

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce, and Science College, Ahmednagar
(Autonomous)
(Affiliated to Savitribai Phule Pune University, Pune)



National Education Policy (NEP)
Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of
B.Sc. Biotechnology (Major)

Implemented from
Academic Year 2023-24

Credit Distribution: B.Sc. Biotechnology (Major) including Minor and OE and other courses.

	Type of Courses	III Yr	IV Yrs (Honours)	IV Yrs Research
Major Marathi	Discipline-Specific Courses (DSC)	46	74	66
	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other Courses	Open Elective (OE)/ Multidisciplinary Courses	12	12	12
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

B. Sc. Programme Framework: Credit Distribution

Year	Semester	Level	Major										Minor	OE	CC	AEC	VEC	Total
			DSC		DSE		SEC		VSC		IN/CED	FP/OT	IKS					
I	I	4.5	T	P	T	P	T	P	T	P	T	P		T/ P	-	-	-	-
I	II	4.5	4	2	-	-	-	2	-	-	-	-	2	03	3	2	2	22
			6	-	-	-		2	-	2	-	-		03	3	2	2	22
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with Major and Minor																		
II	III	5.0	6	2	-	-		2	-	-	-	2		03	3	2	2	22
II	IV	5.0	6	2	-	-		-	-	2	-	2		03	3	2	2	22
Exit Option: Award of UG Diploma in Major with 88 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																		
III	V	5.5	8	2	2	2	-	-	-	2		2		04	-	-	-	22
III	VI	5.5	6	2	2	2	-	-	-	2		4		04	-	-	-	22
Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																		
IV	VII	6.0	8	6	2	2	RM-4		-	-	-	-		-	-	-	-	22
IV	VII I	6.0	8	6	2	2	-	-	-	-	-	4		-	-	-	-	22
Four Year UG Degree(Honours) with Major and Minor with 176 credits																		
IV	VII	6.0	6	4	2	2	RM-4		-	-	-	4		-	-	-	-	22
IV	VII I	6.0	6	4	2	2	-	-	0	-	-	8		-	-	-	-	22
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																		

B. Sc. Programme Framework: Course Distribution

Year	Semester	Level	Major											Minor		OE	CC	AEC	VEC	Total
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP		IKS							
I	-	-	T	P	T	P	T	P	T	P	T	P		T	P	-	-	-	-	-
I	I	4.5	2	1	-	-	-	1	-	-	-	-	1	1		1	1	1	1	10
	II	4.5	2	-	-	-		1	-	1	-	-		1		1	1	1	1	09
Exit Option: Award of UG Certificate in Major with 44 credits and an additional 4 credit core NSQF course /Internship or Continue with major and minor																				
II	III	5.0	2	1	-	-		1	-	-	-	1		1		1	1	1	-	09
II	IV	5.0	2	1	-	-		-	-	1	-	1		1		1	1	1	-	09
Exit Option: Award of UG Diploma in Major with 88 credits and an \additional 4 credit core NSQF course /Internship or Continue with major and minor																				
III	V	5.5	2	1	1	1	-	-	-	1		1		1		-	-	-	-	08
III	VI	5.5	2	1	1	1	-	-	-	1		1		1		-	-	-	-	08
Exit Option: Award of UG Degree in Major and Minor with 132 credits or continue with Major for a 4-year Degree																				
IV	VII	6.0	3	3	1	1	0	1	-	-	-	-		-	-	-	-	-	-	09
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1		-	-	-	-	-	-	09
Four Year UG Degree(Honours) with Major and Minor with 176 credits																				
IV	VII	6.0	2	2	1	1	0	1	-	-	-	1		-	-	-	-	-	-	08
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1		-	-	-	-	-	-	07
Four Year UG Degree (Honours with Research) with Major and Minor with 176 credits																				

Programme Framework (Course Distribution): B.Sc. Biotechnology (Major)

Year	Semester	Level	Major											Total	
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/PR		IKS		
			T	P	T	P	T	P	T	P	T	P	T	T	P/PR
I	I	4.5	2	1	-	-	-	1	-	-	-	-	01	03	02
I	II	4.5	2	-	-	-		1	-	1	-	-		02	02
II	III	5.0	2	1	-	-		1	-	-	-	1		02	03
II	IV	5.0	2	1	-	-		-	-	1	-	1		02	03
III	V	5.5	2	1	1	1	-	-	-	1		1		03	04
III	VI	5.5	2	1	1	1	-	-	-	1		1		03	04
B.Sc. Honours															
IV	VII	6.0	3	3	1	1	RM-1		-	-	-	-		05	04
IV	VIII	6.0	3	3	1	1	-	-	-	-	-	1		04	05
B.Sc. Honours with Research															
IV	VII	6.0	2	2	1	1	RM-1		-	-	-	1		04	04
IV	VIII	6.0	2	2	1	1	-	-	-	-	-	1		03	04

Programme Framework (Credit Distribution): B.Sc. Biotechnology (Major)

Year	Semester	Level	Major											Total
			DSC		DSE		SEC		VSC		FP/OJT /IN/CEP/RP		IKS	
			T	P	T	P	T	P	T	P	T	P	T	
I	I	4.5	4	2	-	-	-	2	-	-	-	-	02	10
I	II	4.5	6	-	-	-		2	-	2	-	-		10
II	III	5.0	6	2	-	-		2	-	-	-	2		12
II	IV	5.0	6	2	-	-		-	-	2	-	2		12
III	V	5.5	8	2	2	2	-	-	-	2		2		18
III	VI	5.5	6	2	2	2	-	-	-	2		4		18
IV	VII	6.0	8	6	2	2	RM-4		-	-	-	-		22

IV	VIII	6.0	8	6	2	2	-	-	-	-	-	4		22
IV	VII	6.0	6	4	2	2	RM-4	-	-	-	-	4		22
IV	VIII	6.0	6	4	2	2	-	-	-	-	-	8		22

Programme Framework (Courses and Credits): B.Sc. Biotechnology (Major)

Sr. No.	Year	Sem	Level	Course Type	Course Code	Title	Credits
1.	I	I	4.5	DSC-1	BS-BT111T	Microbiological Techniques	02
2.	I	I	4.5	DSC-2	BS-BT112T	Biomolecules	02
3.	I	I	4.5	DSC-3	BS-BT113P	Practicals in Microbiological Techniques	02
4.	I	I	4.5	SEC-1	BS-BT114P	Practicals in Biomolecules	02
5.	I	I	4.5	IKS-1	BS-BT115T	Biotechnology – Indian Perspective	02
6.	I	II	4.5	DSC-4	BS-BT121T	Basics in Plant and Animal Sciences	03
7.	I	II	4.5	DSC-5	BS-BT122T	Bioinstrumentation	03
8.	I	II	4.5	SEC-2	BS-BT123P	Practicals in Animal and Plant Sciences	02
9.	I	II	4.5	VSC-1	BS-BT124P	Bioinstrumentation Techniques	02
10	II	III	5.0	DSC-6	BS-BT231T	Cell Biology	03
11	II	III	5.0	DSC-7	BS-BT232T	Genetics and Immunology	03
12	II	III	5.0	DSC-8	BS-BT233P	Practicals in Cell Biology	02
13	II	III	5.0	SEC-3	BS-BT234P	Practicals in Genetics and Immunology	02
14	II	III	5.0	FP-01	BS-BT235P	-	02
15	II	IV	5.0	DSC-9	BS-BT241T	Animal and Plant Development	03

16	II	IV	5.0	DSC-10	BS-BT242T	Molecular Biology	03
17	II	IV	5.0	DSC-11	BS-BT243P	Practicals in Animal and Plant Development	02
18	II	IV	5.0	VSC-2	BS-BT244P	Practicals in Molecular Biology	02
19	II	IV	5.0	CEP-01	BS-BT245P	-	02
20	III	V	5.5	DSC-12	BS-BT351T	Animal and Plant Tissue Culture	04
21	III	V	5.5	DSC-13	BS-BT352T+P	Ecology and Environmental Biotechnology	04
22	III	V	5.5	DSC-14	BS-BT353P	Practicals in Animal Tissue Culture	02
23	III	V	5.5	DSE-01	BS-BT354T(A) OR BS-BT354T(B)	Metabolism OR Biodiversity and Evolution	02
24	III	V	5.5	DSE-02	BS-BT355P(A) OR BS-BT355P(B)	Practicals in Metabolism OR Practicals in Biodiversity and Evolution	02
25	III	V	5.5	VSC-3	BS-BT356P	Practicals in Plant Tissue Culture	02
26	III	V	5.5	FP-02	BS-BT357Pr	--	02
27	III	VI	5.5	DSC-15	BS-BT361T	Microbial Biotechnology	03
28	III	VI	5.5	DSC-16	BS-BT362T	Recombinant DNA Technology	03
29	III	VI	5.5	DSC-17	BS-BT363P	Practicals in Microbial Biotechnology	02
30	III	VI	5.5	DSE-03	BS-BT364T(A) OR BS-BT364T(B)	Enzyme Technology OR Food Biotechnology	02
31	III	VI	5.5	DSE-04	BS-BT365P(A)	Practicals in Enzyme Technology	02

					BS-BT365P(B)	OR Practicals in Food Biotechnology	
32	III	VI	5.5	VSC-4	BS-BT366P	Practicals in Recombinant DNA Technology	02
33	III	VI	5.5	OJT-01	BS-BT367P	-	04

B.Sc. Biotechnology (Major with Honours)

34.	IV	VII	6.0	DSC-18	BS-BT471T	Plant Biotechnology	03
35.	IV	VII	6.0	DSC-19	BS-BT472T	Advanced Biological Chemistry	03
36.	IV	VII	6.0	DSC-20	BS-BT473T	Bioinformatics	02
37.	IV	VII	6.0	DSC-21	BS-BT474P	Practicals in Plant Biotechnology	02
38.	IV	VII	6.0	DSC-22	BS-BT475P	Practicals in Advanced Biological Chemistry	02
39.	IV	VII	6.0	DSC-23	BS-BT476P	Practicals in Bioinformatics	02
40.	IV	VII	6.0	DSE-05	BS-BT477T(A) BS-BT477T(B)	Nanobiotechnology OR Pharmaceutical Biotechnology	02
41.	IV	VII	6.0	DSE-06	BS-BT478P(A) BS-BT478P(B)	Practicals in Nanobiotechnology OR Practicals in Pharmaceutical Biotechnology	02
42.	IV	VII	6.0	RM-01	BS-BT479T/P	Research Methodology	04
43.	IV	VIII	6.0	DSC-24	BS-BT481T	Animal Biotechnology	03
44.	IV	VIII	6.0	DSC-25	BS-BT482T	Advanced Bioanalytical Techniques	03
45.	IV	VIII	6.0	DSC-26	BS-BT483T	Large Scale Manufacturing Process	02

46.	IV	VIII	6.0	DSC-27	BS-BT484P	Practicals in Animal Biotechnology	02
47.	IV	VIII	6.0	DSC-28	BS-BT485P	Practicals in Advanced Bioanalytical Techniques	02
48.	IV	VIII	6.0	DSC-29	BS-BT486P	Practicals in Large Scale Manufacturing Process	02
49.	IV	VIII	6.0	DSE-07	BS-BT487T(A) BS-BT487T(B)	Environmental Biotechnology OR Biostatistics	02
50.	IV	VIII	6.0	DSE-08	BS-BT488P(A) BS-BT488P(B)	Practicals in Environmental Biotechnology OR Practicals in Biostatistics	02
51.	IV	VIII	6.0	OJT-02	BS-BT489P	--	04

B.Sc. Biotechnology (Major Honours with Research)

34.	IV	VII	6.0	DSC-20	BS-BT471T	Plant Biotechnology	03
35.	IV	VII	6.0	DSC-21	BS-BT472T	Advanced Biological Chemistry	03
36.	IV	VII	6.0	DSC-22	BS-BT473P	Practicals in Plant Biotechnology	02
37.	IV	VII	6.0	DSC-23	BS-BT474P	Practicals in Advanced Biological Chemistry	02
38.	IV	VII	6.0	DSE-05	BS-BT475T(A) BS-BT475T(B)	Bioinformatics OR Pharmaceutical Biotechnology	02
39.	IV	VII	6.0	DSE-06	BS-BT476P(A) BS-BT476P(B)	Bioinformatics OR Practicals in Pharmaceutical Biotechnology	02
40.	IV	VII	6.0	RM-01	BS-BT477T/P	Research Methodology	04

41.	IV	VII	6.0	RP-01	BS-BT478P	Project	04
42.	IV	VIII	6.0	DSC-20	BS-BT481T	Animal Biotechnology	03
43.	IV	VIII	6.0	DSC-21	BS-BT482T	Advanced Bioanalytical Techniques	03
44.	IV	VIII	6.0	DSC-22	BS-BT483P	Practicals in Animal Biotechnology	02
45.	IV	VIII	6.0	DSC-23	BS-BT484P	Practicals in Advanced Bioanalytical Techniques	02
46.	IV	VIII	6.0	DSE-07	BS-BT485T(A) BS-BT485T(B)	Environmental Biotechnology OR Biostatistics	02
47.	IV	VIII	6.0	DSE-08	BS-BT486P(A) BS-BT486P(B)	Practicals in Environmental Biotechnology OR Practicals in Biostatistics	02
48.	IV	VIII	6.0	RP-02	BS-BT487Pr	Project	08

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)

Board of Studies in Biotechnology

Sr. No.	Name	Designation
1.	Dr. Shubhangi S. Moharekar	Chairman
2.	Dr. Sanjay T. Moharekar	Member
3.	Dr. Sarika R. Deshmukh	Member
4.	Mr. Ashish S. Wani	Member
5.	Dr. Bimalendu B. Nath	Vice-Chancellor Nominee
6.	Prof. Dr. Nitin S. Desai	Academic Council Nominee
7.	Dr. Jyoti P. Jadhav	Academic Council Nominee
8.	Mr. Nitin Shirole	Industry Expert
9.	Mr. Sachin R. Adsare	Alumni
10.	Dr. Aparnna A. Kulkarni	Member (co-opt)
11.	Mr. Girish P. Kukreja	Member (co-opt)

1. Prologue/ Introduction of the programme:

Biotechnology has expanded and established as an advanced interdisciplinary applied science. The study of Life itself is at the core of it and the interdisciplinary networking potential of biotechnology has given it a separate status in fundamental research as well as in modern industrial enterprise. Global and local focus has slowly shifted to not only current "Century of Knowledge" but also on to technology development and application in life sciences. In the milieu of research and industrialization for economic development and social change, biotechnology is an ideal platform to work. The interdisciplinary nature of biotechnology integrates living systems including animal, plant and microbes and their studies

from molecular biology to cell biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology to biodiversity, from microbiology to bioprocess engineering, from bioremediation to material transformation and so on. The use and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology. Green revolution and white revolution was possible in India thanks to the deeper and intrinsic understanding of biotechnology.

The restructured syllabus is a choice based credit system with semester pattern. Biotechnology has grown extensively in last couple of decades. The syllabi till today had been sufficient to cater to the needs of students for building up their careers in industry and research. However, with the changing scenario at local and global level, we feel that the syllabus orientation should be altered to keep pace with developments in the education and industrial sector. The need of the hour is to design appropriate syllabi that emphasize on teaching of technological as well as the economical aspects of modern biology. The proposed credit based curriculum ensures the requirement of academia and industry. Theory supplemented with extensive practical skill sets will help a graduate student to avail the opportunities in the applied fields (research, industry or institutions) without any additional training. Thus, the university/college itself will be developing the trained and skilled manpower. Biotechnology being an interdisciplinary subject, this restructured syllabus will combine the principles of physical, chemical and biological sciences along with developing advanced technology.

Biotechnology curricula are operated at two levels viz. undergraduate and postgraduate. The undergraduate curricula are prepared to impart primarily basic knowledge of the respective subject from all possible angles while postgraduate syllabus emphasizes on more applied courses. In addition, students are to be trained to apply this knowledge particularly in day-to-day applications of biotechnology and to get a glimpse of research.

The basic aim of the revised course curriculum is to integrate various disciplines of life sciences which will cater the needs of human resources in academia and industry. The Overall objective of the Program is to promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in academics, government organization, biomedical sectors, health and nutrition settings for ultimate benefit of society and sustainable development.

2. Programme Outcomes (POs)

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

The objectives of the course curriculum are:

- To introduce the concepts in various allied subjects
- To enrich students' knowledge in basic and applied aspects of life sciences.
- To help the students to build interdisciplinary approach in teaching/ learning and in research.
- To inculcate the sense of scientific responsibilities and social awareness
- To help students build-up a progressive and successful career in academia and industry.

The present course curriculum will generate skilled human resource required in academia and Industry. In general, as a result of this program, the student will be able to achieve basic and advance knowledge based proficiency in applied subjects of life sciences, create and develop students with interdisciplinary mind set for learning science, improve problem solving aptitude using scientific methods in biotechnology and allied subjects, will adopt scientific approach for implications of biotechnology in society, environment and education, will demonstrate knowledge and learn various biological processes at cellular and molecular level and get expertise in the different techniques used in the fields of Biotechnology.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Biotechnology (Major)

Title of the Course: Microbiological Techniques								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
DSC-1	BS-BT111T	02	00	02	30	15	35	50

Learning Objectives:

1. To study the methodologies mostly involve techniques for culturing, identification, isolation, staining.
2. To gain knowledge about applications of microbiology techniques in other areas of biological research, including genetics, plant physiology, evolution, and molecular biology. Moreover, some of them contribute to better our health, but some cause life-threatening diseases.
3. To learn how microbiology techniques will work and are used in labs.

Course Outcomes (COs)

1. Students will understand the scope and importance of microbiology technique
2. Students will study the different technique for isolation, cultivation and preservation of microorganisms
3. Students will gain knowledge about application of microbiology techniques
4. Students will learn technique to observe microorganisms

Detailed Syllabus:

Unit I: Introduction to Microbial world (02)

Scope and importance of study of Microbiology and relevance in Biotechnology, Different Branches of Microbiology (Brief discussion of application of Microbiology in various fields), Handling of microorganisms and Biosafety measures, application of microbial techniques in biotechnology, recent advancement in microbiological techniques.

Unit II: Isolation, Cultivation and Preservation of microorganisms (08)

Classification, types and use of media (Bacterial and Fungal), Isolation of microorganisms and pure culture techniques: Serial Dilution, Spread plate, Pour plate and Streak plate, enumeration of microorganisms, Cultivation –Concept of Pure culture, co-culture and mixed culture, Colony characteristics. Preservation and Maintenance methods- Refrigeration, Paraffin method or glycerol stock method, Cryopreservation, and Lyophilization (freeze-drying)

Unit III: Control of microbial growth (10)

Concept and Definition of Sterilization, Disinfection and Asepsis, different methods of sterilization and disinfection, Physical method – Heat (Dry and Moist heat), Principle and working of Autoclave and Hot air oven pasteurization, Ionizing radiation and Non-ionizing radiation, Sterilization Efficiency testing, Concept of D value, F value and Z value. Mechanical method – Principle, types and limitations of Filtration, Chemical Agents and their Mode of Action - Aldehydes, Halogens, Quaternary Ammonium Compounds, Phenol and Phenolic Compounds, Heavy Metals, Alcohol, Dyes, and Detergents, Antibiotics and other chemotherapeutic agents- Examples and mode of action (one example each), Concept of MIC and MBC

Unit IV: Microscopy and Observation of Microorganisms (10)

History of Microscopy, Types of Microscopy, Bright field Microscopy, Dark field microscopy, Simple observation technique-Wet Mount, hanging drop technique, Staining Techniques, Theory of staining(Physical and Chemical), Classification of stains, Stain used in microbiology (Basic and Acidic), Definition and Role of Fixative, Mordant, Decoloriser, Accentuator, Principles and methods of staining techniques Monochrome, Negative, Differential (Gram, Acid fast), Special staining-Endospore, capsule, flagella, cell wall, nucleic acid, LPCB

Suggested Readings/Material:

1. Microbiology. by Michael J. Pelczar Jr., Roger D. Reid, et al.
2. Microbiology: An Introduction, Global Edition. Edited by Gerard J. Tortora
3. Brock Biology of Microorganisms (14th Edition) 14th Edition by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock
4. Stanier, Y., Doudoroff, M., & Adelberg, E. A. (1958). General microbiology. General microbiology.
5. Prescott's Microbiology 10th Edition. By Joanne Willey and Linda Sherwood and Christopher J. Woolverton
6. Black, J. G. (2017). Microbiology: principles and explorations. John Wiley & Sons.
7. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
8. Foster, J. W., & Slonczewski, J. L. (2017). Microbiology: an evolving science. WW NORTON.

Title of the Course: Biomolecules								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-2	BS-BT112 T	02	00	02	30	15	35	50

Learning Objectives:

1. To understand types of biomolecules
2. To learn biological functions of biomolecules
3. To understand structures of biomolecules

Course Outcomes (Cos)

1. Students will gain knowledge of structure and properties of water
2. Students will understand types and importance of covalent and non-covalent bonds present in biomolecules.
3. Students will learn structure and functions of major bio-molecules.
4. Students will understand the definition and classification of carbohydrate, lipids and proteins in details.

Detailed Syllabus:

Unit I: Water

(04)

Structure of water, ionization of water, osmosis, pH, titration curves, buffer

Types of bond- Covalent and noncovalent bonds

Unit II: Carbohydrates

(07)

Definition of carbohydrates , Monosaccharides: ketoses and aldoses, D and L configuration, epimers, anomers, Oligosaccharides: glycosidic bond eg. maltose , Polysaccharides: classification based on function, Storage polysaccharide: eg starch, Structural polysaccharides: eg.cellulose,

Biological Functions of Carbohydrate

Unit III: Lipid

(07)

Definition of lipid, Fatty acids- Classification, nomenclature, Classification of lipids: Simple, complex lipids and derived lipids, Simple lipids- Oil, Fat and wax, Complex lipids: Phospholipids and Glycolipids, Derived lipids: Steroids, terpenoids and carotenoids, Biological Function of lipids

Unit IV: Proteins

(07)

Classification of amino acids, zwitterion, titration of amino acid, Isoelectric pH, Protein structure: Primary structure and peptide bond formation, Secondary structure (alpha helix and beta sheet), Tertiary structure (eg. Myoglobin) and Quarternary structure (eg. Haemoglobin), Biological Functions of proteins

Unit V: Nucleic acids:

(05)

Purines, Pyrimidines, Nucleosides, Nucleotides, Polynucleotides, Covalent structure of DNA, Types of RNA- mRNA, tRNA and rRNA

Suggested Readings/Material:

1. Outlines of Biochemistry: 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Fundamentals of Biochemistry. 3rd Edition, (2008), Donald Voet & Judith Voet, John Wiley and Sons, Inc. USA
3. Principles of Biochemistry, 4th edition (1997), Jeffery Zubey, McGraw-Hill College, USA
4. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H. Freeman and company, NY
5. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.
6. Biochemistry. 5th Edition, (copyright 2013), Reginald Garrett and Charles Grisham, Brook/ Cole, Cengage Learning, Boston, USA.
7. An Introduction to Practical Biochemistry. 3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu.Pvt.Ltd. New Delhi, India
8. Biochemical Methods. 1st, (1995), S.Sadashivam, A.Manickam, New Age International Publishers, India

Title of the Course: Practicals in Microbiological Techniques								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-3	BS-BT113 P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn about instruments used in laboratory and to understand their practical handling.
2. To study aseptic transfer techniques
3. To study morphology of microbes.
3. To learn media preparation.

Course Outcomes (Cos)

1. Student will learn to use good laboratory practices.
2. Students will able to prepare stains for staining.
3. Students will able to isolate bacteria and fungi individually.
4. Students will able to observe special structure of bacteria.

Detailed Syllabus:

Sr. No.	Name of Practical	No. of Practical
1	Introduction to Microbiology Laboratory and safety measures	(01)
2	Study principle and SOP of instrument used in microbiology laboratory	(01)
3	Preparation of stains required for staining techniques	(01)
4	Preparation of nutrient broth and nutrient agar (MacConkey's and potato dextrose)	(01)
6	Study of slide culture technique	(01)

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|----|--|------|
| 7 | Isolation and enumeration of bacteria from natural sample by using spread plate method | (01) |
| 8 | Study of bacterial morphology by Monochrome and Negative staining | (01) |
| 9 | Study of Gram character by Gram's staining technique | (01) |
| 10 | Observation of endospore by Schaeffer Fulton method | (01) |
| 11 | Demonstration of capsule by Anthony's method | (01) |
| 12 | Isolation of fungi and its observation by LPCB staining technique | (01) |

Suggested Readings/Material:

1. P. Gunasekaran (2005) Laboratory Manual in Microbiology B.Sc. Wine, Brewing and Alcohol Technology 2021-22 [18]
2. Stanbury, P. F., Whitaker A. & Hall S. T. (2008) Principles of Fermentation Technology
3. Anuradha De. (2009) Practical and applied microbiology
4. John Grainger (2001), Basic practical microbiology Panda U. N. (2005) Handbook of Microbiology and parasitology
5. Anuradha De. (2009) Practical and applied microbiology
6. Prescott Hurley Kline's (2008) Microbiology
7. Sathe S. T., Pharande S. R. (2010) Introduction to Microbiology

Title of the Course: Practicals in Biomolecules								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
SEC-1	BS-BT114P	00	02	02	60	15	35	50

Learning Objectives:

1. To learn safety measures in chemistry laboratory
2. To study the concept of molarity, molality, normality, percent solution, pH measurement, buffer etc.
3. To study the different qualitative analysis of biomolecules
4. To gain knowledge of quantitative estimation of carbohydrates and proteins.

Course Outcomes (Cos):

1. Students can prepare solutions of required normality, molarity and percent solutions.
2. Students can calibrate pH meter and can adjust pH to required value using pH meter.
3. Students can isolate biomolecules from suitable source and can perform their qualitative analysis.
4. Students can estimate concentration of protein and carbohydrates by Biuret method and DNSA method respectively.

Detailed Syllabus:

Sr. No.	Name of Practical	No. of Practical
1	Safety Measures and practices in laboratory	(01)
2	Biochemical calculations (Preparation of molar, normal, percent solutions)	(01)
3	Preparation of solutions and buffers	(01)
4	Isolation and identification of starch from plant source and to	(01)

- perform its confirmatory test.
- | | | |
|----|---|------|
| 5 | Oil extraction from plant source and determination of concentration of free fatty acids. | (01) |
| 6 | Measurement of pH of various solutions using pH indicator and pH meter. | (01) |
| 7 | Qualitative tests- <ul style="list-style-type: none">• Spot tests for carbohydrates• Spot tests for lipids• Spot tests for amino acids and proteins | (03) |
| 8 | To estimate concentration of reducing sugar in given sample by DNSA method | (01) |
| 9 | Estimation of concentration of protein by Biuret method | (01) |
| 10 | Determination of Ascorbic acid | (01) |

Suggested Readings/Material:

1. An Introduction to Practical Biochemistry.3rd Edition, (2001), David Plummer, Tata McGraw Hill Edu. Pvt. Ltd. New Delhi, India
2. Biochemical Methods.1st, (1995), S. Sadashivam, A. Manickam, New Age International Publishers, India
3. An introduction to practical biochemistry,David plummer
4. Introductory practical biochemistry, S.K. Sawhoey, Randhir singh

Title of the Course: Biotechnology – Indian Perspective								
Year: I				Semester: I				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
IKS-1	BS-BT115P	02	00	02	30	15	35	50

Learning Objectives:

- 1 Explore the historical development and milestones of biotechnology in India.
- 2 Identify the key institutions and organizations contributing to the growth of biotechnology in India.
- 3 Assess the major achievements and contributions of DBT in advancing biotechnology in India.
- 4 Examine the role of biotechnology in Indian agriculture, pharmaceuticals, and other sectors.
- 5 Explore future trends, emerging technologies, entrepreneurship opportunities, and challenges in the Indian biotechnology sector.

Course Outcomes (COs)

- 1 Students will be able to define biotechnology, understand its applications, and explain its significance in various sectors.
- 2 Students will acquire knowledge about the historical development and key milestones of biotechnology in India.
- 3 Students will have an understanding of the establishment, evolution, and role of the Department of Biotechnology (DBT) in India.
- 4 Students will assess the role of biotechnology in Indian agriculture, pharmaceuticals, and other sectors.
- 5 Students will analyze future trends, emerging technologies, entrepreneurship opportunities, and challenges in the Indian biotechnology sector.

Detailed Syllabus:

Unit I: Introduction to Biotechnology in India

(07)

Overview of Biotechnology, Historical Perspective: Onset of Biotechnology in India, Early Developments and Milestones in Indian Biotechnology, Key Institutions and Organizations in Indian Biotechnology

Unit II: Department of Biotechnology (DBT) and its Role (04)

Establishment and Evolution of DBT, Objectives and Mandate of DBT, Funding Mechanisms and Programs of DBT, Major Achievements and Contributions of DBT

Unit III: Indian Biotechnology Industry (12)

Overview of the Indian Biotechnology Industry, Indian Biotechnology Companies: Profiles and Contributions, Role of Biotechnology in Indian Agriculture, Role of Biotechnology in Indian Pharmaceutical Sector, Role of Biotechnology in Other Sectors: Healthcare, Environment, Energy, etc.

Unit IV: Ethical and Regulatory Considerations (02)

Ethical Issues in Biotechnology, Regulatory Framework for Biotechnology in India

Unit V: Future Trends and Challenges (05)

Emerging Technologies and Innovations, Entrepreneurship and Start-ups in Biotechnology, Global Collaborations and Partnerships, Challenges and Opportunities in Indian Biotechnology Sector

Suggested Readings/Material:

- 1 "Biotechnology in India: Assessing the Potential" by M. K. Bhan and Rajesh S. Gokhale
- 2 "Biotechnology: Indian Perspectives" edited by Subhash Chandra Parija and G. Padmanaban
- 3 "Biotechnology in India II" edited by D. Balasubramanian and B. N. Johri
- 4 "Indian Biotechnology: History and Future" by Ramaswamy Iyer
- 5 "Department of Biotechnology: A Journey through 25 Years" edited by Renu Swarup and Sunil K. Khare
- 6 "Biotechnology: An Indian Perspective" by R. C. Dubey and D. K. Maheshwari
- 7 "Biotechnology for Beginners" by Reinhard Renneberg and Viola Berkling
- 8 "Introduction to Biotechnology" by William J. Thieman and Michael A. Palladino
- 9 "Introduction to Biotechnology and Genetic Engineering" by A. J. Nair
- 10 "Ethics in Biotechnology" by I. S. Roy and P. C. Roy
- 11 "Biotechnology Regulation and Ethics" edited by Suman Sahai

Title of the Course: Basics of Animal and Plant Sciences								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
DSC-4	BS-BT121T	03	00	03	45	30	70	100

Learning Objectives:

1. To study overview of animal kingdom classification.
2. To learn about animal metabolism regarding Digestion, endocrine system and Respiration
3. To learn animal interactions and study model organisms in animal Biology.
4. To study basic concepts of botany.
5. To study plant water relation and primary metabolism
6. To study the concepts of in vitro plant regeneration.
7. To study the various plants used in beverage industry

Course Outcomes (Cos)

1. Students will study overview of animal kingdom classification.
2. Students will learn the metabolic processes in animals.
3. Students will learn various interactions and model organisms in animal biology.
4. Students will learn concept of Botany.
5. Students will study the physiology of flowering.
6. Students will understand the concepts of in vitro plant regeneration.
7. Students will study the various plants used in beverage industry

Unit I Introduction to Kingdom Animalia:

(3)

Outline Classification and Characteristics, Chordates and Non-Chordates

Unit II Types of Animal Tissue and Metabolism:

(8)

Types of animal tissues and their functions

Overview of Digestive system, Respiratory system, Endocrine system, Excretory system, Circulatory system, Nervous system

Unit III Animal Interactions:

(4)

Host: Definitive host and Intermediate Host, Host parasite interaction-

Positive interaction: Mutualism, Commensalism

Negative interaction: Parasitism, Parasitoids, Competition(Competitive exclusion Principle)

Unit IV Animal Model systems

(2)

Hydra, Honey bee, Drosophila

Unit V Applications of Animals in Biotechnology

(5)

Genetically modified Animals 1. Glofish 2. Engineered mosquitoes. 3. Transparent frogs 4. Engineered cows and their role in Livestock farming 5. Monkey, General ethics related to Genetic modification of animals

Unit VI Introduction to Plant Biology

(6)

Importance of plants in ecosystems and human life, Basic plant structure and organization, A general account of different groups (Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and angiosperms), Overview of plant reproduction and their economic importance with example

Plant Cells and Tissues system: Structure and functions of plant cells, Types and functions of plant tissues (Meristematic, Permanent-Simple and complex, epidermal), internal structures of roots, stems, and leaves.

Unit VII Basics of Plant Physiology

(7)

Water and Mineral Nutrition: Plant-water relations, water uptake, and transport, Mineral uptake and nutrient transport in plants

Photosynthesis: Light reactions and Calvin cycle, Factors affecting photosynthesis, Photorespiration and C4 and CAM pathways

Respiration and Metabolism: Cellular respiration and ATP production, Carbohydrate metabolism, storage, and transport, Secondary metabolites and their roles in plants.

Unit VIII Plant Growth and Development:

(6)

Essential nutrients for Plant growth and their role, Plant hormones and their functions, Regulation of plant growth and development: Photo-biology (movement and photo-

morphogenesis (vegetative)

Introduction to physiology of flowering: Photoperiodism and Vernalization

Plant response to stress (biotic and abiotic)

Unit IX Economic importance of plants: (4)

Cereals, Pulses, Oil seeds, Fiber plants, Medicinal Plants, Timber yielding, plants used in beverages with examples

Suggested Readings:

1. Jordan, E.L. and Verma P.S. 1978, (i) Chordate Zoology S. Chand & Company Ltd. RamNagar. New Delhi.
2. Jordan, E.L. and Verma P.S. 1978 (ii) Invertebrate Zoology. S. Chand & Company Ltd. RamNagar. New Delhi.
3. Modern Text Book of Zoology: Invertebrates., R.L.Kotpal. Publisher, Rastogi Publications, 2012.
4. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt AsiaPTE Ltd. /W.B. Saunders Company.
5. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition JohnWiley & son.
6. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi. Co. Ltd.
7. Biochemistry and Molecular Biology of Plants, 2nd Edition Bob B. Buchanan (Editor), Wilhelm Gruissem (Editor), Russell L. Jones (Editor) ISBN: 978-0-470-71421-8 July 2015
8. Devlin R.M. (1983) - Fundamentals of Plant Physiology (Mac. Millan, New 4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

Title of the Course: Bioinstrumentation								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-5	BS-BT 122T	03	00	03	45	30	70	100

Learning Objectives:

1. To learn the principles and applications of different analytical techniques such as chromatography, centrifugation, Spectroscopic techniques, atomic absorption spectroscopy, etc.
2. To learn the basic concept of Electrophoresis.
3. To learn about the types and importance of Microscopes
4. To understand about Thermoregulation

Course Outcomes (COs)

1. Students will learn different analytical techniques such as chromatography, centrifugation, spectroscopic techniques, atomic absorption spectroscopy, etc.
2. Students will learn the basic concept of Electrophoresis.
3. They will understand about Thermoregulation.
4. They will learn about the types and importance of Microscopes

Detailed Syllabus:

Unit I: Bioinstrumentation: (05)

Introduction, Concepts- Analytical technique, principle, construction, working and applications of pH meter, conductivity meter, polarimeter.

Unit II: Spectroscopy: (12)

Electromagnetic wave, Electromagnetic spectrum, Applications of each region of electromagnetic spectrum for spectroscopy.

Lambert-Beer's Law, types of sources, Introduction to molecular energy levels, Excitation, Absorption, Emission, Rotational spectra, Energy levels of rigid diatomic molecules.

Principle, construction and working and applications: colorimeter, UV-visible spectroscopy (Single beam and double beam spectrophotometer), Mass spectroscopy (Bainbridge mass spectrometer), Atomic absorption spectrometer (AAS).

Unit III: Separation methods (06)

Theory of chromatography, types of chromatography – paper, thin layer chromatography, distillation (simple and fractional), Filtration, crystallization

Unit IV: Centrifugation (07)

Principle, RCF, sedimentation concept, types of rotors, different types of centrifuges: differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications.

Unit V: Microscopy: (08)

Concepts – refraction, reflection, transmission, resolving power.

Construction and working principles of the following microscopes: Stereo zoom (Dissecting), Compound, Light microscopy, Bright & Dark Field microscopy, Inverted, Phase contrast, Fluorescence, Electron microscope: SEM and TEM

Unit VI: Thermoregulation: (07)

Thermometric properties and types of thermometers-clinical, thermocouple, bimetallic, platinum resistance, thermistor thermometers, Body temperature and its regulation.

Suggested Readings/Material:

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khande lwal, Himlaya Publishing House, India.
4. Instrumentation measurements and analysis – 2nd edition (2003). Makra and Choudhari, Tata McGraw Hill, India

Title of the Course: Practicals in Animal and Plant Sciences								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical					
						CIE	ESE	Total
SEC-2	BS-BT123P	00	02	02	60	15	35	50

Learning Objectives:

1. To study overview of animal kingdom classification.
2. To learn about animal metabolism regarding Digestion, endocrine system and Respiration
3. To learn animal interactions and study model organisms in animal Biology.
4. To learn the effect of plant growth regulatore on plant development.

Course Outcomes

1. Students will study overview of animal kingdom classification.
2. Students will learn about animal metabolism regarding Digestion, endocrine system and Respiration
3. Students will learn animal interactions and study model organisms in animal Biology.
4. Students will understand hrebariun preparation.

Detailed Syllabus

Sr.No.	Practicals	No. of Practical
1	Wet mount of freshwater sample and Study of Paramecium Morphology Reproduction-Binary fission & Conjugation	(01)
2	Enumeration of red blood cells using haemocytometer.	(01)
3	Detection of Salivary Amylase enzyme by Starch Iodine test Study of Hydra: Permanent slides	(01) (02)

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| 4 | Morphology, Reproduction, Regeneration in Hydra | |
| 5 | Culturing and Study of Life cycle of Drosophila | (02) |
| 6 | Determination of rate of respiration in germinating seeds | (01) |
| 7 | Estimation of chlorophyll content in photosynthesizing and non- photosynthesizing leaf | (01) |
| 8 | To study effect of plant growth regulators on leaf | (01) |
| 9 | Studies on economically important plants: Students should prepare herbarium specimens with their uses | (02) |

Suggested Reading:

1. Modern Text Book of Zoology: Invertebrates., R.L.Kotpal. Publisher, Rastogi Publications,2012.
2. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition.Hercourt Asia PTE Ltd. /W.B. Saunders Company.
3. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition JohnWiley & son.
4. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi. Co. Ltd.
5. Biochemistry and Molecular Biology of Plants, 2nd Edition Bob B. Buchanan (Editor), Wilhelm Gruissem (Editor), Russell L. Jones (Editor) ISBN: 978-0-470-71421-8 July 2015

Title of the Course: Bioinstrumentation Techniques								
Year: I				Semester: II				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-1	BS-BT 124P	00	02	02	60	30	70	100

Learning Objectives:

1. Learn Absorption spectrum of protein, absorption spectra isoelectric point of amino acids.
2. Understand the pH meter
3. Study electronic components of Bright field, compound microscope.
4. To learn electronic balance for micro measurements.
5. To study techniques like paper and thin layer chromatography.

Course Outcomes (Cos)

1. Students will learn Absorption spectrum of protein, absorption spectra isoelectric point of amino acids.
2. Students will learn and understand electronic balance for micro measurements the pH meter
3. They will learn and study electronic components of Bright field, compound microscope.
4. They will learn techniques like paper and thin layer chromatography.

Detailed syllabus:

Sr.No.	Practicals	No. of Practical
1	Working and components of various types of Centrifuges	(01)
2	Microscopy – Components and working of Bright field compound microscope	(01)
3	Separation and identification of amino acids by paper chromatography	(01)
4	Separation and identification of sugars/pigments by TLC	(01)
5	Determination of absorption spectra of DNA melting (T_m) and protein	(01)
6	Beer and Lambert's Law – Components and working of Colorimeter, Spectrophotometer	(01)
7	Standardization of pH meter and Preparation of buffers and measurement of pH	(01)

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|----|--|------|
| 8 | Determination of maximum wavelength (λ_{max}) for protein and DNA | (01) |
| 9 | To study Separation Techniques like recrystallization, distillation, sublimation | (01) |
| 10 | To find out isoelectric point of amino acids | (01) |
| 11 | Acid base titration by Conductivity meter | (01) |
| 12 | Acid-base titration by pH meter | (01) |

Suggested Reading:

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA.
3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khande lwal, Himlaya Publishing House, India.