



**MOTHER TERESA WOMEN'S UNIVERSITY**  
**KODAIKANAL – 624 102**

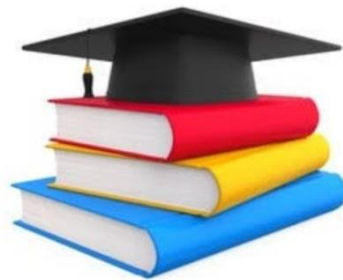


**DEPARTMENT OF BIOTECHNOLOGY**

**B.Sc. BIOTECHNOLOGY**

**Curriculum Framework, Syllabus, and Regulations**

**(Based on TANSCHHE Syllabus under choice Based Credit System – CBCS)**



**(For the candidates to be admitted from the Academic Year 2023-2024)**

**Mother Teresa Women's University, Kodaikanal**  
**Department of Biotechnology**

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## B.Sc. Biotechnology

### 1. About the Programme

B.Sc., Biotechnology is a 3 year Undergraduate Programme and the Programme is offered through six semesters providing a strong foundation of biotechnological concepts. This Programme is rationalized to bestow students with an improved knowledge of the basic cellular and molecular level and acquire an in-depth knowledge of biotechniques. The meticulously structured Programme has a strong interdisciplinary research base in biological sciences, which prepares the student for industry as well as research programmes. Graduates in this discipline significantly will contribute to research and development for society's welfare in terms of Environment, Agriculture, and Medicine.

### 2. Programme Educational Objectives (PEOs)

<b>PEO1</b>	To disseminate knowledge to the students to shape a successful career in Biotechnology.
<b>PEO2</b>	To equip the students with fundamental concepts to handle scientific challenges.
<b>PEO3</b>	To emphasize the need for skilled biotechnologists in the modern scientific society.
<b>PEO4</b>	To create awareness regarding the professional demands and opportunities in the field of biotechnology.
<b>PEO5</b>	To motivate the students to move for higher studies and research to contribute scientifically to the society.

### 3. Program Outcomes (POs)

Upon completion of the B. Sc Biotechnology Programme, the students will be able to

<b>LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME</b>	
<b>Programme Outcomes (PO):</b>	<b>PO1:</b> understand the major concepts in Biology and understand the fundamental principles.
	<b>PO2:</b> develop scientific outlook not only with respect to life science but in all aspects related to life.
	<b>PO3:</b> apply and adapt appropriate techniques, resources, and instrumentation which will help them to pursue higher education or jobs after the programme.
	<b>PO4:</b> effectively communicate scientific information with strong ethics in written and oral formats.
	<b>PO5:</b> understand their roles and responsibilities especially the protection of the people.
	pursue higher education in their respective fields and engage in lifelong learning and enduring proficient progress.

#### 4. Programme Specific Outcomes (PSOs)

On completion of the Programme the students will be able to

<b>Programme Specific Outcomes (PSO):</b>	<b>PSO1:</b> recall the fundamentals of Biotechnology which would enable them to comprehend the emerging and advanced biotechnology concepts in life sciences.
	<b>PSO2:</b> work with deeper knowledge in practical skills and disciplinary and interdisciplinary aspects of biotechnology.
	<b>PSO3</b> have enhanced learning abilities, technological solutions in domains of biotechnology for their applications in industry and research and entrepreneurial skills.
	<b>PSO4:</b> evaluate the need and impact of scientific techniques on the environment and the society, keeping in view their sustainable development.
	<b>PSO5:</b> analyze the knowledge gained in Biotechnology for lifelong learning.

#### 5. Eligibility

- i. Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Examination, Govt. of Tamil Nadu or any other Examination accepted by the syndicate as equivalent there to with at least one of the following subject Biology/Botany/Zoology.
- ii. Candidate should have secured atleast 55% in the above subject and above in the aggregate.
- iii. A relaxation of 10% in the total percentage will be given to SC, ST candidates.

#### 6. General Guidelines for UG Programme

- i. **Duration:** The Programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
- ii. **Medium of Instruction:** English

**7.Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

### 7.1. Evaluation Pattern

METHODS OF EVALUATION		Maximum Marks Theory and Practical	Minimum Marks Theory and Practical
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	<b>25 Marks</b>	<b>10 Marks</b>
	Assignments / Snap Test / Quiz		
	Seminars		
	Attendance and Class Participation		
<b>External Evaluation</b>	End Semester Examination	<b>75 Marks</b>	<b>30 Marks</b>
<b>Total</b>		<b>100 Marks</b>	<b>40 Marks</b>

\* Minimum credits required to pass:140

### 7.2.Internal Assessment-CIA

Theory Course: For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

### 7.3. Theory Question Paper Pattern (Bloom's Taxonomy based-Common for all UG Programmes)

S.No.	Part	Type	Marks
1	A	<b>10*1 Marks=10</b> Multiple Choice Questions(MCQs): 2 questions from each Unit	<b>10</b>
2	B	<b>5*4=20</b> Two questions from each Unit with Internal Choice (either / or)	<b>20</b>
3	C	<b>3*15=45</b> Open Choice: Any three questions out of 5 : one question from each unit	<b>45</b>
Total Marks			<b>75</b>

## 7.4. Methods of Assessment

METHODS OF ASSESSMENT	
<b>Recall(K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions
<b>Understand / Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or Overview
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
<b>Analyze(K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge
<b>Evaluate(K5)</b>	Longer essay/Evaluation essay, Critique or justify with pros and cons
<b>Create(K6)</b>	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

## 8. Project

### 8.1. Project Report

A student should select a topic for the Project Work at the end of the fifth semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 30 typed pages in Times New Roman font with 1.5 line space.

### 8.2. Project Evaluation

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

## 9. Conversion of Marks to Grade Points and Letter Grade

### (Performance in a Course/ Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good
50-59	5.0 – 5.9	B	Average
40-49	4.0 – 4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

## 10. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance lesser than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

## 11. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

## 12. Any Other Information

In addition to the above-mentioned regulations, any other common regulations pertaining to the UG Programmes are also applicable to this Programme.

## 13. Faculty Course File

a.	Academic Schedule	q.	Laboratory Experiments related to the Courses
b.	Students Name List	r.	Internal Question Paper
c.	Time Table	s.	External Question Paper
d.	Syllabus	t.	Sample Home Assignment Answer Sheets
e.	Lesson Plan	u.	Three best, three middle level and three average Answersheets
f.	Staff Workload	v.	Result Analysis (CO wise and whole class)
g.	Course Design(content, Course Outcomes (COs), Delivery method, mapping of COs with Programme Outcomes(POs), Assessment Pattern interms of Revised Bloom's Taxonomy).	w.	Question Bank for Higher studies Preparation (GATE/Placement)
h.	Sample CO Assessment Tools	x.	List of mentees and their academic achievements
i.	Faculty Course Assessment Report(FCAR)		
j.	Course Evaluation Sheet		
k.	Teaching Materials (PPT, OHP etc)		
l.	Lecture Notes		
m.	Home Assignment Questions		
n.	Tutorial Sheets		
o.	Remedial Class Record, if any		
p.	Projects related to the Course		

**15. TEMPLATES FOR SYLLABUS FRAMEWORK FOR UG PROGRAMMES**

As per TANSCHÉ – From 2023-24  
**SEMESTER – 1**

<b>Part</b>	<b>List of Courses</b>	<b>Credits</b>	<b>No. of Hours</b>
<b>Part-1</b>	Language-1 – Tamil	3	6
<b>Part-2</b>	Language-2 – English	3	6
<b>Part-3</b>	Core-1: Theory	5	5
	Core-2: Theory / Practical (Depending on the Discipline)	5	5
	Elective-1 (Departmental Elective)	3	4
<b>Part-4</b>	Skill Enhancement Course SEC - 1 (Subject Based)	2	2
	Foundation Course (Subject Based)	2	2
<b>Total</b>		<b>23</b>	<b>30</b>

**SEMESTER-II**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language-1 – Tamil	3	6
Part-2	Language-2 – English	3	6
Part-3	Core-3: Theory	5	5
	Core-4: Theory/Practical (Depending on the Discipline)	5	5
	Elective-2 (Departmental Elective)	3	4
Part-4	Skill Enhancement Course -SEC - 2 (Soft Skills)	2	2
	Skill Enhancement Course -SEC - 3 (Subject Based)	2	2
<b>Total</b>		<b>23</b>	<b>30</b>



## 15. Syllabus in Detail

### MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL

Framework of the Syllabus to be implemented from the Academic Year 2023-2024  
Curriculum Framework and Syllabus for

#### B.Sc. BIOTECHNOLOGY

(For the candidates to be admitted from the academic year 2023-2024 onwards)

Course content	Paper Code	Course Title	Credits	Hours		(CIA)	(ESE)	Total
				T	P			
<b>Semester I</b>								
Part-I	U23TAL11	Part-I-Language	3	6	-	25	75	100
Part-II	U23ENL21	English I-Part- II	3	6	-	25	75	100
Part-III	U23BTT11	Core I- Cell and Molecular Developmental Biology	5	5	-	25	75	100
	U23BTP11	Core I Practical I- Cell and Molecular Developmental Biology	5	-	5	25	75	100
	U23BTE1A/ U23BTE1B	Elective I- (A) Bioinstrumentation (B) Good Laboratory Practice	3	4	-	25	75	100
Part-IV	U23BTS11	Skill Enhancement Course- SEC-1 Medical Lab Technology	2	2	-	25	75	100
	U23BTF11	Foundation course- Biodiversity	2	2	-	25	75	100
<b>Total</b>			<b>23</b>	<b>30</b>				<b>700</b>
<b>Semester II</b>								
Part-I	U23TAL12	Part-I Language	3	6	-	25	75	100
Part-II	U23ENL22	English II-Part- II	3	6	-	25	75	100
Part-III	U23BTT22	Core Paper III - Genetics	5	5	-	25	75	100
	U23BTP22	Core Practical II - Genetics	5	-	5	25	75	100
	U23BTE2A/ U23BTE2B	Elective II (A) Marine Biotechnology/ (B) Food technology	3	4	-	25	75	100
Part-IV	U23BTS22	Skill Enhancement Course SEC-2-Soft Skills	2	2	-	25	75	100
	U23BTS23	Skill Enhancement Course SEC-3-Biofertilizer	2	2	-	25	75	100
<b>Total</b>			<b>23</b>	<b>30</b>				<b>700</b>

Subject Code	L	T	P	S	Credits	Hrs	SEMESTER-I CORE I- CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	Marks		
								CIA	External	Total
U23BTT11	4	1			5	5		25	75	100
<b>Learning Objectives</b>										
LO1	To provide an insight into the cell as the fundamental unit of life and to compare the structure of the Eukaryotic Cell with the primitive prokaryotic cell									
LO2	To enable the students to analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane.									
LO3	To make the students understand the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication, Transcription, and Translation and post translational modifications of proteins.									
LO4	To train the students to predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways.									
LO5	To practice the students to understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.									
<b>UNITS</b>	<b>Course Contents</b>								<b>No.of Hours</b>	
I	Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).								10	
II	Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.								20	
III	Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.								15	
IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.								15	
V	Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.								15	
<b>Total</b>								<b>75</b>		
<b>Text Books</b>										
1	T. Devasena (2012), Cell Biology, Oxford University Press.									
2	Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.									
3	Gilbert, S.F. 2016. Developmental Biology, 11 <sup>th</sup> edition. Sinauer Associates Inc. Publishers, MA. USA.									

4	Bruce Alberts, 6 <sup>th</sup> Edition (2014). Molecular Biology of the cell, W. W. Norton &Company.
5	James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.
<b>Reference Books</b>	
1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8 <sup>th</sup> Edition (2015). Wiley Publications.
2	James D. Watson, 7 <sup>th</sup> Edition (2014), Molecular Biology of the Gene, Pearson Publications.
3	Geoffrey M. Cooper, 7 <sup>th</sup> Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Oxford University Press.
4	Lodish Harwey, 6 <sup>th</sup> Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
5	Wolpert L, Tickle C, 2015. Principles of Development, 5 <sup>th</sup> edition, Oxford University Press.
<b>Web Resources</b>	
1	<a href="http://www.cellbiol.com/education.php">http://www.cellbiol.com/education.php</a>
2	<a href="https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/">https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/</a>
3	<a href="https://dnalc.cshl.edu/websites/">https://dnalc.cshl.edu/websites/</a>
4	<a href="https://www.cellsignal.com/contents/science/cst-pathways/science-pathways">https://www.cellsignal.com/contents/science/cst-pathways/science-pathways</a>
5	<a href="https://nptel.ac.in/courses/102/106/102106025/11">https://nptel.ac.in/courses/102/106/102106025/11.</a>

### MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	2	1	3	-	3	3	2	3
<b>CLO2</b>	3	3	3	3	-	3	3	2	3
<b>CLO3</b>	3	3	3	2	-	3	3	2	2
<b>CLO4</b>	3	2	3	2	-	3	3	2	3
<b>CLO5</b>	3	3	2	2	-	3	3	2	3
<b>TOTAL</b>	<b>15</b>	<b>14</b>	<b>12</b>	<b>12</b>	<b>0</b>	<b>15</b>	<b>15</b>	<b>10</b>	<b>15</b>
<b>AVERAGE</b>	<b>3</b>	<b>2.8</b>	<b>2.4</b>	<b>2.4</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>

Subject Code	L	T	P	S	Credits	Hrs	PRACTICAL - I CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	Marks		
								CIA	External	Total
U23BTP11			5		5	5		25	75	100
<b>Learning Objectives</b>										
LO1	To demonstrate the operation of Light Microscope									
LO2	To identify blood cells and its components									
LO3	To isolate and identify plant, and animal cells.									
LO4	To summarize the concept of gametes									
LO5	To develop skill to perform cell fractionations.									
<b>UNITS</b>	<b>Course Contents</b>							<b>No.of Hours</b>		
I	Components of a Compound / Light Microscope.							9		
II	Blood smear preparation and Identification of Blood cells Buccal smear preparation and Identification of squamous epithelial cells.							9		
III	Isolation and Identification of plant cells.							9		
IV	Observation of sperm & Egg Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.							9		
V	Cell fractionation and Identification of cell organelles (Demo)							9		
<b>Total</b>								<b>45</b>		
<b>Text Books</b>										
1	K.V. Chaitanya, (2013), <i>Cell and molecular biology</i> : Lab manual, PHI publishers., ISBN 978-81-203-800-4									

### MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	3	3	3	2	3	3	2	2
<b>CLO2</b>	3	3	3	3	3	3	3	2	2
<b>CLO3</b>	3	3	3	3	3	3	3	3	3
<b>CLO4</b>	3	2	3	3	3	3	3	3	3
<b>CLO5</b>	3	3	2	3	2	2	2	3	3
<b>TOTAL</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>13</b>	<b>14</b>	<b>14</b>	<b>13</b>	<b>13</b>
<b>AVERAGE</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.8</b>	<b>2.8</b>	<b>2.6</b>	<b>2.6</b>

Subject Code	L	T	P	Credits	Hrs	SEMESTER I	Marks		
							CIA	External	Total
U23BTE1A	3	1		3	4	ELECTIVE –I (A) BIOINSTRUMENTATION	25	75	100
<b>Learning Objectives</b>									
LO1	To practice experiment with and apply the basic instruments in the laboratory.								
LO2	To predict the functionality of Beer-Lambert's law in identifying and quantifying a biomolecule.								
LO3	To employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.								
LO4	To understand the clinical important isotopes and detection of isotopes.								
LO5	To employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.								
UNITS	Course Contents								No.of Hours
I	pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Compound, Bright field, Phase contrast and Fluorescence Microscope.								15
II	Spectra – Absorption and Emission Spectra – Beer Lambert's law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance spectrometer (NMR).								15
III	Chromatography - Principles – Paper Chromatography, TLC, Gel filtration, Ion-Exchange, Affinity Chromatography Gas Liquid Chromatography and HPLC. Electrophoresis: Principle, Paper Electrophoresis – Cellulose Acetate Electrophoresis - Agarose Gel Electrophoresis – SDS- PAGE and Iso-electric focusing.								15
IV	Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity – GM Counters, Scintillation Counters – Autoradiography – Applications. SOPs for Radioactive materials.								15
V	Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.								15
<b>Total</b>								<b>75</b>	
<b>Text Books</b>									

1	Upadhyay and UpadhyayNath. (2009). “Biophysical Chemistry”, Principles and Techniques.Himalaya Publishing House.
2	L.Veerakumari, (2006) “Bioinstrumentation” MJP publishers , Kindle Edition.
3	SkoogD.A.F.James Holler and Stanky,R.Crouch, (2007) “Instrumental Methods of Analysis” Cengage Learning.
4	Palanivelu P, 2000. Analytical Biochemistry & Separation Techniques, 4th edition, Twenty first century publications.
5	Prakash M, 2009. Understanding Bioinstrumentation, 1st edition, Discovery Publishing House Pvt Ltd

### Reference Books

1	Keith Wilson,John Walker,(2010).Principles and techniques of Biochemistry and Molecular Biology”(7 <sup>th</sup> edition).Cambridge University Press.
2	David L.Nelson, Michael M Cox.Lehninger(2008).”Principles of Biochemistry”,Fifth edition W.H.Freeman,Newyork.
3	Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).
4	L.A Geddes and L.E.Baker (2008) “Principles of Applied Biomedical Instrumentation”WileyIndia Third Edition.
5	Sharma B K, 2005. Instrumental Methods of Chemical Analysis, 24th Edition, GOEL Publishing House.

### MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	3	3	3	3	3	3	3	3
<b>CLO2</b>	3	3	3	3	3	3	3	3	3
<b>CLO3</b>	3	3	3	3	2	3	3	3	3
<b>CLO4</b>	3	3	3	2	3	2	3	3	2
<b>CLO5</b>	3	3	3	3	3	3	3	2	3
<b>TOTAL</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>14</b>	<b>14</b>
<b>Average</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>

Subject Code	L	T	P	Credits	Inst Hours	SEMESTER I	Marks		
							CI A	External	Total
U23BTE1B	3	1		4	4	ELECTIVE I(B) GOOD LABORATORY PRACTICES (GLP)	25	75	100
<b>Learning Objectives</b>									
LO1	To understand the types of labs associated with Biotechnology								
LO2	To learn to use and maintain lab Instruments								
LO3	To know the calculations needed in a laboratory								
LO4	To understand good lab Guidelines								
LO5	To know how to safely dispose of waste								
<b>UNITS</b>	<b>Course Contents</b>								<b>No.of Hours</b>
I	Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.								15
II	Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).								15
III	Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation.								15
IV	Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.								15
V	Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel.								15

<b>Total</b>		<b>75</b>
<b>Text Books</b>		
1	WHO training manual on Good Laboratory Practices, 2 <sup>nd</sup> Edition.	
3		
1	Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.	
<b>Web Resources</b>		
1	<a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "tdr	
2	<a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "publications > documents	
3	<a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "glp	
4	<a href="https://www.who.int/tdr/publications/documents/glp-trainer.pdf">https://www.who.int/tdr/publications/documents/glp-trainer.pdf</a> "-trainer	
5	<a href="http://www.who.int/tdr/publications/documents/glp-handbook.pdf">www.who.int/tdr/publications/documents/glp-handbook.pdf</a>	

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME**

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	3	3	2	2	3	3	3	3
<b>CLO2</b>	3	3	3	2	2	3	3	3	3
<b>CLO3</b>	3	3	3	2	2	3	3	3	3
<b>CLO4</b>	3	3	3	2	2	3	3	3	3
<b>CLO5</b>	3	3	3	2	2	3	3	3	3
<b>TOTAL</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>
<b>AVERAGE</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>



Course Code	U23BTS11	SEMESTER-I SKILL ENHANCEMENT COURSE- SEC-1 MEDICAL LAB TECHNOLOGY				L	T	P	C
		2	-	-	2				
<b>Learning Objectives</b>	<ul style="list-style-type: none"> <li>To understand the basic concepts of medical laboratory techniques</li> <li>To learn the techniques required for clinical diagnosis</li> <li>To perform basic biochemical tests and histopathology tests</li> <li>To gain knowledge on the principles of diagnosis</li> </ul>								
<b>Cognitive Level</b>	K1: Recall    K2: Understand    K3: Apply    K4: Analyze    K5: Evaluate								
<b>UNITS</b>	<b>Course Contents</b>								
<b>Unit I</b>	<b>Basic Hematology</b>								
Specimen collection and handling, transportation of specimens, disposal of specimen after laboratory use. Specimen preservation. Composition of blood. Methods of estimation of Haemoglobin, PCV, total and differential count of WBC, platelet count, clotting, bleeding and prothrombin time. Blood Group - methods of grouping and Rh factor.									
<b>Unit II</b>	<b>Biochemical test</b>								
Tests for specific amino acids, determination of proteins in serum and plasma. Determination of glucose, glucose tolerance test, ketone bodies, glycated hemoglobin, triglycerides, cholesterol, lipoproteins. Examination of body fluids - ascitic fluid, pleural fluid, synovial fluid, pericardial fluid, CSF and amniotic fluid. Urine analysis, abnormal constituents. Faecal specimen - Macroscopic and microscopic examinations - detection of occult blood, Semen analysis. Laboratory analysis of throat swab, sputum specimens, purulent exudates – Tuberculosis									
<b>Unit III</b>	<b>Histopathology</b>								
Tissue reception, labeling, fixation and section cutting, Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking). Handling and care of microtome, types of microtome, sharpening of knives, and section cutting. Frozen section techniques - CO2 freezing, cryostat. Preparation of common stains. H & E, Congo red, methyl violet, Leishman stain, Giesma and staining techniques. Mounting of specimens, record keeping, indexing of slides. Molecular analysis of chromosomal aberrations in leukemias and lymphomas. Molecular diagnosis of genetic diseases.									
<b>Unit IV</b>	<b>Principles of Diagnosis</b>								
History, Physical Examination, Treatment, Differential Diagnosis, Tests and procedure (Clinical laboratory test, Tests using Radioisotopes, Endoscopy, Ultrasound, X-Ray, MRI, CT scan, PET scans, cytologic and Histologic examination of cells and tissue from patients).									
<b>Unit V</b>	<b>Molecular Diagnosis</b>								

Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, In situ PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction. Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequence analysis. Viral diagnostics: immunodiagnosis, molecular diagnosis. SNP-based diagnosis. DNA chips, automation, gene therapy; applications in diagnosis of genetic disorders, Diagnosis of Prenatal & neonatal genetic disorders.		
<b>Text Books</b>	<ol style="list-style-type: none"> <li>1. GP Pal, Textbook of Histology, Publisher: Paras Medical Books, 2015</li> <li>2. B.S. Shah, Short Textbook Of Hematology, Publisher : CBS Publishers &amp; Distributors, 2014</li> <li>3. Nader Rifai, A. Rita Horvath, Carl T. Wittwer, Clinical Chemistry and Molecular Diagnostics, Publisher Elsevier India, 2018</li> </ol>	
<b>References</b>	<ol style="list-style-type: none"> <li>1. Praful. B. Godkar, Darshan. P. Godkar, Text Book of Medical Laboratory Technology. Bhalani Publishing House. 2014.</li> <li>2. F.J. Baker, R.E. Silvertown, Butterworth - Heinemann. Introduction to Medical Laboratory Technology. Butterworth- Heinemann, Saunders Publisher, 2014.</li> <li>3. Todd &amp; Stanford. Clinical Diagnosis and Management by Laboratory Methods. 16<sup>th</sup> ed. 2016.</li> </ol>	
<b>E-reference links:</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.thebalancecareers.com/what-is-a-medical-laboratory-technologist-526029">https://www.thebalancecareers.com/what-is-a-medical-laboratory-technologist-526029</a></li> <li>2. <a href="https://www.leicabiosystems.com/knowledge-pathway/an-introduction-to-specimen-processing/">https://www.leicabiosystems.com/knowledge-pathway/an-introduction-to-specimen-processing/</a></li> <li>3. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1214554/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1214554/</a></li> <li>4. <a href="https://www.justintimemedicine.com/CurriculumContent/p/387">https://www.justintimemedicine.com/CurriculumContent/p/387</a></li> <li>5. <a href="https://www.bloodworksnw.org/medical-services/introduction-to-hematology">https://www.bloodworksnw.org/medical-services/introduction-to-hematology</a></li> </ol>	
<b>Course outcome</b>	Upon completion of this course, the students will be able to	
	<b>CO1</b>	know the methods of sample collection, specimen preservation and estimation methods <b>K2</b>
	<b>CO2</b>	estimate biomolecules and body fluids using several biochemical tests <b>K5</b>
	<b>CO3</b>	understand the methods in histopathology and sample freezing techniques <b>K2</b>
	<b>CO4</b>	learn the principles of diagnosis and apply the techniques to perform tests <b>K2</b>
	<b>CO5</b>	develop skills in handling different types of PCR for molecular diagnosis <b>K1, K2, K3</b>

### Mapping of COs with POs & PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
<b>CO1</b>	S	M	M	S	S	S	M	M	S	S	S	M	S
<b>CO2</b>	S	M	S	S	S	S	S	S	M	S	S	M	S
<b>CO3</b>	M	S	M	M	S	S	S	S	S	M	S	S	S
<b>CO4</b>	S	S	S	S	S	M	S	S	S	S	M	S	S
<b>CO5</b>	S	M	M	S	S	S	S	S	S	S	S	S	S

Strongly Correlating  
Weakly Correlating

(S) - 3 marks ; Moderately Correlating  
(W) - 1 mark ; No Correlation

(M) - 2 marks  
(N) - 0 mark

Course Title & Code	<b>SEMESTER-I FOUNDATION COURSE– BIODIVERSITY</b>		
<b>U23BTF11</b>	<b>Semester-I</b>	<b>Credits:2</b>	<b>Hours/weeks: 5</b>
<b>Cognitive Level</b>	K1: Recall K2: Understand K3: Apply K4: Analyze		
<b>Learning Objectives</b>	<ul style="list-style-type: none"> <li>· To understand the components and to learn the tools of biodiversity.</li> <li>· To have an insight on impacts on biodiversity.</li> <li>· To impart knowledge for biodiversity conservation.</li> </ul>		
<b>Course Outcomes</b>	Upon completion of this course, the students will be able to		
<b>UNITS</b>	Acquire knowledge on the concepts and values of biodiversity and its conservation <b>K1</b> Understand the global patterns of biodiversity <b>K2</b> Assess the impacts on biodiversity <b>K4</b> <div style="text-align: center;"><b>Course Contents</b></div>		
<b>Unit I</b>	<b>Introduction to Biodiversity-</b> Biodiversity-Definition- Biodiversity and kingdom of living organisms -Types-Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity). Importance of biodiversity. Global distribution of richness, Centres of species diversity, Mega diversity centres , Hot spots and biodiversity in India.		
<b>Unit II</b>	<b>Studies of Biodiversity-</b> Assessment of mapping of biodiversity; GIS/Remote-sensing; Species diversity- Measurement, Hot spot analysis. Representative type (one each) studies from Cryptogams, Phanerogams; Sacred flora and fauna, Endemic plants and animals. Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis.		
<b>Unit III</b>	<b>Impacts on Biodiversity-</b> Bio-prospecting, Biopiracy, Hybridized plants, GM crops Bio-prospecting Botanicals for Biocontrol and Health, Threats to biodiversity predator control, exotic introductions, parasites and diseases. Overexploitation threatening living species, Animals threatened by International trade, Common patterns of over exploitation. Link between microbial diversity and ecosystem processes		
<b>Unit IV</b>	<b>In situ Conservation of biodiversity-</b> (Biosphere reserves, National parks, Sanctuaries), Botanical Gardens; Wildlife Sanctuaries, Preservation of wet lands; protection measures taken at global level. Social movement for biodiversity conservation- Chipko movement and Appiko movement. CITES, WWF, NBPGR, IUCN; ICZN rules and their role. Loss of biodiversity and restoration.		

<b>Unit V</b>	<b>Ex situ Conservation of biodiversity</b> - (Cryopreservation, Germplasm banks, Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies). Environmental and biodiversity laws.
<b>Reference</b>	<ol style="list-style-type: none"> <li>1. Aber, J.D. and Melillo J.M., Terrestrial Ecosystems: W.B. Saunders, 2011.</li> <li>2. Ingrowille, M Diversity and Evolution of land plants Chapman and Hall, 2002.</li> <li>3. Gaston KJ, Spicer JI. Biodiversity – an introduction 4th edition, Blackwell, 2014.</li> <li>4. Wilson EO, The diversity of life, Harvard University Press, 2010.</li> <li>5. Krishnamurthy KV, Textbook of biodiversity, Taylor and Francis, 2017</li> <li>6. Richard BP, Principles of Conservation Biology, 4th edition, Sinauer Associates, Inc.. 2016.</li> </ol>
E-referenc e links:	<ol style="list-style-type: none"> <li>1. <a href="https://www.amnh.org/research/center-for-biodiversity-conservation/about-the-cbc/what-is-biodiversity">https://www.amnh.org/research/center-for-biodiversity-conservation/about-the-cbc/what-is-biodiversity</a></li> <li>2. <a href="https://www.researchgate.net/publication/294876262_Biodiversity_Concept_Threats_and_Conservation">https://www.researchgate.net/publication/294876262_Biodiversity_Concept_Threats_and_Conservation</a></li> <li>3. <a href="https://ncert.nic.in/ncerts/l/lebo115.pdf">https://ncert.nic.in/ncerts/l/lebo115.pdf</a></li> <li>4. <a href="https://www.unesco.pl/fileadmin/user_upload/pdf/BIODIVERSITY_FACTSHEET.pdf">https://www.unesco.pl/fileadmin/user_upload/pdf/BIODIVERSITY_FACTSHEET.pdf</a></li> <li>5. <a href="https://www.biodiversitya-z.org/content/biodiversity.pdf">https://www.biodiversitya-z.org/content/biodiversity.pdf</a></li> <li>6. <a href="http://www.oecd.org/env/resources/OECD-work-on-biodiversity-and-ecosystems.pdf">http://www.oecd.org/env/resources/OECD-work-on-biodiversity-and-ecosystems.pdf</a></li> </ol>

### Mapping of COs with POs & PSOs

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	S	S	S	S	S	M	S	S	S
CO3	S	M	S	M	S	S	S	S	S	M	S	S	S
CO4	S	M	S	M	S	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks  
 Moderately Correlating (M) - 2 marks  
 Weakly Correlating (W) - 1 mark  
 No Correlation (N) - 0 mark

Subject Code	L	T	P	S	Credits	Hrs	SEMESTER II CORE II GENETICS	Marks		
								CIA	External	Total
U23BTT22	4	1			5	5		25	75	100
<b>Learning Objectives</b>										
LO1	To learn about the classical genetics and transmission of characters from one generation to the next.									
LO2	To obtain a strong foundation for the advanced genetics.									
LO3	To understand the properties of genetic materials and storage and processing of genetic information.									
LO4	To acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.									
LO5	To understand the Categories Eugenics, Euphenics and Euthenics and gain an indepth Knowledge on Population Genetics.									
UNITS	Course Contents									No.of Hours
I	Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes-Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.									15
II	Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor innmice. Sex –Linked Inheritance and Sex- Determination in Man.									15
III	Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sexduction									15
IV	Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)									15
V	Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.									15



<b>CLO4</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO5</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>TOTAL</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>13</b>	<b>14</b>	<b>14</b>	<b>13</b>	<b>13</b>
<b>AVERAGE</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.8</b>	<b>2,8</b>	<b>2.6</b>	<b>2.6</b>

Subject Code	L	T	P	S	Credits	Hrs	SEMESTER-II CORE PRACTICAL II - GENETICS	Marks		
								CIA	External	Total
U23BTP22	4	1			5	5		25	75	100

### Learning Objectives

LO1	Demonstrate the basic principles of important techniques in Molecular biology and Genetics.	
LO2	Analyze the Polytene chromosome of the organisms	
LO3	Identify Barr bodies from Buccal smear	
LO4	Demonstrate the Preparations and maintenance of culture medium	
LO5	Demonstrate Human karyotyping	
UNITS	Course Contents	No.of Hours
1	Mitotic stages of onion ( <i>Allium cepa</i> ) root tip Meiotic stages of cockroach testes/ Flower bud	9
II	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands	9
III	Identification of Barr bodies from Buccal smear	9
IV	Preparations of culture medium and culture of Drosophila – methods of maintenance Identifications of mutants of Drosophila	9
V	Human karyotyping (Demo)	9
<b>Total</b>		<b>45</b>
<b>Text Books</b>		

### MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
<b>CLO1</b>	3	3	3	3	3	3	3	3	3
<b>CLO2</b>	3	3	3	3	3	3	3	3	3
<b>CLO3</b>	3	3	3	3	2	3	3	3	3
<b>CLO4</b>	3	3	3	2	3	2	3	3	2
<b>CLO5</b>	3	3	2	3	3	3	3	2	3
<b>TOTAL</b>	<b>15</b>	<b>15</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>15</b>	<b>14</b>	<b>14</b>
<b>AVERAGE</b>	<b>3</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>



Subject Code	L	T	P	Credits	Hrs	SEMESTER II	Marks		
							CIA	External	Total
U23BTE2A	3	1		3	4	Elective II (A) MARINE BIOTECHNOLOGY	25	75	100
<b>Learning Objectives</b>									
LO1	To gain knowledge about Marine Ecosystem and Resources.								
LO2	To learn about bioactive compounds from Marine sources								
LO3	To learn about medicinal seaweeds								
LO4	To know about culture of seaweeds and Aquaculture								
LO5	To know about Marine biotech products								
UNITS	Course Contents								No. of Hours
I	Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea-Euphotic-Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.								15
II	Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.								15
III	Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.								15
IV	Culture aspect-Seaweed ( <i>Kappaphycus alvarezii</i> ), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Transgenesis and Cryopreservation.								15
V	Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.								15
<b>Total</b>								<b>75</b>	
<b>Text Books</b>									
1	Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.								

2	Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
3	Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.
4	David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
5	Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience
<b>Reference Books</b>	
1	Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
2	Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
3	Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
4	Gloria Sanchez, Elizabeth Hernandez,(2019), <i>Environmental Biotechnology and cleaner Bioprocess</i> , (1 <sup>st</sup> edition), CRC Press, ISBN 9780367455552
5	Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3 <sup>rd</sup> edition), Wiley –Blackwell.
<b>Web Resources</b>	
1	<a href="http://coe.genomics.org.cn/">http://coe.genomics.org.cn/</a>
2	<a href="http://www.bcb.iastate.edu/">http://www.bcb.iastate.edu/</a>
3	<a href="http://www.nwfsc.noaa.gov/protocols/bioinformatics.html">http://www.nwfsc.noaa.gov/protocols/bioinformatics.html</a>
4	<a href="http://www.ebi.ac.uk/ ExPASy.org/">http://www.ebi.ac.uk/ ExPASy.org/</a>
5	<a href="http://www.expasy.org/">http://www.expasy.org/</a>

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CLO1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO4</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>TOTAL</b>	<b>15</b>	<b>15</b>	<b>13</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>
<b>Average</b>	<b>3</b>	<b>3</b>	<b>2,6</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

Subject Code	L	T	P	Credits	Hrs	SEMESTER II	Marks		
							CIA	External	Total
U23BTE2B	3	1		3	4	ELECTIVE- II(B) FOOD TECHNOLOGY	25	75	100
<b>Learning Objectives</b>									
LO1	To understand the basic concepts of the food industry								
LO2	To learn about classification of food								
LO3	To learn about fruits, vegetables and horticulture								
LO4	To learn about Non vegetarian food								
LO5	To learn about food adulteration and biosensors to detect them								
UNITS	Course Contents								No.of Hours
<b>I</b>	Biotechnology relating to the food industry – Role of bioprocess engineering in biotechnology industry- Regulatory and social aspects of biotechnology in foods- Application of biotechnology in waste treatment of food industries. Historical evolution of food processing technology.								<b>15</b>
<b>II</b>	Cereals and Millets. Wheat- composition, types (hard, soft/ strong, weak). Malting, gelatinization of starch, types of browning- Maillard & caramelization. Rice- and composition, parboiling of rice- advantages and disadvantages. Structure and composition of pulses, toxic constituents in pulses, processing of pulses soaking, germination, decortications, cooking and fermentation. Fats and Oils. Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation. Rancidity – Types- hydrolytic and oxidative rancidity and its prevention.								<b>15</b>
<b>III</b>	Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre. Post-harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.								<b>15</b>
<b>IV</b>	Concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. Aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish - microbiological, physiological and biochemical. Composition and nutritive value of egg, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers. Milk and Milk Products. Chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products.								<b>15</b>

V	Types of food adulterants – test to detect adulterants in foods – metal contaminants - contaminants of processed foods- Food products as analytical samples, general aspects of biosensors- biosensors for food contaminant analysis, commercially available biosensors for food analysis. Food additives, FSSAI regulations, Methods of fortifying and enriching foods.	15
<b>Total</b>		<b>75</b>
<b>Text Books</b>		
1	Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013.	
2	B. Srilakshmi, Food science, New Age Publishers,2002	
3	Joshi, V.K. and Singh, R.S., A. (2013), <i>Food Biotechnology- Principles and practices</i> , I.K.International Publishing House Pvt. Ltd., New Delhi,.	
4	RavishankarRai, V,( 2015), <i>Advances in Food Biotechnology</i> , (First edition), John Wiley & Sons, Inc, ISBN 9781118864555.	
5	Perry Johnson-Green.( 2018), <i>Introduction to Food Biotechnology</i> , Special Indian Edition, <i>CRC Press</i> , ISBN 9781315275703.	
<b>Reference Books</b>		
1	Roday,S. Food Science, Oxford publication, 2011.	
2	Meyer, Food Chemistry, New Age,2004 5. De Sukumar., <i>Outlines of Dairy Technology</i> , Oxford University Press, 2007	
3	Foster, G.N., (2020), <i>Food Biotechnology</i> , ( First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348.	
4	Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin(2005), <i>Food Biotechnology</i> , (2 <sup>nd</sup> edition), <i>CRC Press</i> ,ISBN 9780824753290.	
5	Roday,S. Food Science, Oxford publication, 2011.	
<b>Web Resources</b>		
1	<a href="https://ifst.onlinelibrary.wiley.com/journal/13652621">https://ifst.onlinelibrary.wiley.com/journal/13652621</a>	
2	<a href="https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27">https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27</a>	
3	<a href="https://www.springer.com/journal/13197">https://www.springer.com/journal/13197</a>	
4	<a href="https://www.sciencedirect.com/referencework/9780081005965/food-science">https://www.sciencedirect.com/referencework/9780081005965/food-science</a>	
5	<a href="https://www.ift.org/news-and-publications/food-technology-magazine">https://www.ift.org/news-and-publications/food-technology-magazine</a>	

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CLO1</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO2</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO5</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>TOTAL</b>	<b>15</b>	<b>10</b>	<b>5</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>15</b>
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>

Course Code					SEMESTER-II SKILL ENHANCEMENT COURSE-SEC-2 SOFT SKILLS	Marks		
U23BTS22						CIA	ESE	Total
L	T	P	C	Hrs		25	75	100
2			2	2				
<b>Cognitive Level</b>					<b>K1: Recall</b>	<b>K2: Understand</b>	<b>K3: Apply</b>	
<b>Learning Objectives</b>					<b>The Course aims at</b> <ul style="list-style-type: none"> <li>enabling the learners to make self-discovery</li> <li>enhancing the learners' overall personality</li> <li>instilling the learners with positive attitudes to life</li> <li>enabling the learners to efficiently manage their Time in learning and working environments</li> </ul>			
<b>Course Outcomes</b>					On completion of the course, the learners will be able to CO1: identify their strengths and weaknesses CO2: identify the opportunities and the challenges CO3: inculcate a positive attitude CO4: understand the importance of scheduling their work based on priority CO5: cultivate their LSRW skills for effective communication CO6: prepare their CV/Resume on their own and discharge efficient interview skills.			
<b>UNITS</b>					<b>Course Contents</b>			
<b>Unit I</b>					<b>Soft Skills-Introduction</b> What are soft skills? - Importance of Soft Skills-Difference between Hard Skills and Soft Skills-Kinds of Soft Skills Self-Discovery-SWOC Analysis-Advantages of SWOC analysis			
<b>Unit II</b>					<b>Attitude</b> What is Attitude? -Formation of attitudes-Positive and Negative attitudes - Power of positive attitude-Obstacles in Developing Positive Attitudes-Overcoming Negative Attitude and its Impacts- Developing Positive Attitude			
<b>Unit III</b>					<b>Time Management</b> Value of Time-Sense of Time management- Reasons for procrastination-Overcoming procrastination- Tips for Time Management-Deciding upon Priorities-Effective Scheduling.			
<b>Unit IV</b>					<b>Communication Skills</b> Listening-Listening and Hearing-Active and Passive Listening Speaking-Verbal and Non-verbal Communications Reading- Skimming, Scanning, Intensive, and Extensive Reading Writing-Formal and Informal Letters-Drafting Mails and Memos			
<b>Unit V</b>					<b>Unit V- Interview Skills Preparing Resume/CV</b> Preparing Resume/CV-Covering Letter Interview Etiquette, Dress Code, Dos, and Don'ts			

<b>References</b>	<ol style="list-style-type: none"> <li>1. Alex, K. <i>Soft Skills</i>. S Chand &amp; Co Ltd., Chennai: 2009.</li> <li>2. Butterfield, Jeff et.al. <i>Soft Skills for Everyone</i>. Cengage India, New Delhi: 2022.</li> <li>3. Hariharan, S., N. Sundararajan, S.P. Shanmugapriya. <i>Soft Skills. Gauvrao Books, Chennai:2020</i></li> <li>4. Sharma, Prashant. <i>Soft Skills: Personality Development for Success</i>. BPB Publications, Bengaluru: 2019.</li> </ol> <p>Lodhi, Tushar A Deshmukh, Rageeb Md. Usman, Vaibhav M Darvhekar).</p>
<b>Reference books</b>	<ol style="list-style-type: none"> <li>1. Almonte, Richard. <i>A Practical Guide to Soft Skills: Communication, Psychology, and Ethics for Your Professional Life</i>. Routledge, Oxford: 2021.</li> <li>2. Bardhan, Peeta Bobby &amp; Dr. Krishaveer Abhishek Challa. <i>A Complete Textbook on Soft Skills</i>. Kanishka Publisher, Chennai:2020.</li> <li>3. Mitra, Barun K. <i>Personality Development and Soft Skills</i> (Second Edition). Oxford UVP., New Delhi:2016.</li> <li>4. BAOU. <i>Business Communication &amp; Soft Skills</i>. <a href="https://baou.edu.in/assets/pdf/BBAATR-304.pdf">https://baou.edu.in/assets/pdf/BBAATR-304.pdf</a></li> <li>5. GoSkills. <i>Learn Soft Skills</i>. <a href="https://www.goskills.com">https://www.goskills.com</a> National Council of Educational Research and Training. <a href="https://ncert.nic.in/textbook/pdf/kect108.pdf">Soft skills for effective communication.https://ncert.nic.in/textbook/pdf/kect108.pdf</a></li> <li>6. SIRC of ICAI. <i>Soft Skills and Personality Development</i>.</li> </ol>



Course Code	U23BTS23	SKILL ENHANCEMENT COURSE-SEC-3 BIOFERTILIZER	L	T	P	C
	SEMESTER II		3	-	-	3
<b>Cognitive Level</b>	<b>K2:Understand      K3:Apply      K4:Analyze</b>					
<b>Learning Objectives</b>	<ul style="list-style-type: none"> <li>To understand the basic concepts of Biofertiliser</li> <li>To learn the techniques of manufacture of Biofertiliser</li> <li>To impart knowledge on Enterpreunership skill development</li> </ul>					
<b>UNITS</b>	<b>Course Contents</b>					
<b>Unit I</b>	<b>Introduction</b>					
History, importance of different types of fertilizers and their application to crop plants. Effect of chemical fertilizers on environment.						
<b>Unit II</b>	<b>Biofertilizer</b>					
Algal and fungal (Mycorrhizal) biofertilizers, Bacterial biofertilizers Rhizobial, free living N <sub>2</sub> fixers and phosphate solubilizing bacteria, their significance and practice.						
<b>Unit III</b>	<b>Manures</b>					
A general account of manures such as leaf moulds, composts form Yard Manure and a study of the following oilseed cakes: Castro and Neem as Biopesticides.						
<b>Unit IV</b>	<b>Application of biofertilizers and manures</b>					
A combination of biofertilizer and manure application. Organic farming-compost and Vermi compost.						
<b>Unit V</b>	<b>Mass production of Cyanobacterial Biofertilizers</b>					
Nostoc, Anabaena Azolla. Blue green algae.						
<b>Text Books</b>	<ol style="list-style-type: none"> <li>ReetaKhosla, Biofertilizers and Biocontrol agents for organic Farming, KojoPress, 2017.</li> <li>S.R. Reddy, Principles of Organic Farming, Kalyani, 2017.</li> <li>V. Kumaresan, Biotechnology, Saras Publication, 2015.</li> </ol>					
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>N.S. SubbaoRao, soil microorganisms and plant growth, Science publishers, 2011.</li> <li>N. S. SubbaoRao, Biofertilizer, cbcs publishers, 2020.</li> <li>Ronald M. Atlas &amp; Richard Bertha, Microbial Ecology, Fundamentals &amp; application, addidion Wesley, 2011 .</li> <li>Surjitsen, Krisnenduacharya, Munjularai, Biofertilisers and Biopesticides Techno world publishers, 2019.</li> </ol>					
<b>E-reference links</b>	<ol style="list-style-type: none"> <li><a href="https://www.fertilizer-machine.net/solution_and_market/types-of-fertilizer.html">https://www.fertilizer-machine.net/solution_and_market/types-of-fertilizer.html</a></li> <li><a href="https://www.hunker.com/12401292/harmful-effects-of-chemical-fertilizers">https://www.hunker.com/12401292/harmful-effects-of-chemical-fertilizers</a></li> <li><a href="https://www.nature.com/scitable/knowledge/library/biological-nitrogen-fixation-23570419/">https://www.nature.com/scitable/knowledge/library/biological-nitrogen-fixation-23570419/</a></li> <li><a href="http://lnmuacin.in/studentnotice/2020/mass%20inoculation.pdf">http://lnmuacin.in/studentnotice/2020/mass%20inoculation.pdf</a></li> </ol>					

<b>Course Outcomes</b>	On Successful completion of the course, the students will be able to
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	<b>CO1</b>	know about the basics and history of biofertilizers.	<b>K2</b>
	<b>CO2</b>	illustrate the preparation of biofertilizers.	<b>K3</b>
	<b>CO3</b>	gain knowledge on the preparation of different types of manures.	<b>K2</b>
	<b>CO4</b>	gain knowledge on the types of manures accordingly to the plant type.	<b>K2,K3</b>
	<b>CO5</b>	learn and compare the strategies for mass production of biofertilizers.	<b>K4</b>

### Mapping of COs with POs & PSOs

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	M	S	S	S	S	S	S	M	S
CO2	S	S	S	M	S	S	M	S	S	S	M	S	S
CO3	M	M	S	S	S	S	S	M	S	S	S	M	S
CO4	M	S	S	M	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S	S	M	S

Strongly Correlating (S) - 3 marks  
 Moderately Correlating (M) - 2 marks  
 Weakly Correlating (W) - 1 mark  
 No Correlation (N) - 0 mark

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