anti viral agents.

Unit - IV Replication of viruses **No. of Hours : 8**

Virus replication and genome expression, assembly of TMV; replication of ΦX174, coliphage fd, coliphage λ, and T4 bacteriophage. Molecular mechanisms of phage interaction with bacterial cells.

Unit - V Transmission, ecology and pathophysiology of viruses **No. of Hours : 8**

Transmission of viruses (Direct and Indirect) persistence of viruses and their mechanism; Virus ecology evolution and epidemiology; Structure, life cycle and patho physiology of infectious molecules– Prions & viroids.

Course outcomes:

By the end of this course, the student will be able to
1. Acquire knowledge regarding history, origin and evolution of viruses
2. Learn different methods of isolation and cultivation of viruses
3. Understand better the process of viral infections with host
4. Understand the viral evasion mechanisms
5.Understand the molecular mechanism of leading viral pathology and diagnosis and epidemiology of viral infections
5. Understanding the structure and life cycle of Prions and viroids

Recommended Books:

Text books :
1. Microbiology – An Introduction (2020)by Tortora, Funk & Case, 13th Edition, Pearson education.
2. Introduction to Modern Virology, Basic Microbiology by N Dimmock, A Easton & Keith Leepard,6th Edition, John Wiley and Sons
Reference books:
1. Principles of Virology by SJ Flint, 3rd Edition, ASM Press
2. Brock Biology of Microorganisms (2018) by Michael T Madigan & Kelly S Bender, 15th Edition,Pearson education
3. Virology: Principles and Applications by John Carter & Venetia A Saunders, John Wiley & sons.
4. Fundamentals of molecular virology,2nd ed.: Hoboken, NJ: John Wiley & Sons, c2011
Journals(s):
1. Viruses, MDPI Publishing Group, ISSN: 1999-4915
2. Journal of Virology, ASM journals, ISSN: 0022-538X; 1098-5514
3. Annual review of Virology, Annual Reviews Inc., ISSN: 2327056X, 23270578

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1		2										1
CO2		2										1
CO3		1										1
CO4		3										1
CO5		2										1

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3081	**Molecular Diagnostics**						
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	None	Contact hours				45	
	Course Co-requisite(s)	None	Date Approved					
	Alternate Exposure	None						

Molecular Diagnostics are the tools which are based on the principles of Molecular Diagnosis. It is the process of identifying a disease by understanding the molecules, such as proteins, DNA, and RNA, in a tissue or fluid, which forms the markers of the diseases directly or indirectly. Molecular diagnostics is a new discipline that captures genomic and proteomic expression patterns and uses the information to distinguish between two or more conditions at the molecular level. The course focuses on learning and understanding how the various molecular techniques can be developed and utilized in diagnosis.

Course Objectives:

1. To introduce biochemistry and diagnostic tools for different disease models.
2. To familiarize students with genomic instability and gene mapping
3. To impart knowledge concerning molecular tools used for the diagnosis.
4. To describe the properties of a biomarker.
5. To introduce the concepts of immunotherapy and immunodiagnostics.

UNIT-I Title: Introduction to Molecular Diagnostics No. of Hours: 9

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario. Biochemical tests for detection and quantification of sugar, albumin, urea, protein, globulin, vitamin. Biochemistry and diagnostic tests of following diseases - Duchenne Muscular Dystrophy (DMD), Creatine phosphokinase-(CPK), Phenylketonuria-PKU (phenylketone), G6PD deficiency syndrome (G6PD), Mucopolysaccharidosis, Endocrine disorders related to thyroid and reproduction (TSH, T3, T4, Estradiol, Testosterone, LH, FSH).

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the significance and history of diagnostic.
- Understand the biochemistry of different diseases
- Understand the diagnostic procedures of different diseases

Pedagogy tools: Blended learning, self-reading.

UNIT-II Title: Genomic instability & Chromosome mapping No. of Hours: 9

Mechanism and factors involved. Common fragile sites and methods of induction. Heritable fragile sites. Trinucleotide Repeats. Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps. Diseases resulting from Chromosomal Aberrations.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand different mechanism leading to genomic instability

- Understand the molecular mechanism behind the onset of fragile sites
- Understand the molecular mechanism behind triplet repeats and related disorders
- To perform genetic mapping in Drosophila

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT-III Title: Molecular approaches in the diagnosis of diseases No. of Hours: 9

DNA Extraction Methodologies, DNA Quantitation, Capillary Electrophoresis. DNA based Techniques in the diagnosis of diseases-Hybridization, PCR and RT PCR. RNA signature-based methods in detection of different diseases. Protein and DNA microarrays in diagnosis.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the principle of different molecular methods used for the disease diagnosis.
- Understand the principle of different types of PCR.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT-IV Title: Biomarkers in disease diagnostics No. of Hours: 9

FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the role of biomarkers in Disease diagnosis.
- Understand the concept of predictive value and diagnostic value

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT-V Title: Immunotherapy and Immunodiagnostics No. of Hours: 9

HLA typing, Immunotherapy and immunodiagnostics, antigen-antibody binding interactions and assays; antibodies polyclonal and monoclonal antibodies, Immunoassays – types RIA, ELISA, western blotting and specific applications. Immunodiagnostic methods for detection of microbial infections-WIDAL and VDRL.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the significance of Immunotherapy and immunodiagnostics.
- Understand the principle of hybridoma technology.
- Understand the principle of different immunoassays.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

Textbooks:

1. Medical Biotechnology by Bernard Glick, Terry L delovitch, Cheryl L Patten
2. Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D

Reference Books:

1. An introduction to Human Molecular Genetics by Pasternak et al., Wiley Pubs
2. Human Chromosomes by Miller & Tharman, Springer Publishing Company
3. Genes XII, by Lewin B, Pearson India
4. Elements of medical Genetics by Turnpenny and Ellard, Churchill Livingstone

Journals:

1. The Journal of Molecular Diagnostics, ISSN No. 1525-1578.
2. Molecular Therapy – Methods and Clinical Development, ISSN No. 23290501.
3. Journal of Medicinal Chemistry, ISSN No. 15204804

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1	2											2
CO2				3					3			
CO3			1	2								3
CO4	2											2
CO5			3									2

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

	Course Code	Course Title	L	T	P	J	S	C
	BTSC3091	Food Biotechnology	3					3
	Course Owner	Department of Biotechnology	Syllabus version				1.0	
	Course Pre-requisite(s)	BTSC 1001 Molecules of life BTSC2071General Microbiology	Contact hour				60	
	Course Co-requisite(s)	BTSC 2001 Enzymology & Metabolism	Date Approved					
	Alternate Exposure	None						

This course has been designed to offer students a good command on basic principles of food science and technology and applying these understandings to the growing and dynamic needs of food industries. It helps in developing interest to the students in learning the basic methods of food processing, pre-treatments, and packing of ready to eat foods. Also, this course was designed to enlighten the students with various advances, regulatory aspects and safety parameters of food biotechnology.

Course Objectives:

1. To enlighten the levels of comprehension of concepts of food science.
2. To build up the knowledge about the energy concepts in food technology.
3. To familiarize the microbes and their effects on various foods.
4. To impart knowledge on nutritive aspects of foods.
5. To enlighten the advances in food biotechnology and safety measures.

UNIT- I Title: Food and Energy No. of Hours: 8

Energy content of foods - physiological fuel value- review. Measurement of energy expenditure: BMR, RMR, thermic effect of feeding and physical activity, methods of measurement. estimating energy requirements of individuals and groups.

Learning Outcomes:

After completion of this unit, the student will be able to

- Learn fundamentals of food biotechnology
- Basic knowledge of Measurement of energy expenditure
- Estimating energy requirements of individuals and groups

Pedagogy tools: Blended learning, self-reading.

UNIT- II Title: Food Microbiology No. of Hours: 8

Microorganisms in foods. Factors affecting the microbial growth. Microbial food borne diseases. Control measures for food poisoning out breaks. Analysis of microorganisms and their products in foods, role of microbes in fermented foods and genetically modified foods.

Learning Outcomes:

After completion of this unit, the student will be able to

- Learn Factors affecting the microbial growth and Microorganisms in foods
- Understand microbial food borne diseases and their out breaks
- Analysis of microorganisms and their products in foods
- Fermented foods and genetically modified foods.

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- III Title: Nutritive Aspects of Foods; Food Additives No. of Hours: 8

Food groups, functions of foods, nutritive value, composition, preservation and storage of cereals, pulses, nuts & oil seeds, milk and milk products, egg, fish, meat, vegetables, fruits, sugars, fats and oils. Food additives: Synthetic & natural colorants, natural & artificial sweeteners, stabilizers and emulsifiers.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain the concept of food groups
- Explain the role and importance of nutrition in preserved foods
- Understand the various methods of preservation and storage of foods
- Importance of Synthetic & natural food additives
- Role of stabilizers and emulsifiers

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- IV Title: Applications of Enzymes in Food Industry; Food Packaging No. of Hours: 8

Applications of enzymes in food industry: Amylases, Proteases, Renin, Lipases, Glucose isomerase, lactase, pectinase in food industry. Production of bread, cheese, idly, beverages and appetizers. Food packaging methods and materials.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain the applications of enzymes used in various branches of food and feed industry
- Learn mechanism of various enzymatic actions used in specific processes
- Explain the role of enzymes in production of various foods
- Understand State functions of packaging
- Learn various forms of packaging materials in common use contemporarily

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

UNIT- V Title: Advances in Food Biotechnology; Food Safety No. of Hours: 8

Functional foods: Advances in Biotechnology for the production of functional foods; Regulatory aspects of food biotechnology; Future strategies for development of biotechnology-enhanced functional foods for human nutrition. Food safety, evaluation of food quality and quality assurance (PFA, FSSAI, HACCP, ISO and FSO systems).

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand the recent advances in Biotechnology for the production of functional foods
- Explain the regulatory aspects of Food Biotechnology
- Explain the future strategies for development of biotechnology-enhanced functional foods
- Understand various food safety parameters

Pedagogy tools: Blended learning, case lectures, video lectures, self-reading

Textbook(s):

1. Text book of Human Nutrition by Mehtab S Bamji, 3rd Edition, Oxford and IBH publishing Pvt. Ltd.
2. Food Packaging: Principles and practice by GL Robertson, 3rd Edition, Taylor and Francis group.
3. Food Science by B Srilakshmi, 2nd Edition, New Age International Publishers Pvt. Ltd.
4. Fundamental Food Microbiology (2013) by Bibek Ray, 5thEdition, CRC Press.
5. Food Microbiology (2015) by Martin R Adams, Royal Society of Chemistry; 4th Edition

Reference Book(s):

1. Food Microbiology by Frazier, 4th Edition, WC McGraw-Hill Incorporation.

2. Food Chemistry by Meyer LH, Affiliated East and west Press Ltd., Bombay, 1987
3. Food Microbiology: An Introduction (2017) by Thomas J. Montville *et al.,* 4th Edition, ASM Press
4. Food Microbiology: Fundamentals and Frontiers (2012) by Michael P. Doyle 4thEdition, ASM Press
5. Food Microbiology- Principles into Practice; Volume 1: Microorganisms related to foods, foodborne diseases, and food spoilage; Volume 2: Microorganisms in Food Preservation and Processing by Osman Erkmen & T. Faruk Bozoglu, Wiley publishers, 2016.

Journals(s):

1. Annual review of food science and technology, Annual Review Inc. ISSN: 19411413, 19411421
2. Food Microbiology, Elsevier Publishers, ISSN: 0740-0020
3. International Journal of Food Microbiology, An official journal of the International Committee on Food Microbiology and Hygiene (ICFMH) of the IUMS, Elsevier Publishers, ISSN: 0168-1605

	Programme Objectives (POs)								PSOs			
	1	2	3	4	5	6	7	8	1	2	3	4
CO1							2		2			
CO2				2					2			
CO3		3							1			
CO4							2		2			
CO5							2		3			

1-Low, 2- Medium and 3- High Correlation

APPROVED IN:
BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:
English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.