R. E. Society's
R.P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce
(Autonomous), Ratnagiri

Syllabus for
T. Y. B. Sc. Biotechnology Programme
Semester V and VI

Under Choice Based Credit System (CBCS)

To be implemented from the Academic Year
2025 - 2026

Name of Programme	**B. Sc. Biotechnology**
Level	UG
No. of Semesters	06
Year of Implementation	**2023 – 24**
Programme Specific Outcomes (PSO)	1. To impart skills in handling the cultures of micro – organisms. 2. To impart the knowledge of molecular biology techniques. 3. To impart the skills of Science communication. 4. To impart knowledge of society and make students aware about the Problems in society. 5. To understand basic principles of research methodology and identify a research problem. 6. To gain critical thinking and analytical skills to understand new diagnostic methods. 7. To write a business plan. 8. To design strategies for successful implementation of ideas.
Relevance of PSOs to the local, regional, national, and global developmental needs	Biotechnology is important at Global, Regional and local level. The significance of Biotechnology identified at all these levels and it is relevant to everyday life. The curriculum design of B. Sc. Biotechnology programme helps in understanding various concepts in detail. This programme includes hands on skills and knowledge of the different techniques related to molecular biology, tissue culture, basic chemistry and basic microbiology. This also involves the knowledge of problems in society. The application part is taken care of so that the learner shall be able to connect the phenomena around him with the curriculum. This programme also imparts the research values among the learners. The hard and softs skills acquired during the completion of this programme shall make him employable.

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 % marks in the first part and by conducting the Semester End Examinations of 60 % marks in the second part.

Standard of Passing:

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment & Semester End Examination. The learner shall obtain minimum of 40 % marks (i. e. 8 out of 20) in the Internal Assessment and 40 % marks in Semester End Examination (i. e. 12 out of 30) separately, to pass the course and minimum of Letter Grade "P" in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Performance Grading:

Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/Program	**% of Marks**	**Alpha-Sign / Letter Grade Result**
9.00-10.00	90.0 -100	0 (Outstanding)
8.00 ≤ 9.00	80.0 ≤ 90.0	A+ (Excellent)
7.00 ≤ 8.00	70.0 ≤ 80.0	A (Very Good)
6.00 ≤ 7.00	60.0 ≤ 70.0	B+ (Good)
5.50 ≤ 6.00	55.0 ≤ 60.0	B (Above Average)
5.00 ≤ 5.50	50.0 ≤ 55.0	C (Average)
4.00 ≤ 5.00	40.0 ≤ 50.0	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

Bachelor of Science (B.Sc.) in Biotechnology Programme
Under Choice Based Credit System (CBCS)
Course Structure

T. Y. Biotechnology

(To be implemented from Academic Year 2025-26)

Course Code	Semester V	Credits	Course Code	Semester VI	Credits
	Discipline Specific Course (DSC)			**Discipline Specific Course (DSC)**	
	Major Mandatory			**Major Mandatory**	
25_USBTM501	Genetic Engineering	**02**	25_USBTM601	Industrial Biotechnology	**02**
25_USBTM502	Pharmacology	**02**	25_USBTM602	Neurochemistry	**02**
25_USBTM503	Marine Biotechnology	**02**	25_USBTM603	Environmental Biotechnology	**02**
25_USBTM504	Biotechnology Practical V	**02**	25_USBTM604	Biotechnology Practical VII	**02**
25_USBTM505	Biotechnology Practical VI	**02**	25_USBTM605	Biotechnology Practical VIII	**02**
	Major Electives (Any 1)			**Major Electives (Any 1)**	
25_USBTE506	Biosafety	**02**	25_USBTE606	Cytogenetics	**02**
25_USBTE507	Biosafety Practical	**02**	25_USBTE607	Cytogenetics Practicals	**02**
OR			OR		
25_USBTE508	Clinical Immunology	**02**	25_USBTE608	Developmental Biology	**02**
25_USBTE509	Clinical Immunology Practical	**02**	25_USBTE609	Developmental Biology Practicals	**02**
	Vocational Skill Course (VSC)			**Vocational Skill Course (VSC)**	
25_USBTV510	Plant and Animal Tissue Culture	**02**	25_USBTV610	Entrepreneurship Development	**02**
25_USBTV511	Plant and Animal Tissue Culture Practical	**02**	25_USBTV611	Agribiotechnology	**02**
	Field Project (FP)			**On Job Training (OJT)**	
25_USBTF512	Field Project	**04**	25_USBTJ612	On Job Training	**04**
Total Credits		**22**	**Total Credits**		**22**

SMART Criteria for Course Outcomes:

Specific: Each course outcome is specific, outlining the knowledge and skills students are expected to acquire in relation to the specific topics covered.

Measurable: Each outcome can be measured through assessments, tests, or projects to determine the level of understanding and proficiency achieved by the students.

Achievable: The outcomes are achievable within the duration of the course, considering the number of lectures allocated to each topic.

Relevant: The outcomes are relevant to the subject of financial services and capital market, addressing important concepts, types, and mechanisms involved.

Time-bound: The outcomes are expected to be achieved by the end of the course, providing a clear timeline for assessment and evaluation.

Syllabus for Bachelor of Science in Biotechnology for the year 2025-26

Nomenclature of the Course	Genetic Engineering
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTM501
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 - Impart the knowledge of genetic engineering of plants and animals.

CO2 - Provide the skills in molecular biology tools and gene editing.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Genetic engineering of plants and animals	1.1 Genetic engineering of plants; Methodology – **2 Lectures** 1.2 Transgenic plants: Physical methods of transferring genes to plants: Electroporation. Microprojectile bombardment, liposome mediated, protoplast fusion - **4 Lectures** 1.3 Vectors for plant and animal cells - **2 Lectures** 1.4 Transgenic mice – Methodology: Retroviral method, DNA microinjection, ES method – **3 Lectures** 1.5 Cloning livestock by nuclear transfer, Green Fluorescent Protein - **2 Lectures** 1.6 Transgenic fish - **2 Lectures**
II	Tools in molecular biology and Gene editing	2.1 Cloning vectors – Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET - **4 Lectures** 2.2 Gene cloning – Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes - **3 Lectures** 2.3 Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART, HRT- **2 Lectures** 2.4 RNAi, ZNF (Zinc finger nucleases), TALENS (Transcription Activator Like Effector Nucleases), CRISPER/Cas system (Clustered Regularly Interspersed Repeats) - **6 Lectures**

Learning Resources recommended:

1. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
2. Biotechnology B.D. Singh.
3. Biotechnology- Fundamentals and Applications, 3rd Edition S.S. Purohit.
4. iGenetics: A molecular approach 3rd Edition, Peter J. Russell.
5. Principles of gene manipulation, 7th Edition, Primrose S. B., Twyman R. M.
6. Gene cloning and DNA analysis, 6th Edition, T. A. Brown.
7. Genomics, Cantor C. R. and Smith C. L., Jouhn Wiley & Sons. (1999)

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Genetic engineering of plants and animals	Chalk and Talk, AV resources	15
II	Tools in molecular biology and Gene editing	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Genetic engineering of plants and animals	Long Answer	06
Q. 1 B)	I Genetic engineering of plants and animals	Objective	04
Q. 2 A)	II Tools in molecular biology and Gene editing	Long Answer	06
Q. 2 B)	II Tools in molecular biology and Gene editing	Objective	04
Q. 3	I Genetic engineering of plants and animals and II Tools in molecular biology and Gene editing	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Pharmacology
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTM502
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 - Impart the knowledge of general principles of pharmacology.

CO2 – Impart the knowledge of drug absorption and distillation.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	General principles of pharmacology	1.1 Mechanism of drug action - **2 Lectures** 1.2 Drug receptors and biological responses – **2 Lectures** 1.3 Second-messenger systems, the chemistry of drug–receptor binding – **2 Lectures** 1.4 Dose–response relationship: therapeutic index - **3 Lectures** 1.5 ED, LD - **2 Lectures** 1.6 Potency and Intrinsic Activity – **2 Lectures** 1.7 Drug antagonism – **2 Lectures**
II	Drug absorption and distillation	2.1 Absorption of drugs from the alimentary tract - **2 Lectures** 2.2 Factors affecting rate of gastrointestinal absorption – **2 Lectures** 2.3 Absorption of drugs from lungs - **1 Lecture** 2.4 Skin - **1 Lecture** 2.5 Absorption of drugs after parenteral administration factors influencing drug distribution – **3 Lectures** 2.6 Binding of drugs to plasma proteins – **3 Lectures** 2.7 Physiological barriers to drug distribution – **3 Lectures**

Learning Resources recommended:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig, C.R, Stitzel, R. E 5th edition
3. Clinical Pharmacology Bennet, PN, Brown, M.J, Sharma, P 11th edition Elsevier

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	General principles of pharmacology	Chalk and Talk, AV resources	15
II	Drug absorption and distillation	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I General principles of pharmacology	Long Answer	06
Q. 1 B)	I General principles of pharmacology	Objective	04
Q. 2 A)	II Drug absorption and distillation	Long Answer	06
Q. 2 B)	II Drug absorption and distillation	Objective	04
Q. 3	I General principles of pharmacology and II Drug absorption and distillation	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Marine Biotechnology
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTM503
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 – Impart the knowledge of marine Biotechnology and acquire the significance of marine drugs, enzymes.

CO2 – Acquire the significance of marine functional foods, nutraceuticals and gain the role of marine bioresources in cosmetics.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Marine Biotechnology – Marine drugs and enzymes	1.1 Introduction to Marine Biotechnology- **1 lecture** 1.2 Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms- **2 lectures** 1.3 Methods for Microbial Bioprospecting in Marine Environments **- 2 lectures** 1.4 Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna – marine toxins, antiviral and antimicrobial agents – **4 lectures** 1.5 Approved Marine Drugs as Pharmaceuticals **– 2 lecture** 1.6 Marine Microbial Enzymes- Marine Extremozymes and Their Significance – **4 lectures**
II	Marine functional foods, nutraceuticals and Cosmetics	**2.1 Marine Functional Foods:** 2.1.1 Marine-Derived Ingredients with Biological Properties - **3 lectures** 2.1.2 Functional Foods Incorporating Marine-Derived Ingredients **- 2 lectures** **2.2 Marine Nutraceuticals:** 2.2.1 Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids - **2 lectures** 2.2.2 Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics **- 3 lectures** **2.3 Cosmetics from Marine Sources: 5 lectures** 2.3.1 Cosmetics: Definition and Regulations 2.3.2 Cosmeceuticals 2.3.3 Target Organs and Cosmetics Delivery Systems

		2.3.4 Components of Cosmetics 2.3.5 Treatments Based on Marine Resources 2.3.6 Products Based on Marine Resources

Learning Resources recommended:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.

2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017)

3. R. S. K. Barnes, R. N. Hughes (auth.)-An Introduction to Marine Ecology, Third Edition Wiley-Blackwell (1999)

4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)

5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)

6. W. Evans-Trease and Evans Pharmacognosy 15th ed.-Saunders (2010).

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Marine Biotechnology – Marine drugs and enzymes	Chalk and Talk, AV resources	15
II	Marine functional foods, nutraceuticals and Cosmetics	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Marine Biotechnology – Marine drugs and enzymes	Long Answer	06
Q. 1 B)	I Marine Biotechnology – Marine drugs and enzymes	Objective	04
Q. 2 A)	II Marine functional foods, nutraceuticals and Cosmetics	Long Answer	06
Q. 2 B)	II Marine functional foods, nutraceuticals and Cosmetics	Objective	04
Q. 3	I Marine Biotechnology – Marine drugs and enzymes and II Marine functional foods, nutraceuticals and Cosmetics	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical V
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTM504
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 – Impart knowledge and hands on experience of the various practicals related to Genetic engineering and Pharmacology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1. Transformation in *E. coli*. 2. Genomic DNA Extraction: Animal cells. 3. Restriction enzyme digestion (Kit may be used). 4. DNA ligation (Kit may be used). 5. Gradient plate technique 6. Bacterial gene expression (Kit may be used). 7. Vector mapping by restriction endonuclease. 8. LD 50, ED 50 evaluation using suitable models e.g. Daphnia

Learning Resources recommended:

1. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
2. Biotechnology B.D. Singh.
3. Biotechnology- Fundamentals and Applications, 3rd Edition S.S. Purohit.
4. iGenetics: A molecular approach 3rd Edition, Peter J. Russell.
5. Principles of gene manipulation, 7th Edition, Primrose S. B., Twyman R. M.
6. Gene cloning and DNA analysis, 6th Edition, T. A. Brown.
7. Genomics, Cantor C. R. and Smith C. L., Jouhn Wiley & Sons. (1999)
8. Modern Pharmacology with clinical Applications Craig, C.R, Stitzel, R.E 5th edition
9. Clinical Pharmacology Bennet, PN, Brown, M.J, Sharma, P 11th edition Elsevier

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical VI
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTM505
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 – Impart knowledge and hands on experience of the various practicals related to Marine Biotechnology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular, Demonstration Practicals and Visit	1. Visit to nearby coastal areas or marine research centres. 2. Study of any 5 marine bacteria and algae (Macro and micro) 3. DPPH assay for antioxidant extracted from marine algae 4. Extraction of carotenoids from marine algae/Bacteria/Fungi 5. Extraction and estimation of Gelatin from Fish. 6. Extraction of Collagen from Fish and estimation of collagen by Bradford method. 7. Extraction of alkaloids from marine organisms and their separation by TLC.

Learning Resources recommended:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press Taylor & Francis (2017)
3. R. S. K. Barnes, R. N. Hughes (auth.)-An Introduction to Marine Ecology, Third Edition Wiley-Blackwell (1999)

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular, Demonstration Practicals and Visit	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Type of Experiment**	**Marks**
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biosafety
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTE506
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

By the end of the course, the student will be able to:
CO1 – Impart the knowledge of Biosafety practices.
CO2 – Provide the knowledge about detection and testing of contaminants.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Introduction to biosafety and GLP	1.1 Introduction - **1 lecture** 1.2 Biological Risk Assessment, Hazardous Characteristics of an Agent- **2 lectures** 1.3 Genetically modified agent hazards – **1 lecture** 1.4 Cell cultures - **1 lecture** 1.5 Hazardous Characteristics of Laboratory Procedures – **1 lecture** 1.6 Potential Hazards Associated with Work Practices – **2 lectures** 1.7 Safety Equipment and Facility Safeguards - **1 lecture** 1.8 Pathogenic risk and management - **2 lectures** 1.9 Concept of GLP- **1 lecture** 1.10 Preparation of SOPs - **1 lecture** 1.11 Calibration records - **1 lecture** 1.12 Validation of methods - **1 lecture**
II	Testing of contaminants and Biosafety in Biotechnology	2.1 Microbial Contamination in food and pharma product - **1 lecture** 2.2 Some common microbial contaminants - **2 lectures** 2.3 Microbiological Assays for pharmaceutical products – **2 lectures** 2.4 Concepts on biosafety in Biotechnology - **2 lectures** 2.5 Regulating rDNA technology -**2 lectures** 2.6 Regulating food and food ingredients – **2 lectures** 2.7 Genetically engineered crops, livestock Bioethics – **2 lectures** 2.8 Contemporary issues in Bioethics - **2 lectures**

Learning Resources recommended:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.

2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers.

3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Introduction to biosafety and GLP	Chalk and Talk, AV resources	15
II	Testing of contaminants and Biosafety in Biotechnology	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Introduction to biosafety and GLP	Long Answer	06
Q. 1 B)	I Introduction to biosafety and GLP	Objective	04
Q. 2 A)	II Testing of contaminants and Biosafety in Biotechnology	Long Answer	06
Q. 2 B)	II Testing of contaminants and Biosafety in Biotechnology	Objective	04
Q. 3	I Introduction to biosafety and GLP and II Testing of contaminants and Biosafety in Biotechnology	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biosafety Practical
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTE507
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – Impart knowledge and hands on experience of the various practicals related to biosafety.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1.Validation of micropipette, measuring cylinders, colorimeters 2. Calibration of pH meter and weighing balance 3. Vitamin B12 bioassay 4. Testing for adulterants in food; ex. Starch in milk 5. Making SOP for any 2 major laboratory instruments 6. Sterility of injectables

Learning Resources recommended:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.

2. Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.

3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Type of Experiment**	**Marks**
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Clinical Immunology
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTE508
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – Categorize and understand the different types of hypersensitivity reactions (Type I-IV).

CO2 – Provide a comprehensive understanding of the regulatory mechanisms of cytokines and their implications in allergic and autoimmune conditions.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Innate immune reactions and hypersensitivity	1.1 Innate immune response: overview Inflammation, Antiviral defense; Microbial Evasion of Innate Immunity, Regulation of Innate Immune Responses. Role of innate immunity in stimulating adaptive immune responses - **5 lectures** 1.2 Introduction to hypersensitivity - **1 lecture** 1.3 Types and treatment/ therapy; Type I Hypersensitivity Reactions (Allergy) - **3 lectures** 1.4 Antibody-Mediated (Type II); Hypersensitivity reactions - **2 lectures** 1.5 Immune Complex-Mediated (Type III) Hypersensitivity - **2 lectures** 1.6 Delayed-Type (Type IV) Hypersensitivity (DTH) - **2 lectures**
II	Cytokines and Autoimmunity	2.1 Cytokines - history , properties , functional categories of cytokines (overview), cytokine receptors, role of cytokines and cytokine receptors in disease - **7 lectures** 2.2 Autoimmune Diseases which target Specific Organs: Hashimoto's Thyroiditis, Type 1 Diabetes Mellitus, Myasthenia Gravis - **3 lectures** 2.3 Systemic Autoimmune Diseases: Systemic Lupus Erythematosus (SLE), Multiple Sclerosis, Rheumatoid Arthritis - **4 lectures** 2.4 Treatment/ therapy - **1 lecture**

Learning Resources recommended:

1. Kuby Immunology, Eighth Edition, ISBN: 978-1-319-26722-3
2. Kuby Immunology, Seventh Edition
3. Basic Immunology: Functions and Disorders of the Immune System 7th Edition Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
4. Cellular and Molecular Immunology 7th Edition Abul K. Abbas , Andrew H. Lichtman, Shiv Pillai
5. IMMUNOLOGY A Short Course 7th Edition Richard Coico, Geoffrey Sunshine
6. Introductory Immunology Basic Concepts for Interdisciplinary Applications 1st Edition Jeffrey K. Actor

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Innate immune reactions and hypersensitivity	Chalk and Talk, AV resources	15
II	Cytokines and Autoimmunity	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Innate immune reactions and hypersensitivity	Long Answer	06
Q. 1 B)	I Innate immune reactions and hypersensitivity	Objective	04
Q. 2 A)	II Cytokines and Autoimmunity	Long Answer	06
Q. 2 B)	II Cytokines and Autoimmunity	Objective	04
Q. 3	I Innate immune reactions and hypersensitivity and II Cytokines and Autoimmunity	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Clinical Immunology Practical
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTE509
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – Impart knowledge and hands on experience of the various practicals related to clinical immunology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1. Poster making on any of the following topics: i) Autoimmunity ii) Cytokines 2. Anti-globulin testing (Coomb's Test) (Demonstration) 3. Analysis of Immunoglobulins by Serum electrophoresis 4. Detection of antigen-antibody complexes by Rocket immunoelectrophoresis. 5. Complement Fixation Test (CFT) 6. Passive agglutination – RA Factor Test 7. Immunodiffusion technique – Single Radial Immunodiffusion by Mancini method 8. Immunodiffusion technique – Double Immunodiffusion by Ouchterlony method 9. ELISA (Kit based.) - HEPELISA. 10. DOT-ELISA.

Learning Resources recommended:

1. Kuby IMMUNOLOGY, Eighth Edition, ISBN: 978-1-319-26722-3
2. Kuby IMMUNOLOGY, Seventh Edition
3. Basic Immunology: Functions and Disorders of the Immune System 7th Edition Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
4. Cellular and Molecular Immunology 7th Edition Abul K. Abbas , Andrew H. Lichtman , Shiv Pillai
5. IMMUNOLOGY A Short Course 7th Edition Richard Coico, Geoffrey Sunshine
6. Introductory Immunology Basic Concepts for Interdisciplinary Applications 1st Edition Jeffrey K. Actor

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Plant and Animal Tissue Culture
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTV510
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Vocational Skill Course (VSC)

Course Outcomes:

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

CO1 – Impart the knowledge of plant tissue culture.

CO2 – Impart the knowledge of animal tissue culture.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Plant Tissue Culture	1.1 Cell Theory, Concept of Cell Culture, Cellular Totipotency – **3 Lectures** 1.2 Organization of Plant Tissue Culture Laboratory: Equipments and Instruments – **3 Lectures** 1.3 Aseptic Techniques: Washing of Glassware, Media Sterilization, Aseptic Workstation, Precautions to maintain Aseptic Conditions – **3 Lectures** 1.4 Culture Medium: Nutritional requirements of the explants, PGR's and their in-vitro roles, Media Preparation – **3 Lectures** 1.5 Callus Culture Technique: Introduction, Principle and Protocols – **3 Lectures**
II	Animal Tissue Culture	2.1 Basics of Animal Tissue Culture – Introduction, Cell Culture Techniques, Equipment and Sterilization Methodology – **3 Lectures** 2.2 Introduction to Animal Cell Cultures: Nutritional and Physiological: Growth Factors and Growth Parameters – **3 Lectures** 2.3 General Metabolism and Growth Kinetics – **3 Lectures** 2.4 Primary Cell Cultures: Establishment and Maintenance of Primary Cell Cultures of Adherent and Non-Adherent Cell Lines with examples – **3 Lectures** 2.5 Application of Cell Cultures – **3 Lectures**

Learning Resources recommended:

1. Culture of Animal cells- Ian Freshney -- John Wiley & Sons
2. Principles and Practice of Animal Tissue culture- Sudha Gangal - University Press
3. Plant Biotechnology- K. G. Ramavat S.Chand Publications
4. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge University Press

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Plant Tissue Culture	Chalk and Talk, AV resources	15
II	Animal Tissue Culture	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Plant Tissue Culture	Long Answer	06
Q. 1 B)	I Plant Tissue Culture	Objective	04
Q. 2 A)	II Animal Tissue Culture	Long Answer	06
Q. 2 B)	II Animal Tissue Culture	Objective	04
Q. 3	I Plant Tissue Culture and II Animal Tissue Culture	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Plant and Animal Tissue Culture Practical
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTV511
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Vocational Skill Course (VSC)

Course Outcomes:

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

CO1 – Impart knowledge and hands on experience of the various practicals related to plant and animal tissue culture.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1. Working and use of various Instruments used in Biotechnology Laboratory (Autoclave, Hot air Oven, Centrifuge, Incubator, Rotary Shaker, Filter Assembly, LAF, pH meter and Colorimeter) 2. Laboratory Organization and Layout for Plant and Animal Tissue Culture Laboratory 3. Surface sterilization of explant 4. Preparation of Stock Solutions and Preparation of Media for PTC 5. Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture 6. Preparation of synthetic seeds. 7. Isolation of plant protoplast by enzymatic and mechanical methods. 8. Media Preparation and Sterilization (ATC) 9. Trypsinization of Tissue and Viability Count

Learning Resources recommended:

1. Culture of Animal cells- Ian Freshney -- John Wiley & Sons
2. Principles and Practice of Animal Tissue culture- Sudha Gangal - University Press
3. Plant Biotechnology- K. G. Ramavat S.Chand Publications
4. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge University Press

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Inclusion of Field Project in the course curriculum of the B.Sc. in Biotechnology programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of Field Project is to inculcate ability to interpret particular aspect of the study in his/ her own words.

Guidelines for Field Project

The Field Project for Bachelor of Science in Biotechnology is designed to provide students with hands-on learning experiences in understanding different methods and techniques. The project aims to expose students to development-related issues in both rural and urban settings. It offers opportunities for students to observe and study actual field situations related to Biotechnology and programmes that guide the development process. Additionally, students will explore innovative practices to address complex problems in the society.

Course Objectives:
By the end of the course, students should be able to -
1. Think critically, organize and analyze scientific data.
2. Develop advanced scientific writing skills to write research articles, reviews, thesis and proposals and to make oral, poster or Powerpoint presentations.
3. Understand the best practices of scientific writing by adhering to research ethics and by avoiding plagiarism.

Course Duration: One Semester Minimum 20 days / 120 hours of field project work.

Course Outline:

1. **Introduction to Field Project (10 Hours)**
   Understanding the significance of field-based learning in societal development. Identifying the objectives and expected outcomes of the field project.
   Selecting suitable rural and urban settings for the project.
2. **Field Visits and Observations (30 Hours)**
   Organizing field visits to selected rural and urban areas. Observing and documenting the societal conditions, challenges and opportunities in the community.
   Engaging with local stakeholders and understanding their perspectives.
3. **Research and Data Collection (20 Hours)**
   Designing research methodologies and data collection tools. Collecting primary and secondary data related to development issues. Analyzing and interpreting the data to identify key challenges and potential solutions.
4. **Understanding Policies and Programmes (20 Hours)**
   Exploring government policies and programmes related to societal development. Studying the role of various organizations in implementing development initiatives.
5. **Identifying Innovative Solutions (20 Hours)**
   Brainstorming and ideating innovative practices to address identified societal problems. Developing action plans for implementing proposed solutions.

6. **Preparing Project Report and Presentations (20 Hours)**
   Preparing a detailed project report as per the format and making presentations for the same. Developing Report writing and presentation skills among the learner.

Rubrics for Field Project Report Evaluation:

1. **Content (40 Marks):**

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unsatisfactory (1)
Introduction and Objectives	Clear and well-defined	Clearly stated	Adequately stated	Vaguely stated	Not stated or unclear
Literature Review	Comprehensive and relevant	Relevant and adequate	Limited relevance	Inadequate or missing	Not included
Field Visits and Observations	Thorough and detailed	Adequate information	Limited data collection	Incomplete or lacking detail	No field observations made
Data Analysis	In-depth analysis	Analyzed effectively	Some analysis performed	Superficial or incomplete	No data analysis conducted
Understanding of Policies and Programmes	Strong understanding	Adequate understanding	Limited understanding	Inadequate or inaccurate	No understanding displayed
Identified Socio-Economic Problems	Comprehensive and clear	Clearly identified	Some problems identified	Inadequate or vague	No problems identified
Conclusion	Concise and conclusive	Clear and summarized	Somewhat conclusive	Unclear or missing	No conclusion provided
Recommendations	Well-developed and feasible	Feasible and relevant	Partially feasible	Infeasible or lacking detail	No recommendations given

2. Presentation (20 Marks):

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unsatisfactory (1)
Structure and Organization	Well-structured and logical	Clear organization	Adequate organization	Lacks structure	Disorganized and unclear
Language and Clarity	Clear, concise, and fluent	Fluent language	Some clarity issues	Difficult to understand	Incoherent and unclear
Visual Presentation	Professional and engaging	Neat and presentable	Some visual aids used	Minimal use of visuals	No visuals used
Grammar and Spelling	No errors in grammar/spelling	Minor errors	Some errors	Frequent errors	Numerous errors

3. Research Methodology (10 Marks):

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unsatisfactory (1)
Appropriate Method Selection	Highly appropriate	Mostly appropriate	Adequate method choice	Inappropriate methods	No clear method used
Data Collection and Analysis	Thorough data collection	Adequate data analysis	Limited analysis	Incomplete or weak analysis	No data analysis done

4. Creativity and Innovation (20 Marks):

Criteria	Excellent (10)	Good (8)	Satisfactory (6)	Needs Improvement (4)	Unsatisfactory (2)
Innovation in Problem Solving	Highly innovative	Innovative solutions	Some creativity shown	Lacks creativity	No innovative solutions

5. Overall Impression (10 Marks):

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Unsatisfactory (1)
Overall Quality	Exceptional quality	High quality	Acceptable quality	Below acceptable	Poor quality
Contribution and Learning	Outstanding contribution	Significant contribution	Some contribution	Limited or no learning	No contribution or learning

Conclusion:

The Field Project for Bachelor of Science in Biotechnology provides students with invaluable experiences in understanding societal contexts and development-related issues. Through field visits, research and innovative thinking, students gain practical insights into addressing complex challenges and contributing to the societal development of communities. The rubrics for evaluation ensure a comprehensive assessment of students' learning and contributions during the project.

a) **Title Page:**

Mentioning the title of the report, name of the student, program, institution and the period of training/project.

b) **Certificate of Completion:**

A certificate issued by the organization or guide confirming the successful completion of the project.

c) Declaration:

A statement by the student declaring that the report is their original work and acknowledging any assistance or references used.

d) Acknowledgment:

Recognizing individuals or organizations that provided support, guidance or resources during the project.

e) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

f) Executive Summary:

A bird's eye view of your entire presentation has to be precisely offered under this Category. A brief overview of the project, its objectives, and key findings should be mentioned.

g) Introduction:

Background information about the field project and its significance. Objectives and scope of the project.

h) Literature Review:

Overview of relevant literature and studies related to the chosen field and development issues.

i) Methodology:

Description of the research methods used for data collection, such as interviews, surveys, or observations. Explanation of the data analysis techniques employed.

j) Field Visits and Observations:

Detailed accounts of the field visits including locations, dates and observations made during the visits. Photographs or visual aids to support the observations.

k) Data Analysis:

Presentation and interpretation of the data collected during the field visits. Charts, graphs, or tables to illustrate the findings.

i) Understanding Policies and Programmes:

Explanation of relevant government policies and programmes related to the identified development issues. Assessment of how these policies will be implemented in the field context.

ii) Identified Societal Problems:

Detailed description of the complex societal problems observed in the community. Analysis of the root causes and implications of these problems.

l) Innovative Solutions:

Presentation of innovative practices proposed to address the identified problems. Description of the action plans to implement these solutions.

m) Conclusion & Recommendations:

Summary of the key findings and outcomes of the field project. Reflections on the overall experience and learning during the project. Specific recommendations for policymakers, organizations, or stakeholders to address the identified issues.

n) References & Appendices:

List of all sources cited in the project report. Additional supporting materials, such as interview transcripts, survey questionnaires, or field visit notes can be attached as appendices.

The project report based on 'Field Project' shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work
- Paper Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Project Report shall be bounded.

Format

1st page (Main Page)

Title of the problem of the Project

A Project Submitted

to

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce, Ratnagiri (Autonomous)

under

University of Mumbai

for partial completion of the degree

of

Bachelor in Science

in special Group Biotechnology

Under the Faculty of Science

By

Name of Student

Under the Guidance of

Name of the Guiding Teacher

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce, Ratnagiri (Autonomous)

Near District Court

Month and Year

On separate page

Index

On separate page

Declaration by learner

I the undersigned Miss/Mr. _____
[Name of the learner] here by, declare that work embodied in this project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own research work and has not been previously submitted to any other University for any other Degree/ Diploma to this or any other University.
Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.
I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by
Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(Model structure of the acknowledgement)

To list who all have helped me is difficult because they are so numerous and the depth is so enormous.

I would like to acknowledge the following as being idealistic channels and fresh dimensions in the completion of this project.

I thank the **R. P. Gogate college of Arts & Science and R. V. Jogalekar College of Commerce, Ratnagiri (Autonomous) & University of Mumbai** for giving me opportunity to do this project.

I would like to thank my Principal, _____for providing the necessary facilities required for completion of this project.

I take this opportunity to thank our Head _____, for his moral support and guidance.

I would also like to express my sincere gratitude towards my project guide _____ whose guidance and care made the project successful.

I would like to thank my College Library, for having provided various reference books and magazines related to my project.

Lastly, I would like to thank each and every person who directly or indirectly helped me in the completion of the project especially my Parents and Peers who supported me throughout my project.

Syllabus for Bachelor of Science in Biotechnology for the year 2025-26

Nomenclature of the Course	Industrial Biotechnology
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTM601
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 - Impart the knowledge of Dairy technology.

CO2 - Gain the detailing of fermentation processes, downstream processing and QA-QC.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Dairy Technology	1.1 Types of microorganisms present in milk: acid and gas producing, protein and fat splitting, pathogenic and inert organisms -**1 lecture** 1.2 Biochemical changes during storage and abnormal fermentation- **1 lecture** 1.3 Factors affecting bacteriological quality - **1 lecture** 1.4 Microbiological examination of milk - **2 lectures** 1.5 Dairy technology Preservation methods - **2 lectures** 1.6 Starter Cultures - **1 lecture** 1.7 Fermented products – Production process and spoilage of Cheese: Swiss and Cheddar - **2 lectures** 1.8 Butter - **1 lecture** 1.9 Yogurt - **1 lecture** 1.10 Buttermilk – **1 lecture** 1.11 Milk borne diseases: bacterial, Viral and other diseases - **2 lectures**
II	Fermentation Processes – Downstream processing and QA-QC	2.1 Concept of scale up, scale down; Commercial production of various bioprocess based products (Bioethanol, Citric acid) - **2 lectures** 2.2 Single cell protein - **1 lecture** 2.3 Microbial polysaccharides and their applications in food processing industries - **2 lectures** 2.4 Downstream processing: Definition, criteria and typical steps involved in DSP (with examples) - **2 lectures** 2.5 Concept of GMP and Requirements of GMP implementation – **2 Lectures**

		2.6 Quality Control (QC): Concept of QC and Requirements for implementing QC **- 3 Lectures** 2.7 QA concepts: Concept of QA and Requirements for implementing – **3 Lectures**

Learning Resources recommended:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition
2. Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.
3. Dairy technology by Yadav and Grower
4. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
5. Industrial Microbiology Prescott and Dunn CBS publishers
6. Fermentation technology by Stanbury and Whittkar
7. Glazer, A.N. and Nikaido, H. (2008). Microbial Biotechnology. Cambridge University Press. 576 pp.
8. Pharmaceutical Microbiology by Russel and Hugo

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Dairy Technology	Chalk and Talk, AV resources	15
II	Fermentation Processes – Downstream processing and QA-QC	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Dairy Technology	Long Answer	06
Q. 1 B)	I Dairy Technology	Objective	04
Q. 2 A)	II Fermentation Processes – Downstream processing and QA-QC	Long Answer	06
Q. 2 B)	II Fermentation Processes – Downstream processing and QA-QC	Objective	04
Q. 3	I Dairy Technology and II Fermentation Processes – Downstream processing and QA-QC	Short Note	10

Nomenclature of the Course	Neurochemistry
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTM602
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 - Impart the knowledge of the anatomy and functions of the neurons and the action of the various Neuro toxins.

CO2 – Get insight into the different aspects related to neurochemistry.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Neurochemistry – I	1.1 Anatomy and Functions of Neurons – **2 Lectures** 1.2 Organization of the brain – **2 Lectures** 1.3 Neuronal pathways and systems - **3 Lectures** 1.4 The Propagation of nerve impulses - **2 Lectures** 1.5 Ion conducting channels – **3 Lectures** 1.6 A Plethora of Neuro toxins - **3 Lectures**
II	Neurochemistry – II	2.1 Neuronal metabolism – **2 Lectures** 2.2 Synapses and gap junctions - **2 Lectures** 2.3 Neurotransmitters - **3 Lectures** 2.4 Additives, Psychotropic and Toxic Drugs - **2 Lectures** 2.5 The Senses: Sight, Smell, Taste, Hearing, Touch - **2 Lectures** 2.6 The Chemistry of Learning, Memory and Thinking - **2 Lectures** 2.7 Circadian cycles and Sleep - **2 Lectures**

Learning Resources recommended:

Biochemistry – The Chemical Reactions of Living Cells by Metzler D. E. Elsevier, Page No. 1762 - 1808

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Neurochemistry – I	Chalk and Talk, AV resources	15
II	Neurochemistry – II	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Neurochemistry – I	Long Answer	06
Q. 1 B)	I Neurochemistry – I	Objective	04
Q. 2 A)	II Neurochemistry – II	Long Answer	06
Q. 2 B)	II Neurochemistry – II	Objective	04
Q. 3	I Neurochemistry - I and II Neurochemistry – II	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Environmental Biotechnology
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTM603
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

By the end of the course, the student will be able to:
CO1 - Gain knowledge about wastewater treatments.
CO2 - Provide the understanding of hazardous waste management.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Wastewater treatment	1.1 Wastewater treatment - Introduction, biological treatment, impact of pollutants on biotreatment, use of packaged organisms and genetically engineered organisms in waste treatment – **5 Lectures** 1.2 Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal – **5 Lectures** 1.3 Biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption - **5 Lectures**
II	Hazardous waste management	2.1 Biodegradation of waste from – 2.1.1 Tanning industry - **2 Lectures** 2.1.2 Petroleum industry - **2 Lectures** 2.1.3 Paper and pulp industry - **2 Lectures** 2.1.4 Dairy – **2 Lectures** 2.1.5 Distillery - **2 Lectures** 2.1.6 Dye – **1 Lecture** 2.1.7 Antibiotic industry - **2 Lectures** 2.2 Removal of oil spillage and grease deposits – **2 Lectures**

Learning Resources recommended:

1. Environmental Biotechnology Allan Scragg Oxford University press

2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International

3. Environmental Biotechnology (Industrial pollution management) S.N. Jogdand Himalaya Publishing House

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Wastewater treatment	Chalk and Talk, AV resources	15
II	Hazardous waste management	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Wastewater treatment	Long Answer	06
Q. 1 B)	I Wastewater treatment	Objective	04
Q. 2 A)	II Hazardous waste management	Long Answer	06
Q. 2 B)	II Hazardous waste management	Objective	04
Q. 3	I Wastewater treatment and II Hazardous waste management	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical VII
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTM604
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 – To impart knowledge and hands on experience of the various practicals related to Industrial Biotechnology and Neurochemistry.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular, Demonstration Practicals and Visit	1. Determination of fat content of paneer using Gerber method 2. Estimation of Milk protein - Pynes method 3. Microbial analysis of Milk by MBRT 4. Microbial analysis of Milk by RRT 5. Phosphatase test in Milk 6. DMC of milk sample 7. Isolation of Normal flora from Milk and curd 8. Visit a Dairy plant to observe the preparation of Concentrated and dried milk and other dairy products 9. Chemistry of thinking: a. Study of different regions of brain using models b. Stroop test and blind spot test c. Colour blindness and optical illusions

Learning Resources recommended:

1. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.

2. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition

3. Industrial Microbiology Prescott and Dunn CBS publishers

4. Dairy technology by Yadav and Grower

5. Biochemistry – The Chemical Reactions of Living Cells by Metzler D. E. Elsevier

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular, Demonstration Practicals and Visit	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical VIII
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTM605
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Mandatory

Course Outcomes:

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

CO1 – To impart knowledge and hands on experience of the various practicals related to Industrial and Environmental Biotechnology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular, Demonstration Practicals and Visit	1. Study the effect of heavy metals on the growth of bacteria. 2. Determination of Total Solids from an effluent sample. 3. Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample 4. Estimation of chromium from Effluents (Demonstration) 5. Isolation of Rhizobium 6. Isolation of Azotobacter 7. Isolation of Phosphate solubilizing bacteria 8. Visit to ETP/ CET. 9. Visit to green house facility and submission of field visit report.

Learning Resources recommended:

1. Environmental Biotechnology Allan Scragg Oxford University press

2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International

3. Environmental Biotechnology (Industrial pollution management) S.N. Jogdand Himalaya Publishing House

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular, Demonstration Practicals and Visit	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Type of Experiment**	**Marks**
Q. 1	Major	20
Q. 2	Minor	10

Nomenclature of the Course	Cytogenetics
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTE606
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – Impart the knowledge of the structure of chromosomes and types of chromosomal aberrations.

CO2 – Provide the knowledge of the principles underlying sex determination, linkage and mapping.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Cytogenetics - I	1.1 Structure of Chromosome – Heterochromatin, Euchromatin, Polytene chromosomes. 1.2 Variation in chromosomal structure and number: 1.2.1 Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy 1.2.2 Syndromes – Klinefelter, Turner, Cri-du-Chat, Trisomy-21, Trisomy 18 and Trisomy 13
II	Cytogenetics - II	2.1 Sex Determination and Sex Linkage: Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) 2.2 Dosage compensation and Barr Body 2.3 Genetic Linkage, Crossing over 2.4 Chromosomal mapping: Tetrad analysis, Two-point cross, Three point cross, Pedigree analysis.

Learning Resources recommended:

1. iGenetics by Peter Russell, Pearson Education

2. Microbial Genetics by Freifelder – Narosa Publishing House

3. Genes XI, 11th Edition (2012), Benjamin Lewin, Publisher – Jones and Barlett Inc. USA.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Cytogenetics – I	Chalk and Talk, AV resources	15
II	Cytogenetics – II	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Cytogenetics – I	Long Answer	06
Q. 1 B)	I Cytogenetics – I	Objective	04
Q. 2 A)	II Cytogenetics – II	Long Answer	06
Q. 2 B)	II Cytogenetics – II	Objective	04
Q. 3	I Cytogenetics - I and II Cytogenetics – II	Short Note	10

Nomenclature of the Course	Cytogenetics Practical
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTE607
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – To impart knowledge and hands on experience of the various practicals related to cytogenetics.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1. Study of chromosomal aberrations - Deletion, Duplication, Inversion, Translocation and Syndromes – Klinefelter, Turner, Cri-du-Chat, Trisomy-21, Trisomy 18 and Trisomy 13. 2. Study of Polytene chromosomes. 3. Mapping based on Tetrad analysis and Three point cross. 4. Pedigree analysis – Autosomal and Sex-linked.

Learning Resources recommended:

1. iGenetics by Peter Russell, Pearson Education

2. Microbial Genetics by Freifelder – Narosa Publishing House

3. Genes XI, 11th Edition (2012), Benjamin Lewin, Publisher – Jones and Barlett Inc. USA.

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Type of Experiment**	**Marks**
Q. 1	Major	20
Q. 2	Minor	10

Nomenclature of the Course	Developmental Biology
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTE608
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

By the end of the course, the student will be able to:
CO1 – Impart the knowledge of human embryonic development and post fertilization events.
CO2 – Gain insight into the understanding of implantation, infertility and ethical issues.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Developmental Biology - I	1.1 Definition, scope and historical perspective of developmental biology. 1.2 Human Embryonic development: Events during fertilization, in vitro fertilization, Zona pellucida, glycoprotein, Oelemma protein and their role in fertilization, sperm antigens and their functional significance. 1.3 Post fertilization events: Early embryonic development, formation of blastula, embryonic germ layer.
II	Developmental Biology - II	2.1 Implantation and endometrium antigens involved in implantation. 2.2 Immunology of pregnancy, Superovulation, embryo culture and embryo transfer technology. 2.3 Infertility and reproductive vaccines 2.4 Cryopreservation of sex gametes and embryos 2.5 Ethical issues related to embryo research.

Learning Resources recommended:

1. Gilbert, S. F. (2006), Developmental Biology, VIII Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.

2. Balinsky, B. I. (2008). An introduction to Embryology, International Thomson Computer Press.

3. Kalthoff (2000), Analysis of Biological Development, II Edition, McGraw-Hill Professional.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Developmental Biology – I	Chalk and Talk, AV resources	15
II	Developmental Biology – II	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Developmental Biology - I	Long Answer	06
Q. 1 B)	I Developmental Biology - I	Objective	04
Q. 2 A)	II Developmental Biology - II	Long Answer	06
Q. 2 B)	II Developmental Biology - II	Objective	04
Q. 3	I Developmental Biology - I and II Developmental Biology - II	Short Note	10

Nomenclature of the Course	Developmental Biology Practical
Class	T. Y. B. Sc.
Semester	V
Course Code	25_USBTE609
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other~~
Type	Major Elective

Course Outcomes:

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

CO1 – To impart knowledge and hands on experience of the various practicals related to Developmental Biology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	1. Identification of developmental stages of chick embryo using permanent mounts or photographs 2. Preparation of a temporary stained mount of chick embryo. 3. Study of developmental stages of *Anopheles*. 4. Study the developmental stages of *Drosophila* from stock culture or photographs. 5. Study of the different types of placenta.

Learning Resources recommended:

1. Gilbert, S. F. (2006), Developmental Biology, VIII Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.

2. Balinsky, B. I. (2008). An introduction to Embryology, International Thomson Computer Press.

3. Kalthoff (2000), Analysis of Biological Development, II Edition, McGraw-Hill Professional.

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	**Marks**
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	**Type of Experiment**	**Marks**
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Entrepreneurship Development
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTV610
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Vocational Skill Course (VSC)

Course Outcomes:

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

CO1 – To develop and systematically apply an entrepreneurial way of thinking.

CO2 – To identify and create the business opportunities.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	1.1 Concept of Entrepreneur; Entrepreneurship; Need and Importance 1.2 Factors Influencing Entrepreneurship 1.3 Essentials of a Successful Entrepreneur, Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning 1.4 Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection 1.5 Preparation of a Business Plan, Characteristics and Importance of Planning
II	Marketing, sales, advertising and International market research	2.1 Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment 2.2 Need for International Market Research, Domestic *vs.* International Market Research 2.3 Cost and Methodology of Market Research 2.4 Desk and Field Research

Learning Resources recommended:

1. Towards Entrepreneurship by Dr. M. R. Kurup

2. Handbook of Entrepreneurship Development by Basotia and Sharma

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Chalk and Talk, AV resources	15
II	Marketing, sales, advertising and International market research	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Long Answer	06
Q. 1 B)	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Objective	04
Q. 2 A)	II Marketing, sales, advertising and International market research	Long Answer	06
Q. 2 B)	II Marketing, sales, advertising and International market research	Objective	04
Q. 3	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning and II Marketing, sales, advertising and International market research	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Agribiotechnology
Class	T. Y. B. Sc.
Semester	VI
Course Code	25_USBTV611
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other~~
Type	Vocational Skill Course (VSC)

Course Outcomes:

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

CO1 – Impart the knowledge of agricultural systems and provide understanding of plant stress biology.

CO2 – Explore the significance of molecular markers in plant breeding and gain knowledge about the importance of biofertilizers and biopesticides.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Agricultural systems and plant stress biology	1.1 Introduction to Agriculture and Agriculture systems - **1 Lecture** 1.2 Green-house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation - **2 Lectures** 1.3 Construction material, covering material and its characteristics, growing media, green house irrigation system. Nutrient management - **3 Lectures** 1.4 Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment – **3 Lectures** 1.5 Phytotrons, fertigation and roof system -**1 Lecture** 1.6 Precision Cultivation - tools, sensors for information acquisition - **2 Lectures** 1.7 Abiotic stress – Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photooxidative stress - **2 Lectures** 1.8 Biotic stress - plant interaction with bacterial, viral and fungal pathogens, systemic and induced resistance – pathogen derived resistance, signalling - **1 Lecture**
II	Molecular markers in plant breeding, Biofertilizers and biopesticides	2.1 **Genetic markers in plant breeding -** Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP)- **2 Lectures** 2.2 Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping] - **1 Lecture**

		2.3 Plant DNA Barcoding- Barcoding Markers (matK, rbcl, ITS, tmHpsbA) - **1 Lecture** 2.4 **Biofertilizer:** Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers -**2 Lectures** 2.5 Non-symbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate- Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance- **2 Lectures** 2.6 Plant Growth Promotion by Fungi-- Mycorrhizae Arbuscular, Mycorrhizae Ectomycorrhizae **-1 Lecture** 2.7 Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations-**3 Lectures** 2.8 **Biopesticides –** types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application) - **3 Lectures**

Learning Resources recommended:

1. M. Ajmal Ali, G. Gyulai, F. Al-Hemaid -Plant DNA Barcoding and Phylogenetics, LAP Lambert Academic Publishing (2015)

2. P. Parvatha Reddy (auth.)-Sustainable Crop Protection under Protected Cultivation-Springer Singapore (2016)

3. S.B. Anderson (ed.), Plant Breeding from Laboratories to Fields, InTech, 2013

4. Henry Leung, Subhas Chandra Mukhopadhyay (eds.) - Intelligent Environmental Sensing (2015, Springer International Publishing)

5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)

6. Altieri, Miguel A.Farrell, John G-Agroecology- The Science of Sustainable Agriculture, Second Edition-CRC Press (2018)

7. Arie Altman, Paul Michael Hasegawa-Plant Biotechnology and Agriculture_ Prospects for the 21st Century-Academic Press (2011)

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Agricultural systems and plant stress biology	Chalk and Talk, AV resources	15
II	Molecular markers in plant breeding, Biofertilizers and biopesticides	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Agricultural systems and plant stress biology	Long Answer	06
Q. 1 B)	I Agricultural systems and plant stress biology	Objective	04
Q. 2 A)	II Molecular markers in plant breeding, Biofertilizers and biopesticides	Long Answer	06
Q. 2 B)	II Molecular markers in plant breeding, Biofertilizers and biopesticides	Objective	04
Q. 3	I Agricultural systems and plant stress biology and II Molecular markers in plant breeding, Biofertilizers and biopesticides	Short Note	10

Guidelines and Evaluation pattern for On Job Training (100 Marks)

Introduction:

Inclusion of On Job Training in the course curriculum of the B.Sc. in Biotechnology programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of On Job Training is to inculcate ability to interpret particular aspect of the study in his/ her own words.

Guidelines for On Job Training

On-the-Job Training: Students will be required to undertake a designated task in an organization or industry relevant to their field of study. The course aims to provide students with practical exposure and hands-on experience in a professional work environment related to their field of study.

Course Objectives:
By the end of the course, students should be able to -

1. Gain exposure to real-world insights and apply theoretical knowledge to practical situations
2. Enhance his/her skills regarding problem-solving, decision-making, and communication skills.
3. Understand organizational dynamics and work culture.
4. Build industry connections and networking opportunities.

Course Duration:
Minimum 20 days / 120 hours of On Job Training with an Organization/ NGO/ Charitable Organization/ Private firm.

- The theme of the internship should be based on any study area of the Major course.
- Project Report should be of minimum 50 pages.
- Experience Certificate is Mandatory.

Report Structure:
The students will be required to submit a comprehensive report at the end of the On-the-Job Training. A project report has to be brief in content and must include the following aspects:

a) **Title Page:**

Mentioning the title of the report, name of the student, program, institution and the period of training.

b) Certificate of Completion:

A certificate issued by the organization or supervisor confirming the successful completion of the training.

c) Declaration:

A statement by the student declaring that the report is their original work and acknowledging any assistance or references used.

d) Acknowledgment:

Recognizing individuals or organizations that provided support, guidance or resources during the training.

e) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

f) Executive Summary:

A bird's eye view of your entire presentation has to be precisely offered under this category.

g) Introduction on the Company:

A Concise representation of company/ organization defining its scope, products/services, etc.

h) Your Role in the Organization during the On Job Training:

The key aspects handled, the department under which you were deployed and brief summary report duly acknowledged by the reporting head.

i) Challenges:

The challenges confronted while churning out theoretical knowledge into practical world.

j) Conclusion:

A brief overview of your experience and suggestions to bridge the gap between theory and practice.

Course Outcomes:

1. Apply theoretical knowledge and concepts acquired during the academic program to real-world work scenarios.
2. Develop practical skills and competencies necessary for successful professional engagement.
3. Demonstrate effective problem-solving, decision-making and critical thinking abilities in a work environment.
4. Adapt to and navigate organizational dynamics and work culture in the chosen industry/ institute.

5. Prepare a comprehensive report documenting the training/project experience, findings and recommendations.

The project report based on 'On Job Training' shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work
- Paper Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Training Report shall be bounded.

Sd/-
(Rashmi A. Bhave)
The Chairperson, BoS