MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE

(An Autonomous College)

Affiliated to Periyar University, Salem | Accredited by **NAAC** with '**A**' Grade

Recognized by **UGC** under Section 2(f) & 12 (B)

ESTD-1994

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)

A UNIT OF VANETRA GROUP

Learn. Lead

DEGREE OF BACHELOR OF SCIENCE

Learning Outcomes - Based Curriculum Framework

- Choice Based Credit System

Syllabus for B.Sc., Biotechnology

(Semester Pattern)

(For Candidates admitted from the academic year 2023-2024 and onwards)

Regulation and Syllabus for

B.Sc Biotechnology

(With effect from the Academic Year 2023-24)

VISION

To redefine the scope of higher education by infusing into each of our pursuits, initiatives that will encourage intellectual, emotional, social and spiritual growth, thereby nurturing a generation of committed, knowledgeable and socially responsible citizens.

MISSION

- To Ensure State of the world learning experience
- To espouse value based Education
- To empower rural education
- To instill the spirit of entrepreneurship and enterprise
- To create a resource pool of socially responsible world citizens

QUALITY POLICY

To Seek- To Strive- To Achieve greater heights in Arts and Science, Engineering, Technological and Management Education without Compromising on the Quality of Education.

DEPARTMENT OF BIOTECHNOLOGY

VISION

Provide job oriented, value based biotechnological education and to enable them for getting placements

MISSION

- To develop their knowledge to pursue higher education.
- To encourage research activities.
- To promote biotech education in to various application oriented disciplines.
- To make an awareness about of literacy, unity and equality.
- To develop the job oriented curriculum

PREAMBLE

Biotechnology is a field that combines basics of life science (biology) and technology. It has been one of the most fast-growing fields in last few decades. The realm of Biotechnology involves understanding and application of basic sciences such as Physics, Chemistry, and Mathematics as well as applied sciences such as Microbiology, Food technology, Bioinformatics, Recombinant DNA technology. State of the art technologies such as Artificial Intelligence and Machine learning are now being explored for their application in Biotechnology. B.Sc., Biotechnology is a six semester's programme which encompasses theory and practical in different areas of Biotechnology. It also contains a research component through one semester project work to enhance the depth of knowledge and to develop research skills. These projects aim to enhance knowledge and research skills in biotechnology throughout the course. The degree programme helps learners as a basic programme, which the learners may either pursue higher studies or seek employment. The syllabi for the Three-year B.Sc. degree course in Biotechnology are framed in such a way that the students at the end of the course, can be adept at Biotechnological techniques for pursuing higher studies and can also apply Biotechnological methods judiciously to a variety of industrial needs.

PROGRAMME LEARNING OUTCOME

NATURE AND EXTENT OF THE PROGRAMME

The B.Sc. Biotechnology programme is of Three years duration. Each year is divided into two semesters. Each semester will be of sixteen weeks duration. The teaching and learning in the B.Sc. Biotechnology programme will involve theory classes (lectures), tutorials, practical and dissertation. The curriculum will be taught through formal lectures with the aid of ICT tools like power-point presentations, audio and video tools and other teaching aids can be used as and when required. The specialized subjects could be augmented by special lectures from the eminent experts in the relevant fields, which can be incorporated along with regular teaching. The latest developments in the field involving emerging technologies could be incorporated in the form of seminars, workshops, training, conferences etc.

AIM OF THE PROGRAMME

The Programme aims at providing a holistic understanding of the discipline and equips the students with life and transferable skills to pursue higher education or a career in biotechnology. The objectives of the LOCF in biotechnology, therefore, To generate competent human resources skilled to contribute towards the sustainable development of industry, teaching, and research in different areas of Biotechnology.

GRADUATE ATTRIBUTES

Graduate attributes are the high-level qualities, skills and understandings that a student should gain as a result of the learning and experiences. They equip students and graduates for lifelong personal development, learning and to be successful in society. Students will be equipped to be active citizens both nationally and globally. The students graduating in biotechnology should also develop excellent communication skills both in the written as well as spoken language which are a must for them to pursue higher studies from some of the best and internationally acclaimed universities and research institutions spread across the globe. The graduate attributes reflect disciplinary knowledge and understanding, generic skills, including global competitiveness all students in different academic fields of study should acquire/attain and demonstrate. Some of the characteristic attributes that a graduate should demonstrate are as follows

GA 1 Analytical Reasoning

GA 2 Critical Thinking

GA 3 Problem Solving Skills

GA 4 Communication Skills

GA 5 Leadership Quality

GA 6 Team work

GA 7 Lifelong Learning

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will be able to promote learning environment to meet the industry expectation.

PEO2: Graduates will be incorporated the critical thinking with good Communication and Leadership skills to become a self-employed

PEO3: Graduates will be upholding the human values and environmental sustenance for the betterment of the society.

PROGRAMME OUTCOMES (POs)

PO1: Graduates will acquire dynamic skills through proper perception of the course objectives that leads to scientific and analytical comprehension of the concepts;

PO2: Graduates will focus on sustainable goals that might bring about spherical developments

PO3: Graduates will infuse a spirit converging on bricking a team work, interpersonal andadministrative skills to think critically and execute effectively

PO4: Graduates will apply reasoning appropriately to scale the humps in learning and solute them to the core.

PO5: Graduates will engage the skills obtained in independent and collaborative learning as a perennial process.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Upon completion of the program,

PSO1: Graduates understand the basic concepts of Biotechnology and its applications on different living systems like microbes, animals and plants.

PSO2: Graduates should be able to embark upon research and develop new eco-friendly sustainable technologies in the domain of biotechnology, which can contribute to the hale and healthy environment and society.

PSO3: Graduates obtain knowledge and skill to get opportunities in industry, research institutions, academics, government organizations and entrepreneurship development.

PSO4: Develop problem solving ability by utilizing the conceptual knowledge, analytical techniques, computational thinking and statistical approaches

PSO5: Biotechnology courses to evaluate the real-life problems and develop a sense of social, ethical, environmental and professional responsibility

REGULATIONS (2023-2024)

1. DURATION OF THE PROGRAME

1.1. Three years (six semesters)

1.2. Each academic year shall be divided into two semesters. The odd semesters shall consist of the period from June to November of each year and the even semesters from December to May of each year.

1.3. There shall be not less than 90 working days for each semester.

2. ELIGIBILITY FOR ADMISSION

2.1. Candidate for admission to the first year of B.Sc. Degree Course in Biotechnology shall be required to have passed the Higher Secondary Examination with Biological Sciences (Botany/Zoology, Biology) Academic/Vocational Stream-Agri, Home Science, and Poultry as per norms set by the Government of Tamilnadu or an Examination Accepted as equivalent there to by the syndicate.

3. CREDIT REQUIRMENTS AND ELIGIBILITY FOR AWARD OF DEGREE

3.1. A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years and passed the examinations of all the Six Semesters prescribed earning a minimum of 140 credits as per the distribution given in Regulation for Part I, II, III, IV & V and also fulfilled such other conditions as have been prescribed there of.

4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

4.1. The Course Components and Credit Distribution shall consist of the following:(Minimum Number of Credits to be obtained)

Part Wise Distribution	Study Components	Credit Distribution
PART I	Tamil or Other Languages	12
PART II	English	12
PART III	Core, Allied, Elective and Project Courses	91
PART IV	i. Basic Tamil/Advanced Tamil/NME	04
	ii. Soft Skill Courses/SBEC	10
	iii. Environmental Studies	02
	iv. Value Education	02
	v. Internship	02
	vi. Foundation Course	02
	vii. Professional Competency Skills	02
PARTV	Extension Activity	01
Total Credits		140

4.2 DETAILS OF COURSE OF STUDY OF PARTS I–V

4.2.1 PART I: Tamil and Other Languages Hindi or French at the option of candidates and according to the syllabus and text-books prescribed from time to time:

4.2.2 PART II: English: According to the syllabus and text-books prescribed from time to time

4.2.3 PART III: Core, Allied, Project and Elective Courses: As prescribed by the concerned Board of Studies

4.2.4 PART IV:

i. Basic Tamil/Advanced Tamil/NME:

a. Students who have not studied Tamil up to XII STD and have taken any Language other than Tamil in Part I shall take Basic Tamil comprising of Two Courses (level will be at 6thStandard).

b. Students who have studied Tamil up to XII STD and have taken any Language other than Tamil in Part – I shall take Advanced Tamil comprising of Two Courses.

c. Students who have studied Tamil up to XII STD and also have taken Tamil in Part–I shall take Non-Major Elective comprising of Two Courses.

i. Soft Skill Courses/SBEC

ii. Environmental Studies

iii. Value Education

iv. Internship

v. Foundation Course

vi. Professional Competency Skills(Online)

4.2.5 PARTV: Extension Activity:

Students shall be awarded a maximum of 1 Credit for Compulsory Extension Service. All the Students shall have to enroll for NSS /NCC/ NSO (Sports & Games) Retract / Youth Red Cross or any other Service Organizations in the College and shall have to put in compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the College before 31st March in a year. If a student lacks 40 hours attendance in the first year, he or she shall have to compensate the same during the subsequent years.

Those students who complete minimum attendance of 40 hours in one year will get 'half-a- credit and those who complete the attendance of 80 or more hours in Two Years will get 'one credit'. Literacy and Population Education and Field Work shall be compulsory components in the above extension service activities.

4.3. Inclusion of the Massive Open Online Courses (MOOCs)available on SWAYAM and NPTEL

4.3.1 Students can choose the MOOC Course Available on SWAYAM and NPTEL under Core, Elective or Soft skill category. He/ she will be awarded degree only after producing valid certificate of the MOOC course for credit Mobility

5. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

5.1Eligibility: Students shall be eligible to go to subsequent semester only if the yearn sufficient attendance as prescribed by the Periyar University.

5.2. Attendance: All Students must earn 75% and above of attendance for appearing for the End Semester Examination. (Theory/Practical)

5.3. Condonation of shortage of attendance: If a Student fails to earn the minimum attendance (Percentage

stipulated), the Principals shall condone the shortage of attendance up to a maximum limit of 10%(i.e. between 65% and above and less than 75%) after collecting the prescribed fee for Theory/Practical examination separately, towards the condonation of shortage of attendance. Such fees collected and should be remitted to the University.

5.4. Non-eligibility for condonation of shortage of attendance: Students who have secured less than 65% but more than 50% of attendance are NOTELIGIBLE for condonation of shortage of attendance and such Students will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the program and they may be permitted to taken ext University examination by paying the prescribed condonation fee

5.5. Detained students for want of attendance: Students who have earned less than 50% of attendance shall not be permitted to proceed to the next semester and to complete the Program of study. Such Students shall have to repeat the semester, which they have missed by rejoining after completion off in all semester of the course, by paying the fee for the break of study as prescribed by the College from time to time.

5.6. Condonation of shortage of attendance for married women students: In respect of married women students undergoing UG programs, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55%instead of 65% if they conceive during their academic career. Medical certificate from the Doctor (D.G.O) from the Government Hospital and the prescribed fee along with attendance details shall be forwarded to the college to consider the condonation of attendance mentioning the category

5.7. Zero Percent (0%) Attendance: The Students, who have earned 0% of attendance, have to repeat the program (by rejoining) without proceeding to succeeding semester and they have to obtain prior permission from the College/University immediately to rejoin the program.

5.8 Transfer of Students and Credits: The strength of the credits system is that it permits inter Institutional transfer of students. By providing mobility, it enables individual students to develop their capabilities fully by permitting them to move from one Institution to another in accordance with their aptitude and abilities by obtaining necessary permission from the university.

5.8.1 Transfer of Students is permitted from one Institution to another Institution for the same program with same nomenclature.

Provided, there is a vacancy in the respective program of Study in the Institution where the transfer is requested.

Provided the Student should have passed all the courses in the Institution from where the transfer is requested.

5.8.2 The marks obtained in the courses will be converted and grades will be assigned as per the College norms.

5.8.3 The transfer students are eligible for classification.

5.8.4 The transfer students are not eligible for Ranking, Prizes and Medals.

5.8.5 Students who want to go to foreign Universities up to two semesters or Project Work with the prior approval of the Departmental/College Committee are allowed to get transfer of credits and marks which will be converted in to Grades as per the University norms and are eligible to get CGPA and Classification; they are not eligible for Ranking, Prizes and Medals.

5.9 Students are exempted from attendance requirements for online courses of the College and MOOC's.

6. EXAMINATION AND EVALUATION

6.1. Register for all subjects: Students shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination. For this purpose, Students shall register for all the arrear subjects of earlier semesters along with the current (subsequent) Semester Subjects.

6.2. Marks for Internal and End Semester Examinations for PART I, II, III, and IV

Category	Theory	Practical
Internal Assessment	25	**40**
End semester Examination	**75**	**60**

6.3. Procedure for Awarding Internal Marks Internal Examination Marks–Theory

Components	Marks
CIA I & II	**15**
Attendance	**5**
Assignment/Quiz	**5**
Total	**25**

6.4 Awarding Marks for Attendance (outof5)

Percentage of Attendance	Marks
Below 60%	0marks
60% to 75%	3marks
75% to 90%	4marks
Above 90%	5marks

6.5 Components for Practical CIA.

Components	Marks
CIA–I	**15**
CIA- II	**15**
Observation Note	**05**
Attendance	**5**
Total	**40**

6.6 Components for Practical ESE.

Components	Marks
Completion of Experiments	**50**
Record	**05**
Viva voce	**05**
Total	**60**

6.7 Guidelines for Value Education Yoga and Environmental Studies (Part IV)

6.7.1. The Course Value Education Yoga is to be treated as 100% CIA course which is offered in V Semester for I year UG students.

6.7.2. The Course Environmental Studies is to be treated as 100% CIA course which is offered in IV Semester for I year UG students.

6.7.3 Total Marks for the Course =100

Components	Marks
Two Tests (2x30)	**60**
Field visit and report (10+10)	**20**
Two assignments (2x10)	**20**
Total	**100**

The passing minimum for this course is 40%

6.7.3 Incase, the candidate fails to secure 40% passing minimum, he/she may have to reappear for the same in the subsequent odd/even semesters.

6.8 Internship/Industrial Training, Mini Project and Major Project Work

Internship/Industrial Training		Mini Project	Major Project Work		
Components	**Marks**	**Marks**	**Components**		Marks
CIA*[2]			**CIA** a) Attendance **b)** Review /Work Diary***[1]**	10Marks 30Marks	**40**
Work Diary	25	-			
Report	50	50			
Viva–voce	25	50			
Examination					
Total	**100**	**100**	**ESE***[2] a) Final Report 40 Marks b) Viva-voce 20 Marks		**60**
			Total		**100**

*1.Review is for Individual Project and Work Diary is for Group Projects (Group consisting of minimum 3 and maximum 5)

*2 Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

6.9 Guidelines for Professional Competency Skill-Online Mode (Part IV)- Online Exam3hours

Components	Marks
100 Objective Type Questions 100*1=100Marks	**100**

Objective type Questions from Question Bank.

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he/she may have to reappear for the same in the subsequent semesters.

QUESTION PAPER PATTERN FOR CIA I, II AND ESE	
(3HOURS)	**MAXIMUM:75Marks**
SECTION-A (**Objective Type**) **Answer ALL Questions** ALL Questions Carry EQUAL Marks	(10x1=10marks)
SECTION-B **(Either or Type)** **Answer ALL Questions** ALL Questions Carry EQUAL Marks	(5x5=25marks)
SECTION-C **(Either or Type)** **Answer ALL Questions** ALL Questions Carry EQUAL Marks	(5x8=40marks)
(SyllabusforCIA-I2.5Unit,SyllabusforCIA-IIAll5Unit)	

6.10. PASSING MINIMUM

6.10.1 There shall be no passing minimum for Internal.

6.10.2 For external examination, passing minimum shall be 40% [Forty Percentage] of the maximum marks prescribed for the course for each Course/Practical/Project and Viva-Voce.

6.10.3 In the aggregate [External/Internal] the passing minimum shall be of 40%.

6.10.4 He/She shall be declare do have passed the whole examination, if he/she passes in all the Courses and Practical wherever prescribed as per the scheme of the examinations by earning 140 CREDITS in Part I, II, III, IV& V. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 credit to qualify for the Degree.

6.11 SUPPLIMENTARY EXAMINATION:

Supplementary Examinations is conducted for the students who appeared in the final semester examinations. Eligible criteria for appearing in the Supplementary Examinations are as follows:

6.11.1. Eligibility: A Student who is having arrear of only one theory course in any of the semester or two theory course in the Final semester of the UG degree programme alone is eligible for Supplementary Examinations.

6.11.2. Non-eligibility for those completed the program: Students who have completed their Program duration but having arrears are not eligible to appear for Supplementary Examinations.

6.12. RETOTALLING, REVALUATION AND PHOTOCOPY OF THE ANSWER SCRIPTS:

6.12.1 Re-totaling: All UG Students who appeared for their Semester Examinations are eligible for applying for re-totaling of their answer scripts.

6.12.2 Revaluation: All current batch Students who have appeared for their Semester Examinations are eligible for Revaluation of their answer scripts. Passed out candidates are not eligible for Revaluation.

6.12.3 Photo copy of the answer scripts: Students who have applied for revaluation can apply for the Photocopy of answer scripts by paying prescribed fee.

7. CLASSIFICATION OF SUCCESSFUL STUDENTS

RANGEOF MARKS	GRADEPOINTS	LETTERGRADE	DESCRIPTION
90-100	9.0-10.0	O	**Outstanding**
80-89	8.0-8.9	D+	**Excellent**
75-79	7.5-7.9	D	**Distinction**
70-74	7.0-7.4	A+	**Very Good**
60-69	6.0-6.9	A	**Good**
50-59	5.0-5.9	B	**Average**
40-49	4.0-4.9	C	**Satisfactory**
00-39	0.0	U	**Re-appear**

ABSENT	0.0	AAA	**ABSENT**

7.1 Computation of Grade Point Average (GPA) in a Semester, Cumulative Grade Point Average (CGPA) and Classification

GPA for a Semester:=∑iCiGi,∑iCi

That is, GPA is the sum of the multiplication of grade points by the credits of the courses divided by the sum of the credits of the courses in a semester.

CGPA for the entire programme: = ∑n∑iCniGni, ∑n∑iCni That is, CGPA is the sum of the multiplication of grade points by the credits of the entire programme divided by the sum of the credits of the courses of the entire programme

Where,

Ci= Credits earned for course in any semester,

Gi=Grade Points obtained for course in any semester=Semester in which such courses were credited.

7.2 Letter Grade and Classification

CGPA	GRADE	CLASSIFICATIONOF FINALRESULT
9.5-10.0	O+	**First Class-Exemplary***
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	**First Class with Distinction***
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	**First Class**
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	**Second Class**
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C+	**Third Class**
4.0 and above but below 4.5	C	
0.0 and above but below 4.0	**U**	**Re-appear**

*The Students who have passed in the first appearance and within the prescribed semester of the UG Programme (Major, Allied and Elective courses only) are eligible.

8. RANKING

Students who pass all the examinations prescribed for the Program in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking I, II and III.

9. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAM TO QUALIFY FOR ADEGREE

9.1. A Student who for whatever reasons is not able to complete the program within the normal period (N) or the Minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the back log to be qualified for the degree. (Time Span=N+2 years for the completion of programme)

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B.Sc.,-BIOTECHNOLOGY abstract under LOCF-CBCS Pattern with effect from 2023-2

Structure of Credit Distribution as per the TANSCHE / UGC Guidelines

S. No.	Study Components	Part	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI		No.of Paper	Total Credit
			No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit		
1	LANGUAGE - I	I	1	3	1	3	1	3	1	3					4	12
2	LANGUAGE - II	II	1	3	1	3	1	3	1	3					4	12
3	DISCIPLINE SPECIFIC COURSE(DSC)-THEORY	III	2	8	2	10	2	10	1	5	2	10	1	5	10	48
4	DSC - PRACTICAL	III	1	2	1	2	1	2	1	2	1	2	1	2	6	12
5	GENERIC ELECTIVE COURSES(GEC)- THEORY	III	1	3	1	3	1	3	1	3					4	12
6	GEC- PRACTICAL	III					1	2							1	2
7	DISCIPLINE SPECIFIC ELECTIVE COURSES(DSE)	III									2	6	2	6	4	12
8	PROJECT WORK	III											1	5	1	5
9	INTERNSHIP	IV									1	2			1	2
10	ONLINE - COMPETITIVE EXAMINATION	IV											1	2	1	2
11	SKILL ENHANCEMENT COURSES(SEC)	IV			1	2			2	4	1	2			4	8
12	NON MAJOR ELECTIVE COURSES(NME)	IV	1	2	1	2									2	4
13	PROFESSIONALCOMPETENCY	IV											1	2	1	2
14	ABILITY ENHANCEMENT COMPULSORY COURSES(AECC)-EVS	IV							1	2					1	2
15	ABILITY ENHANCEMENT COMPULSORY COURSES(AECC)- VALUE EDUCATION - YOGA	IV									1	2			1	2
16	FOUNDATION COURSE(FC)	IV	1	2											1	2

17	EXTENSION ACTIVITY	V												1	**1**	**1**	**1**
	Cumulative Credits		**8**	**23**	**8**	**25**	**7**	**23**	**8**	**22**	**8**	**24**	**8**	**23**	**47**	**140**

Total No.of Subjects	47
Marks	**4600**

PART	**No. of Credits**
PART - I	12
PART - II	12
PART - III	91
PART - IV	24
PART - V	1
Grand Total	**140**

Extra Credit (2+2)	4
	144

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
- Rasipuram - 637408
Scheme of Examinations LOCF-CBCS Pattern
(for the Students Admitted from the Academic Year: 2023-2024 Onwards)
Programme : B.Sc. BIOTECHNOLOGY

S.No.	PART	STUDY COMPONENTS	COURSE_ CODE	TITLE OF THE COURSE	Hrs./W		CREDIT POINTS	MAX.MARKS		
					Lect.	Lab.		CIA	ESE	TOTAL
SEMESTER - I										
1	I	LANGUAGE-I	23M1UFTA01	Tamil I	6		3	25	75	100
2	II	LANGUAGE-II	23M1UFEN01	English I	6		3	25	75	100
3	III	DSC THEORY - I	23M1UBTC01	Cell and Molecular Developmental Biology	4		4	25	75	100
4	III	DSC THEORY - II	23M1UBTC02	Human physiology	4		4	25	75	100
5	III	DSC PRACTICAL - I	23M1UBTP01	Practical : Cell and Molecular Developmental Biology and biological chemistry		3	2	40	60	100
6	III	GEC THEORY - I	23M1UBCA02	Allied: Biological chemistry	3		3	25	75	100
7	IV	NMEC - I		NMEC - I	2		2	25	75	100
8	IV	FC THEORY - I	23M1UBTFC1	General Biology	2		2	25	75	100
				TOTAL	**27**	**3**	**23**	**215**	**585**	**800**
SEMESTER - II										
1	I	LANGUAGE - I	23M2UFTA02	Tamil II	6		3	25	75	100
2	II	LANGUAGE - II	23M2UFEN02	English II	6		3	25	75	100
3	III	DSC THEORY - III	23M2UBTC03	Genetics	4		5	25	75	100
4	III	DSC THEORY - IV	23M2UBTC04	Fundamentals of Microbiology	4		5	25	75	100
5	III	DSC PRACTICAL - II	23M2UBTP02	Practical: Genetics and Microbiology		3	2	40	60	100
6	III	GEC THEORY - II	23M2UBCA04	Allied: Microbial physiology	3		3	25	75	100
7	IV	NMEC - II		NMEC - II	2		2	25	75	100
8	IV	SEC - I	23M2UBTS01	Vermicompost technology	2		2	25	75	100
				TOTAL	27	3	25	215	585	800
SEMESTER - III										
1	I	LANGUAGE - I	23M3UFTA03	Tamil III	6		3	25	75	100
2	II	LANGUAGE - II	23M3UFEN03	English III	6		3	25	75	100
3	III	DSC THEORY - V	23M3UBTC05	Biology of Immune system and Immune technology	5		5	25	75	100
4	III	DSC THEORY - VI	23M3UBTC06	Bioinstrumentation	5		5	25	75	100
5	III	DSC PRACTICAL - III	23M3UBTP03	Practical: Immunotechnology and bioinstrumentation		3	2	40	60	100

6	III	GEC THEORY - III			3		3	25	75	100
7	IV	GEC PRACTICAL - I			2		2	40	60	100
				TOTAL	27	3	23	205	495	700
SEMESTER - IV										
1	I	LANGUAGE - I	23M4UFTA04	Tamil IV	6		3	25	75	100
2	II	LANGUAGE - II	23M4UFEN04	English IV	6		3	25	75	100
3	III	DSC THEORY - VII	23M4UBTC07	Genetic Engineering	6		5	25	75	100
4	III	DSC PRACTICAL - IV	23M4UBTP04	Practical: Genetic Engineering, Bioinformatics and Biostatistics		4	2	40	60	100
5	IV	GEC THEORY - IV			4		3	25	75	100
6	IV	SEC - II	23M4UBTS02	Marine Biotechnology	2		2	25	75	100
7	IV	SEC - III	23M4UBTS03	Cryogenics and cryobiology	2		2	25	75	100
8	IV	AECC - ENVIRONMENTAL STUDIES*	23M4UEVS01	Environmental Studies	-	-	2	100		100
		* Self Study		TOTAL	26	4	22	290	510	800
SEMESTER - V										
1	III	DSC THEORY - VIII	23M5UBTC08	Plant Biotechnology	6		5	25	75	100
2	III	DSC THEORY - IX	23M5UBTC09	Animal Biotechnology	6		5	25	75	100
3	III	DSE THEORY - I			5		3	25	75	100
4	III	DSE THEORY - II			5		3	25	75	100
5	III	DSC PRACTICAL - V	23M5UBTP05	Practical: Plant Biotechnology and Animal Biotechnology		4	2	40	60	100
6	IV	SEC - IV	23M5UBTS04	Quality control in industries	2		2	25	75	100
7	IV	INTERNSHIP	23M5UBTIS1	Internship	-		2	100	-	100
8	IV	AECC - VALUE EDUCATION	23M5UVED01	Value Education	2		2	100	-	100
				TOTAL	26	4	24	365	435	800
SEMESTER - VI										
1	III	DSC THEORY - X	23M6UBTC10	Environmental and Industrial Biotechnology	6		5	25	75	100
2	III	DSC PRACTICAL - VI	23M6UBTP06	Practical: Environmental and Industrial Biotechnology		4	2	40	60	100
3	III	DSE THEORY - III			5		3	25	75	100
4	III	DSE THEORY - IV			5		3	25	75	100
5	IV	SEC - V	23M6UBTS05	Pharmaceutical Biotechnology	3		2	25	75	100
6	III	PROJECT WORK	23M6UBTPR1	PROJECT WORK	7		5	40	60	100

7	IV	PROFESSIONAL COMPETENCY SKILL	23M6UBTOE1	Biotechnology for Competitive Examinations	-		2	100	-	100
8	V	EXTENSION ACTIVITY	23M6UEXA01	Extension Activity	-	-	1	-	-	-
				TOTAL	26	4	23	280	420	700
				OVERALL TOTAL	**159**	**21**	**140**	**1570**	**3030**	**4600**
1	V	EXTRA CREDIT COURSE-ONLINE			-	-	2	-	-	-
2	V	VALUE ADDED COURSE			-	-	2	-	-	-

HOD **ACADEMIC COUNCIL-MEMBER SECRETARY** **PRINCIPAL**

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTC01	CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	DSC THEORY I	I	4	4			4

Objective	The students will be able to understand the structure and functions of cell organelles and also understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Discovery and diversity of cells** - Cell theory - Structure of prokaryotic(bacteria) and eukaryotic cells (plant and animal cells).	K1	10
II	**Structure and Functions of Cell Organelles**: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.	K2	10
III	**Structure and functions of DNA and RNA** -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting.	K3	10
IV	**Cell cycle** - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extracellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.	K4	15
V	**Gametogenesis** - Spermatogenesis and Oogenesis in mammals. Fertilization - Types of cleavage, blastula formation, gastrulation and formation of germ layers in animals- Organogenesis.	K5	10
Course Outcome	**CO1:** Understand the prokaryotic and Eukaryotic cell	K1	
	CO2: Discuss in detail the cell membrane and function	K2	
	CO3: Overview of the central dogma of life.	K3	
	CO4: Compare and contrast the events of cell cycle and its regulation Gaining knowledge for cell to cell signalling.	K4	
	CO5: Analyse about sequential changes from single cell organization to organ level in the development of multicellular organisms	K5	

Learning Resources	
Text Books	1.T. Devasena (2012), Cell Biology, Oxford University Press. 2.Gupta, Renu &Makhija, Seema &Toteja, Ravi. (2018). Cell Biology: Practical Manual. 3.Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA. 4.Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company. 5.James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.

Reference Books	1. Karp‟s Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications. 2. James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications. 3. Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press. 4. Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications. 5. Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.			
Website Link	1. http://www.cellbiol.com/education.php2. 2. https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/ 3. https://dnalc.cshl.edu/websites/ 4. https://www.cellsignal.com/contents/science/cst-pathways/science-pathways 5. https://nptel.ac.in/courses/102/106/102106025/			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTC01	CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	DSC THEORY-I	I	4	4			4

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	L	M	S	M	M	M	M
CO2	S	M	M	S	S	S	M	S	M	M
CO3	S	S	S	M	S	S	S	L	M	M
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	S	M	L	S	S	S	M	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTC02	HUMAN PHYSIOLOGY	DSC THEORY- II	I	4	4			4

Objective	The students will be able to understand the digestive secretions and absorptive mechanisms		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Digestive System**: Overview of the digestive system, secretions of digestive tract, digestive hormones, process of digestion, absorption, assimilation of carbohydrates, proteins, fats, nucleic acids. Absorption of vitamins, minerals and water	K1	12
II	**Respiratory System**: Overview of the respiratory system, pulmonary ventilation, Alveolar ventilation, composition and partial pressure of inspired air, alveolar air and expired air, exchange and transport of respiratory gases.	K2	12
III	**Muscle physiology and Cardiovascular System:** overview of muscle tissue, contraction and relaxation of skeletal muscle, cardiac muscle tissue and cardiac conduction system, cardiac cycle, cardiac output, blood pressure and human skeletal system, skeletal divisions and functions of skeleton.	K3	10
IV	**Excretory System:** Overview of renal system, Renal physiology: - glomerular filtration, tubular reabsorption and secretion, production of dilute and concentrated urine. Reproductive System: Overview of male and female reproductive system, menstrual cycle, physiology of pregnancy,(fetal development), fertilization process, parturition and lactation	K4	10
V	**Nervous System:** Overview of nervous system, classification of nervous system, signal transmission at synapse, neurotransmitters. Special Senses: Physiology of Olfaction, Gustation, Vision, Hearing and equilibrium	K5	10

Course Outcome		
	CO1: Build an in depth knowledge about basic physiological principles of various organs in the human body.	**K1**
	CO 2: Understand physiology of various systems and its functions**.**	**K2**
	CO 3: Adequate knowledge on cardiovascular system and skeletal system	**K3**
	CO 4: Analyse **p**hysiology of excretory system	**K4**
	CO 5: Adequate knowledge on sensory organs	**K5**

Learning Resources	
Text Books	1. Essentials of Medical Physiology, K. Sembulingam and Prema Sembulingam, 6 th Edition, 2012 2. Principles of Anatomy and Physiology, Tortora and Grabowski, 2003,JohnWiley&Sons,Inc. 3. Human Physiology, Chatterjee. C. 11th edition Medical agency allied, Calcutta.
Reference Books	1. Textbook of medical physiology, A.C. Guyton 10th edition. 2. Human body, Atlas, Publication Garden cheers. 3. A Text Book of Human physiology, Sarada Subrahmanyam et al., 2010, S Chand & Company
Website Link	https://mymedicallibrary.files.wordpress.com/2016/08/jaypee-essentials-of-medical-physiology-6thedition.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

Course Code	Course Title	Course Type	Sem.	Hours	L	T	P	C
23M1UBTC02	HUMAN PHYSIOLOGY	DSC THEORY- II	I	4	4			4

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	M	S	S	M	S	L	S
CO2	S	S	S	L	S	M	M	S	S	S
CO3	S	M	S	S	M	S	M	S	M	S
CO4	S	L	S	S	S	S	S	S	S	S
CO5	S	M	M	L	S	S	M	S	S	M
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. K. Revathi	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTC03	GENETICS	DSC THEORY-III	II	4	4			4
Objective	Students learn about the classical genetics and transmission of characters from one generation to the next and obtain a strong foundation for the advanced genetics.							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Mendel's experiments**, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel,s laws. Dominance (complete and incomplete). Interaction of Genes- Epistasis and lethal genes. Multiple alleles in Drosophila and Blood group inheritance in man.	K1	12
II	**Linkage** - linkage in Drosophila- Morgan"s experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex Determination in Man.	K2	10
III	**Fine structure of the gene** and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction	K3	11
IV	**Mutation** – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis- Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)	K4	12
V	**Population Genetics**– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics and Euthenics.	K5	10
Course Outcome	**CO1:** Apply the historical overview of microbial genetics and genetic Materials	K1	
	CO2: Comprehend the concept of replication of genetic materials	K2	
	CO3: Understand about the regulation of gene expression and mutation	K3	
	CO4: Grasp the Basic of genetics and their role	K4	
	CO5: Demonstrate the knowledge on mutation	K5	

Learning Resources	
Text Books	1. Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram Nath Publications, Meerut, 250001. www.knrnpublications.com, ISBN-978- 81-907011-2-9 2. Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S.Chand & Co., New Delhi – 10055. 3. Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S.Chand and Co., New Delhi, 110055.

Reference Books	1. Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill. 2. Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H. Freeman. New York. 3. Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd			
Website Link	1. https://nptel.ac.in/courses/102/106/102106025/ 2. http://www.ocw.mit.edu 3. http://enjoy.m.wikipedia.org https://www.acpsd.net			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2UBTC03	GENETICS	DSC THEORY-III	II	4	4			4	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M	S	M	S	M	S
CO2	S	L	S	M	S	S	M	S	M	S
CO3	S	M	S	S	M	S	M	S	M	S
CO4	S	M	S	S	S	S	S	S	M	S
CO5	S	M	M	M	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr. D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTC04	FUNDAMENTALS OF MICROBIOLOGY	DSCTHEORY- IV	II	4	4			5

Objective	To provide in depth knowledge to students about history of microbiology, classification of microorganism, growth and cultivation of microorganism, their benefical role and harmful effects		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Story of Microbiology** (Biogenesis and abiogenesis, spontaneous generation), Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope and applications of microbiology –Contributions of scientists in the field of microbiology	K1	12
II	**Structure of bacteria** (Gram positive and Gram negative) - Bacterial growth and measurement of growth, Media and its types Staining methods (Gram‟s, capsule, spore, LCB mount). Methods of preservation of microorganisms. Invitro cultivation of, virus and algae.	K2	11
III	**Sterilization methods** - physical and chemical methods. Definition and classification of antibiotics. Mode of action of different groups of antibiotics.– Antimicrobial resistance and its mechanism. MRSA, ESBL	K3	10
IV	**Bioinsecticides** - Bacillus thuringiensis, Baculoviruses- Biofertilizers - Azospirillum and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt). Types of microscopy – Definitions, light, dark field, phase contrast fluorescence, and electron microscopes	K4	11
V	**Microbial Disease-** host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).	K5	11
Course Outcome	**CO1:** Remember and recall the historical events which paved the development of different types of microscopes.	K1	
	CO2: Understand and differentiate the different types of microbes	K2	
	CO3: Analyze the media composition and grow the desired microbe	K3	
	CO4: Apply the knowledge to enumerate the microorganisms from natural environment.	K4	
	CO5: Evaluate the success of understanding the microbial diseases	K5	

Learning Resources	
Text Books	1. Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition., McGraw –Hill, New York. 2. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.

Reference Books	1. Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. 2. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC 3. Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient Black Swan, 2013.
Website Link	1. Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB) 2. https://www.cliffsnotes.com/study guides/biology/microbiology/introduction-tomicrobiology/a-brief-history-of microbiology 3.https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/06%3A_Culturing_Microorganisms/6.08%3A_ Counting_Bacteria

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTC04	FUNDAMENTALS OF MICROBIOLOGY	DSCTHEORY- IV	II	4	4			5

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	L	L	S	L	L	L	L
CO2	S	L	L	L	L	S	M	M	L	M
CO3	S	L	L	M	L	S	M	M	M	M
CO4	S	L	L	M	L	S	M	M	M	M
CO5	S	L	L	L	L	S	L	L	L	M

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3UBTC05	**BIOLOGY OF IMMUNE SYSTEM AND IMMUNE TECHNOLOGY**	DSC Theory-V	III	**5**	**3**	2		**5**

Objective	Students can able to clarify the role of immune cells and their mechanism in body defence mechanisms.		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction to Immunology**. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired	K1	12
II	**Antigen:** Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research. Antigen processing and presentation (MHC molecules – structure, types and functions).	K2	12
III	**Antigen – Antibody interactions**- Agglutination and precipitation reactions, Immunodiffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Fluorescent antibody technique and Western Blotting. Purification of antibodies.	K3	12
IV	**The complement system and activation and regulation**. Types – Classical, alternative and Lectin pathway. Biological function of complement proteins.Cytokines- Structure, types and biological functions. Vaccines – Types, Production and application	K4	12
V	**Hypersensitivity Reactions and Types.** Major Histocompatability Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing. Auto immunity and autoimmune disorders. Transplantation immunology, Graft vs Host reaction mechanism of graft rejection. **Current Trends: *Mucosal and regional immunology***	K5	12
	..... Self study		
Course Outcome	**CO1:** Understand the importance of normal flora of human body.	K1	
	CO2: Discuss the various bacterial pathological events	K2	
	CO3: Predicts a list of disease causing bacteria	K3	
	CO4: Point out human-fungal interaction on fungal diseases	K4	

	CO5: Categorize the types of mycoses caused in human	K5	

Learning Resources	
Text Books	1. Kannan, I., 2010. Immunology. MJP Publishers, Chennai 2. Nandini Shetty, 1996, Immunology: introductory textbook – I. New Age International, New Delhi
Reference Books	1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 12th edition, Wiley- Blackwell. USA 2. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition. 3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York
Website Link	https://www.ncbi.nlm.nih.gov/books/NBK279395/ https://med.stanford.edu/immunol/phd-program/ebook.html
Self-Study Material	https://www.shiksha.com/medicine-health-sciences/immunology-chp

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3UBTC05	**BIOLOGY OF IMMUNE SYSTEM AND IMMUNE TECHNOLOGY**			DSC Theory-V	III	**5**	**3**	2		**5**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	S	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and flipped classroom
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Rajasekaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3UBTC06	Bioinstrumentation	DSC THEORY -VI	III	5	3	2		5
Objective	Students will be able to understand the pH meter, Buffer preparation, principle of different microscope, chromatography, Electrophoresis and Centrifuge.							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**PH –Definition**: PH meter. Measurement of PH calibration of PH meter-Buffers-Preparation of Buffers. Principle and applications of compound, Bright field, Phase contrast and Fluorescence Microscope.	K1	12
II	**Spectra**-Absorption and Emission Spectra-Beer Lambert's law-Colorimeter, UV-Visible Spectrophotometer. Fourier transform Infrared spectroscopy (FTIR), Mass spectroscopy-Atomic absorption spectrometer (AAS)-Nuclear magnetic resonance spectrometer (NMR). Raman spectroscopy.	K2	12
III	**Chromatography:** Principles-Paper chromatography, TLP, Ion exchange, Affinity chromatography gas liquid chromatography and HPLC. **Electrophoresis:** Principle, paper Electerophoresis-Cellulose Acetate electrophoresis-Agarose Gel Electrophoresis SDS PAGE and Isoelectric focusing.	K3	12
IV	**Radioactive-Isotopes**: Clinically important isotopes-Measurement of Radioactivity-GM counters, Scintillation Counters- Autoradiography-Applications. SOPs for Radioactive materials.	K4	12
V	**Centrifugation**: Principles-RCF, Sedimentation Concept-Different types of centrifuge-Types of rotors-Centrifugation types: Differential and Density gradient centrifugation –Ultra centrifuge. **Current Trends: *Electron Microscope***	K5	12
	..... Self Study		
Course Outcome	**CO1:** Recognize the basics instrumentation analysis	K1	
	CO2: Discuss the working principle of spectroscopy	K2	
	CO3: Explain the Separation and Purification Techniques	K3	
	CO4: Executing the Scintillation Counters- Autoradiography working principle and applications.	K4	
	CO5: Sketch the centrifugation and type of centrifuge	K5	

Learning Resources	
Text Books	1. Upadhyay and Upadhyaya Nath (2009).”Biophysical chemistry”, Principles and Techniques. Himalaya Publishing House.
Reference Books	1. Keith Wilson, John Walker,(2010) Principles and techniques of Biochemistry and Molecular biology (7th edition). Cambridge University Press. 2. David L.Nelson, Michael M.cox. Lehninger (2008)”Principles of Biochemistry” Fifth edition W.H.Freeman, New York 3. Khandpur R S 2014 Handbook of Biomedical Instrumentation 3rd edition, McGraw Hill Education (India).
Website Link	1. https://microbiologysociety.org/members-outreach-resources/links.html 2. https://www.isham.org/mycology-resources/mycological-links

Self-Study Material	https://nlist.inflibnet.ac.in/search/Record/978-0-387-26016-7			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3UBTC06	Bioinstrumentation	DSC THEORY -VI	III	5	3	2		5	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and flipped classroom
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
K.Chitra	Dr. P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4UBTC07	**GENETIC ENGINEERING**	**DSC THEORY-VII**	**IV**	**6**	**4**	**2**		**5**

Objective	The students will be able to understand knowledge about the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Genetic Engineering** – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies- Enzymes-Restriction enzymes, modifying enzymes, ligation. Vectors-Cloning vectors: plasmid - definition, properties and types. pUC19 & pBR322- phage vectors (λ & M13), Expression vectors; YAC (S. cerevisiae as a model) & BAC (E. coli) host) – introduction of rDNA into host cells.	K1	12
II	**Identification of recombinants**: selection and screening for Recombinants. DNA sequencing – Construction of Genomic DNA library and cDNA library, Chromosome walking. Human Genome Project. Polymerase Chain reaction-Methodology and its Types.	K2	12
III	**Gene transfer techniques** – Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer - Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes.	K3	12
IV	**Gene Expression** – Expression system and their applications - protein based products – Protein engineering– production of protein from cloned genes. Site directed Mutagenesis, Restriction Fragment Length Polymorphism (RFLP).	K4	12
V	**Application** of Recombinant DNA technology in medicine, industry, Agriculture and r-DNA technology - merits and demerits. **Current Trends**: ***CRISPR-Based Gene Drives for Pest Control ***	K5	12
	…… Self Study.		
Course Outcome	**CO1:** Recite knowledge about the techniques of aseptic manipulation.	K1	
	CO2: Interpret knowledge about gene cloning	K2	
	CO3: Compile techniques in gene transfer	K3	
	CO4: Comprehend the r-DNA technology, molecular markers and marker assisted selection	K4	
	CO5: Evaluate the application of genetic engineering	K5	

Learning Resources	
Text Books	1. Primrose Sandy B. and Richard Twyman, (2006) Principles of Gene Manipulation and Genomics (7th Edition), Wiley-Blackwell 2006. 2. Dubey R.C, (2014). Advanced Biotechnology (1st edition), Chand and Company.
Reference Books	1. Sathyanarayanan U, (2013) Biotechnology, Books and allied (P) ltd. 2. Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6th Edition) Wiley Blackwell, 2010. 3. Winnacker L Ernst, (2003).From genes to clones -Introduction to gene technology (4th edition), Panima Publishing Corporation,
Website Link	1. https://www.teachengineering.org/lessons/view/uoh_genetic_lesson01 2. https://opentextbc.ca/biology/chapter/10-1-cloning-and-genetic-engineering/ https://nptel.ac.in/courses/102103016 3. https://science.umd.edu/classroom/bsci124/lec41.html 4. https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology

Self-Study Material	1. https://www.nature.com/articles/s41598-020-69259-6			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4UBTC07	**GENETIC ENGINEERING**		**DSC THEORY-VII**	**IV**	**6**	**4**	**2**		**5**	
CO-PO Mapping										
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	M	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and flipped classroom
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTC08	**PLANT BIOTECHNOLOGY**	**DSC THEORY-VIII**	**V**	**6**	**4**	**2**		**5**
Objective	Students can explore the history of Biotechnology and state the importance of organization of plant genome							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction:** History of plant biotechnology, Conservation of Plant using Biotechnology. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.	K1	12
II	**Hormones:** Auxins, cytokinins and gibberlins – molecular basis of action – phytochrome – role in photomorphogeneisis – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.	K2	12
III	**Media composition** (MS media) - Micropropagation techniques - direct and indirect organogenesis - somoclonal variation - somatic embryogenesis - haploid and triploid - Protoplast isolation, fusion and culture - hybrid and cybrid production, Synthetic seed production. Secondary metabolite production.	K3	12
IV	**Gene Transfer**: Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti and Ri Plasmid vectors and their utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.	K4	12
V	**Application:** Crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Transgenic plants- plant vaccines, genetically modified food - future perspectives & ecological impact of transgenic plants. **Current Trends**-*Edible Vaccine Production*	K5	12
	…… Self Study.		
Course Outcome	**CO1:** Recite knowledge about the techniques of Plant Tissue Culture, Lab. organization & measures adopted for aseptic manipulation.	K1	
	CO2: Interpret knowledge about the nutritional requirements of cultured tissues.	K2	
	CO3: Compile the large scale clonal propagation of plants through various PTC Techniques	K3	
	CO4: Comprehend the r-DNA technology, methods of gene transfer, molecular markers and marker assisted selection	K4	
	CO5: Evaluate the transgenic resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement	K5	

Learning Resources	
Text Books	1. Sudhir, M. 2000. Applied Biotechnology and Plant Genetics. Dominant publishers and distributors. 2. Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.
Reference Books	1. Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill. 2. Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi. 3. Chawla, H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.

Website Link	1. https://nptel.ac.in/courses/102103016 2. https://science.umd.edu/classroom/bsci124/lec41.html 3. https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology			
Self-Study Material	1. https://www.biotechnologynotes.com/transgenic-plants/edible-vaccines-applications-advantages-and-limitations/627#google_vignette			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M5UBTC08	**PLANT BIOTECHNOLOGY**		**DSC THEORY-VIII**	**V**	**6**	**4**	**2**		**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	M	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and flipped classroom
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTC09	**ANIMAL BIOTECHNOLOGY**	**DSC THEORY-IX**	**V**	**6**	**4**	**2**		**5**

Objective	Students can able to understand the basic concepts of animal cell culture, application of cell lines, gene transfer and gene expressions		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Animal cell culture** – History and development, Pluripotency, Media, balanced salt solutions, Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell lines. Essential equipments required for animal cell culture	K1	12
II	**Types of cell culture**- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.	K2	12
III	**Transfect ion of cells in culture**- Animal viral vectors for transfection, Physical methods of transfect ion, HAT selection, selectable markers. Micro manipulation of cells, Gene targeting, gene silencing and Gene knockout and their applications.	K3	12
IV	**Protein production** by genetically engineered mammalian cell lines, Stem cells and their applications-; Cell culture as a source of valuable products -Transgenic Animals.	K4	12
V	**Collection and preservation of embryos-** Semen banking, AI, IVF and ICSI. Case Study-any two relevant studies. **Current Trends: *Animal cells as bioreactor***	K5	12
	*.....*Self Study.	K5	
Course Outcome	**CO1:** Recognize the basic pattern of animal cell culture and controlling.	K1	
	CO2: Explain the laboratory layout, design & media requirements for animal cell culture	K2	
	CO3: Illustrate the gene transfer technology and gene expression	K3	
	CO4: Integrate the transgenic animal and stem cell technology	K4	
	CO5: Construct the applications of animal biotechnology in various fields	K5	

Learning Resources	
Text Books	1. Ramasamy.P. 2002.Trends in Biotechnology, University of Madras of Publications, Pearl Press 2. Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.

Reference Books	1. R. Ian Freshney, Culture of Animal cells – A Manual of Basic Technique Fourth Edition, WILEY LISS & Publications. 2. Glick, B.R. and Pasternark. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA 3. Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington 4. Traven. 2001. Biotechnology. Tata McGraw – Hill. 5. Walker,J.M. and Gingold, E.B. 1999.Molecular biology and Biotechnology, 3rd edition. Panima Publishing Corporation
Website Link	1. https://microbenotes.com/animal-cell-culture/ 2. https://thebiologynotes.com/embryo-transfer/
Self-Study Material	1. https://nlist.inflibnet.ac.in/search/Record/CR9780511565069

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M5UBTC09	**ANIMAL BIOTECHNOLOGY**	**DSC THEORY-IX**	**V**	**6**	**4**	**2**		**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
K.Chitra	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTC10	**ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY**	**DSC THEORY- X**	**VI**	**6**	**4**	**2**		**5**

Objective	Students can acquire knowledge about waste management and bioprocess engineering		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Environmental Pollution** – Sources and types - Water, Air, Thermal, Industrial and Radiation - Global environmental changes. Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog. Environmental issues, management strategies and safety, Biotechnological approaches for management.	K1	12
II	**Waste water treatment**: Aerobic and anaerobic methods (Primary, Secondary and Tertiary) –Use of aquatic plants in waste water treatment. Solid waste management. Bioenergy and SCP from waste. Drinking water treatment. Biotechnological approach to industrial effluent (Paper, Tannery, Textile) Pesticide waste disposal.	K2	12
III	**Bioprocess Engineering**-Steps in bioprocess development. Design of bioreactors - Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Animal and plant cell bioreactors. Factors affecting broth viscosity, Mixing in Fermenters. Fermentation systems Batch culture, Continuous culture, Fed-batch culture,	K3	12
IV	**Downstream processing**: Filtration, Centrifugation, Cell disruption, Liquid-liquid extraction, Chromatography, membrane processes, Drying, Crystallization, Whole broth processing. Different types of fermented foods produced from microorganisms- Idli, Sauerkraut - Dairy productsCheese and Yoghurt. Microbial biomass, Microbial enzymes– Amylase & protease, Immobilization of enzymes: Methods, Properties, Applications, Advantages and Disadvantages of Immobilization, Biosensors and Biochips -Types and applications. Microbial Polysaccharide production: Xanthan, Dextran.	K4	12
V	**Leaching:** Ore leaching (methods and examples), MEOR, Production of antibiotics – Penicillin - streptomycin. Alcoholic beverages: Wine, Beer – Biofertilizers- Rhizobium & Azotobacter. Biopesticides – Bacillus thuringiensis and microbial toxin production and their applications - Biosurfactants, Vitamins- Folic acid & Vitamin B12, Organic acids. **Current trends: Sustainable development of non-renewable energy source**	K5	12
	*…… * Self Study.		
Course Outcome	**CO1:** Recite the impact of environmental pollution.	K1	
	CO2: Interpret the methods involved in waste water treatment	K2	
	CO3: Compile a list of fermentation methods in bioprocess	K3	
	CO4: Comprehend the applications and commercialization of product	K4	
	CO5: Evaluate the end alcoholic product to market	K5	

Learning Resources				
Text Books	1. Chatterji, A.K., 2002. Introduction to Environmental Biotechnology, Prentice-Hall of India, New Delhi. 2. Anil Kumar De., 2000. Environmental Chemistry, 4th Edition. New Age International,New Delhi.			
Reference Books	1. Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England, 2. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall (2013). Principles of Fermentation Technology Second Edition, Elsevier Science Ltd 3. Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton (2001), Industrial Microbiology: An Introduction. . Blackwell Science Ltd 4. Nduka Okafor, Modern Industrial Biotechnology & Microbiology (2002), Science Publishers, Edenbridge Ltd. 5. Waites, Morgan, Rockey and Higton, Industrial Microbiology: An Introduction, Blackwell Science (2001).			
Website Link	1. https://nptel.ac.in/courses/120/108/120108004/ 2. https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20- 3. %20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf 4. www. Prenhall.com/Madigan 5. www.e-bug.eu/ 6. www.microbeworld.org/			
Self-Study Material	1. https://pubs.usgs.gov/circ/2007/1294/reports/paper6.pdf			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M6UBTC10	**ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY**	**DSC THEORY- X**	**VI**	**6**	**4**	**2**		**5**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	S	S
CO4	S	M	S	M	S	S	M	S	S	S
CO5	S	S	S	S	M	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.K. Revathi	Dr. P. Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTP01	**CORE PRACTICAL - CELL AND MOLECULAR, DEVELOPMENTAL BIOLOGY AND BIOLOGICAL CHEMISTRY**	DSC PRACTICAL - I	I	3			3	2
Objective	To teach students the cell division, chick embryo, organic compounds and analyse the unknown sample.							

S.No.	**List of Experiments / Programmes**	**Knowledge Levels**	**Sessions**
1	Components of a Compound / Light Microscope	K1	3
2	Blood smear preparation and Identification of Blood cells	K1	3
3	Buccal smear preparation and Identification of squamous epithelial cells.	K1	3
4	Isolation and Identification of plant cells and animal cells	K2	3
5	Observation of sperm & Egg	K1	3
6	Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs	K3	3
7	Cell fractionation and Identification of cell organelles (Demo)	K4	3
	Biological chemistry		3
8	Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (**Aniline not to be given for exam**) Detection of elements (N, Halogens)	K4	3
9	Distinguish between aliphatic and aromatic compounds	K3	3
10	Distinguish between Saturated and unsaturated compounds	K3	3
	Qualitative Analysis		3
11	Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch.	K2	3
12	Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine. Histidine	K2	3
13	Estimation of Glycine- Formal Titration	K4	3
14	Determination of Ascorbic acid – DCPIP method.	K4	3
15	Estimation of Ferrous sulphate using standard Mohr's salt	K4	3
	Colorimetric Analysis		3
16	Estimation of glucose- Ortho touluidine method	K5	3
17	Estimation of Cholesterol- Zak's method	K5	3
18	Estimation of proteins – Lowry's method	K5	3
Course Outcome	**CO1:** Find out the various stages of Cell division Sex chromatin determination by performing a Barr body experiment	K1	
	CO2: Different stages of chick embryo	K2	
	CO3: Analyze the organic compounds present in the cell	K3	
	CO4: Categorize components in unknown sample	K4	
	CO5: Asses the unknown concentration of a solution	K5	

Learning Resources	
Text Books	1. K.V. Chaitanya, (2013), *Cell and molecular biology*: Lab manual, PHI publishers,. ISBN 978-81-203-800-42. 2. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011. 3. S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005. 4. Irwin H.Segel, Biochemical calculations,Liss, Newyork,1991.

Reference books	1. Dr. O P Panday, D N Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016. 2. Hands Thacher Clarke, A hand book of Oraganic:Qualitative and quantitative Analysis, 2007. 3.N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S.Viswanathan Co. Pvt. Ltd., 1998.			
		T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTP01	**CORE PRACTICAL - CELL AND MOLECULAR, DEVELOPMENTAL BIOLOGY AND BIOLOGICAL CHEMISTRY**	DSC PRACTICAL - I	I	3			3	2

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	M	S	S	M	S	M	S
CO2	L	L	L	M	S	S	L	S	M	S
CO3	S	S	L	M	M	S	M	S	S	M
CO4	S	M	M	S	S	S	M	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	CIA I, CIA II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTP02	PRACTICAL-GENETICS AND MICROBIOLOGY	DSC PRACTICAL-II	II	3			3	2
Objective	Students can able to demonstrate the basic principles of important techniques in Genetics and Microbiology							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
1	Mitotic stages of onion (Allium cepa) root tip	**K1**	3
2	Meiotic stages of cockroach testes/ Flower bud	**K1**	3
3	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands	**K1**	3
4	Identification of Barr bodies from Buccal smear	**K2**	3
5	Preparations of culture medium and culture of Drosophila – methods of maintenance	**K2**	3
6	Identifications of mutants of Drosophila Human karyotyping (Demo)	**K2**	3
7	Sterilization techniques – Preparation of Media	**K2**	3
8	Inoculation techniques- Pour plate, spread plate and streak plate (simple, continuous, „T‟ streak and quadrant streak methods)	**K2**	3
9	Isolation of bacteria from air, soil and water. Serial dilution method.	**K2**	3
10	Staining techniques: Simple, Gram‟s, Capsule Spores,	**K3**	3
11	Preparation of temporary mounts- Lacto phenol cotton blue staining	**K3**	3
12	Motility test: Hanging drop technique.	**K3**	3
13	Biochemical characterization - catalase, oxidase, IMVIC test and TSI.	**K3**	3
14	Antibiotic sensitivity test by Kirby-Bauer method (demonstration).	**K3**	3
Course Outcome	**CO1:** Examine and evaluate the stages of Mitosis	**K1**	
	CO2: Analyze the sex chromatin present in different cells	**K1**	
	CO3: Acquire skills on laboratory rules and regulations	**K2**	
	CO4:Visualize the cells by employing different types of microscopes	**K2**	
	CO5: Understand the concepts of microbial culturing techniques	**K3**	

Learning Resources	
Text Books	1. Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi 2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
Reference Books	1. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. 2. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
Website	1. http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-andprinciples-microbiology/24403.

		T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTP02	PRACTICAL-GENETICS AND MICROBIOLOGY		DSC PRACTICAL-II		II	3			3	2

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	S	S
CO4	S	M	S	M	S	S	M	S	S	S
CO5	S	S	S	S	M	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	Model Practical and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3UBTP03	PRACTICAL: IMMUNOTECHNOLOGY AND BIOINSTRUMENTATION	DSC PRACTICAL-III	III	3		-	3	2
Objective	To perform blood grouping and determine blood type. able to count WBC and RBC							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	1. Separation of Serum and Plasma 2. Blood grouping and Rh typing 3.WBC counting 4.RBC counting 5.Differential blood count	K2	9
II	6.WIDAL Slide test 7.ASO test 8.Immunoelectrophoresis 9.Double Immunodiffusion 10.Single Radial Immunodiffusion	K3	9
III	11.ELISA – Demonstration 12.Western blotting(demo) 9 72 13.Dot blot (demo) 14.Handling of Laboratory animals – Demonstration 15.Skin test – Demonstration	K4	9
IV	**BIOINSTRUMENTATION** 16.Preparation of Buffer (Phosphate Buffer) 17.Determination of pH of biological samples using pH meter 18. Estimation of DNA and proteins by UV spectrophotometer. 19. Chromatographic analysis of sugar, amino acids, lipids by paper chromatography.	K4	9
V	20. Separation of chlorophyll pigments by column chromatography technique. 21.Separation of DNA by Agarose Gel Electrophoresis (AGE) 22.Separation of protein by SDS PAGE	K5	9
Course Outcome	**CO1:** Understand the practical skills in Immunology	K2	
	CO2: Exploratory and analyzing the results involved in immune techniques	K3	
	CO3: Discuss about the skills of instrument handling	K4	
	CO4: Enumerate the mechanism of biological instruments	K4	
	CO5: Interpretation of biomolecule separation	K5	

Learning Resources	
Text Books	1. Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS 2. Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications
Reference Books	1. Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley Blackwell. 2. Rose. (1992). Manual of Clinical Lab Immunology, ASM. 3. Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing 4. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition. 5. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt‟s Essential Immunology, 11thEdition., Wiley-Blackwell 6. Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology.2018
Website Link	1. https://cinj.org/sites/cinj/files/documents/C4ProcedureForSerumAndPlasmaSepartion.pdf 2. https://uotelafer.edu.iq/wp-content/uploads/2020/03/blood-group.pdf

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3UBTP03	PRACTICAL: IMMUNOTECHNOLOGY AND BIOINSTRUMENTATION	DSC PRACTICAL-III	III	3		-	3	2

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	L	M	M	S
CO2	S	S	S	M	M	L	S	S	M	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	S	S	M	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	CIA I, CIA II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Rajasekaran	Dr.P. Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4UBTP04	**PRACTICAL:GENETIC ENGINEERING, BIOINFORMATICS AND BIOSTATISTICS**	**DSC PRACTICAL - IV**	**IV**	**4**			**4**	**2**

Objective	Students are able to gain knowledge on recombinant DNA construction using bioinformatics tools and statistical tools.

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	1.Isolation of genomic DNA 2.Isolation of plasmid DNA 3.Isolation of RNA	K1	10
II	4.Production of competent cells for transformation 5.Bacterial transformation	K2	10
III	6.Restriction Digestion of DNA 7.Ligation of digested DNA fragments 7.Restriction Fragment Length Polymorphism(DEMO) 8.PCR(Demonstration)	K3	10
IV	9.Biological databases (NCBI, Swissprot and PDB) 10. Sequence retrieval and alignment 11. BLAST FASTA 12. Protein visualization tools (Rasmol) 13. Identification of functional domains in nucleotide binding proteins using a domain analysis server like SMART	K4	10
V	14. Preparation of bar diagram, line diagram and pie diagram using MS EXCEL. 15. Measurement of Central tendency- mean, geometric mean, median using MS EXCEL 16. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL. 17. Calculation of student's "t" test using MS EXCEL 18.Analysis of variance (ANOVA)	K5	10
Course Outcome	**CO1:** Recite the on isolation techniques	K1	
	CO2: Interpret the gene transfer mechanism	K2	
	CO3: Compile a the Genetic engineering markers	K3	
	CO4: Comprehend the recent technology involved of bioinformatics	K4	
	CO5: Evaluate the skills in computer automated analysis	K5	

Learning Resources	
Text Books	1. S. John Vennison . (2009). Laboratory Manual For Genetic Engineering 1st Edition, Kindle Edition 2. Primrose, S.B. (1998). Principle of genome analysis. 2nd edition. Blackwell Science publishers.
Reference Books	1. Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. (1998). Biological sequence analysis. Cambridge University Press. 2. Friedman, C.P. and Wyatt. J.C. (1997). Computers and Machine: Evaluation methods in medicinal information. Springer-Verlag, New York.

Website Link	1. https://www.cambridge.org/core/books/an-introduction-to-genetic-engineering/A3B274BAC608CE61F02B78BFC24836C9 2. https://www.sciencebuddies.org/science-experiments/genetic-engineering			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4UBTP04	**PRACTICAL:GENETIC ENGINEERING, BIOINFORMATICS AND BIOSTATISTICS**	**DSE PRACTICAL - IV**	**IV**	**4**			**4**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	CIA I, CIA II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTP05	**PRACTICAL : PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY**	**DSC PRACTICAL - V**	**V**	**4**	**-**	**-**	**4**	**2**
Objective	To apply my expertise and skills in plant biotechnology and animal biotechnology towards advancing scientific research.							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	1. Plant tissue culture media preparation & sterilization techniques. 2. Seed germination, Callus induction, shoot tip initiation, root initiation using MS media.	K1	9
II	3. Anther culture 4. Isolation of plant protoplast & viability test.	K2	9
III	5.Preparation of Animal Tissue culture medium and membrane filtration 6.Preparation of Single Cell Suspension 7. Cell counting and Cell viability Test (Trypan blue exclusion assay). 8. Culture of chick embryo fibroblast (monolayer) culture. 9. Inoculation of virus and observation. 10. Establishment of continuous cell lines (HeLa) (Demo)	K3	9
IV	10.Isolation of plant DNA (Demo) 11.Isolation of Agrobacterium plasmid DNA (Demo)	K4	12
V	12.Trypsinization of monolayer and sub culturing (Demo) 13.MTT Assay (Demo) 14.Cryopreservation and thawing (Demo)	K5	10
Course Outcome	**CO1:** Relate the knowledge on the media preparation and techniques	K1	
	CO2: Compare the different pathways of plant regeneration	K2	
	CO3: Organize the cell culture techniques of using body fluids	K3	
	CO4: Contrast the DNA and RNA from plant	K4	
	CO5: Determine the animal tissue culture techniques	K5	

Learning Resources	
Text Books	1. Madhavi Adhav, 2009, Practical Biotechnology and Plant Tissue Culture, S.Chand & Company Ltd. 2. C. C. Giri, Archana Giri, 2007, Plant Biotechnology: Practical Manual, I.K. International Pvt Ltd.
Reference Books	1. Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, 2009, Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application, Springer 2. Debajit Borah (2018), *Environmental Biotechnology Theory and Lab Practices*, (2nd edition), Hardcover – Global Vision Publishing House, ISBN: 9788182205840 3. S. Lal, Vikas. (2018), *Public Health Management Principles And Practice*, (2nd Edition), CBS Publishers and Distributors Pvt Ltd,ISBN 13: 9789387742932 4. S. Harisha. (2012), *Biotechnology procedures and experiments handbook*,ISBN13 9781934015117
Website Link	1. https://www.plantcelltechnology.com/pct-blog/different-types-of-tissue-culture-processes 2. https://www.thermofisher.com/in/en/home/references/gibco-cell-culture-basics.html

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M5UBTP05	**PRACTICAL : PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY**	**DSC PRACTICAL - V**	**V**	**4**	**-**	**-**	**4**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	M	S	S	M	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	CIA I, CIA II and ESE

Designed By	**Verified By**	**Approved By**
K.Chitra	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTP06	**PRACTICAL: ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY**	**DSC PRACTICAL-VI**	**VI**	**4**			**4**	**2**
Objective	To make students have a strong foundation and know about the environment, its issues and management of the environment.							

Unit	Course Content	Knowledge Levels	Sessions
I	1.Isolation of Air borne Pathogens 2. Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.	K2	9
II	3. Water analysis – MPN and BOD. 4. Immobilization of whole yeast cells/ enzyme by Alginate beads. 5.Production of wine and estimation of alcohol 6. Production of Biogas – In vitro & Compost Making.	K3	9
III	7. Biofertilizer production/Spirulina production - field visit. (Report should be included in the record) 8.Isolation and identification of starter organisms from Idli batter/ curd	K4	9
IV	9. Grading of raw milk (Dye reduction test, MBRT test). 10. Determination of efficiency of Pasteurization by quantitative Phosphatase test.	K4	9
V	11. Preparation and Efficiency testing of Biofertilizer/ Biopesticide. (Demo) 12. Production of microbial Polysaccharide. (Demo) 13.Lignin degradation by using microorganism and assays (Demo) 14.Textile dye degradation by using microbes (demo)	K5	9
Course Outcome	**CO1:** Demonstrate methods to observe and measure microorganisms by standard microbiological techniques	K2	
	CO2: Interpret about immobilization and production of Wine, Biogas and compost	K3	
	CO3: Develop skills in bio fertilizer production and microbial identification.	K4	
	CO4: Elucidate raw milk and determine the pasteurization efficacy..	K4	
	CO5: Evaluate efficiency tests of biofertilizers and biopesticides, microbial polysaccharide production	K5	

Learning Resources	
Text Books	1. Aneja K R, Laboratory Manual of Microbiology and Biotechnology, MEDTECH, 2014.ISBN-13 : 978-9381714553 2. Vijaya Ramesh, (2007), Food Microbiology, MJP Publishers, Chennai, ISBN-13 : 978-8180940194
Reference Books	3. Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed., (1983), A Manual of Laboratory Techniques, National Institute of Nutrition, ICMR, Hyderabad.
Website Link	1 https://www.youtube.com/watch?v=3UafRz3QeO8 2 https://www.youtube.com/watch?v=jpuNYpvBmDM 3 https://www.youtube.com/watch?v=tUCfkNKyQyc

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M6UBTP06	**PRACTICAL: ENVIRONMENTAL & INDUSTRIAL BIOTECHNOLOGY**	**DSC PRACTICAL-VI**	**VI**	**4**			**4**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	M	M	M	S
CO2	S	S	S	M	M	M	S	S	M	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	S	S	M	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	CIA I, CIA II and ESE

Designed By	**Verified By**	**Approved By**
Dr. K. Revathi	Dr. P. Selvamaleeswaran	Dr.S.Shahitha Member Secretary

List of Foundation Course (FC) for B. Sc., Biotechnology

SYLLABUS-LOCF-CBCS Pattern

EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards

S.NO	SEM	COURSE_CODE	TITLE OF THE COURSE
1	I	23M1UBTFC1	General Biology

B.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTFC1	GENERAL BIOLOGY	FC-1	I	2	2			2
Objective	On successful completion of the course, students will be able to understand the Provide knowledge about the structure and function of cells							

Unit	Course Content	Knowledge Levels	Sessions
I	**Ultrastructure of Eubacteria**- Cell membrane- Extra mural layer - Slime – Capsule – Cytoplasmic inclusions – Mesosomes – Nuclear material – Reserve materials - Pigments – Cell appendages – Flagella – Pili.	K1	7
II	**Ultrastructure and functions of Eukaryotic cell organelles** – Cell wall – Cell membrane - Mitochondria – Chloroplast – Endoplasmic reticulum – Golgi complex – Nucleus – Ribosomes – Other cell inclusions and Flagella	K2	7
III	**Cell division in Bacteria** – Binary fission - Cell division in Eukaryotes – Mitosis and Meiosis. Reproduction in Microbes.	K3	7
IV	**Botany:** Ultrastructure of plant cell. General characters of Thallophyta-, Bryophyta, Pteridophyta-, Angiosperms. Zoology: Ultrastructure of Animal cell. General characterstics of Vertebrate –Invertebrate	K4	7
V	**Human physiology**-Digestive System and Excretion, Respiratory System, Nervous System, Muscular System and Cardiovascular System	K5	7
Course Outcome	**CO1:** Explore the ultra structure of prokaryotes	**K1**	
	CO 2: Gain knowledge about eukaryotes**.**	**K2**	
	CO 3: Learn about cell divisions.	**K3**	
	CO 4: Know about the basics of plant kingdom.	**K4**	
	CO 5: Learn about the basis of human physiology	**K5**	

Learning Resources	
Text Books	1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers 2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company 3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall. 4. Jain V.K. (2000) Fundamentals of Plant Physiology, 5th edition. S.Chand & Co Ltd; New Delhi. 5. Pandey B.P. (2007) Plant Anatomy, S. Chand & Co. De, New Delhi
Reference Books	1. Ekambarantha Ayyar, and Ananthakrishnan, T.N. 1993 Outlines of Zoology, Vol. I & II Viswanathan and co Madras. 2. Dr. C. Chatterjee I & II, Human Physiology. Medical Allied Agency, Kolkatta. 3. Sarada Subramaniam and K. Madhavan Kutty, Human Physiology. S. Chand and Co, New Delhi. 4. Ross and Wilson, Anatomy and Physiology, 8th Edition, Churchill Livingston 5. Sambasiviah I, Kamalakara Rao. A.P. Augustine Chellappa, S [1983] Text Book ofAnimal Physiology, S. Chand & Co., New Delhi.
Website Link	https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology https://courses.lumenlearning.com/boundless-biology/chapter/eukaryotic-cells/ https://m.jagranjosh.com/general-knowledge/amp/classification-of-plant-kingdom1453445359-1 https://www.visiblebody.com/anatomy-and-physiology-apps/anatomy-and-physiology https://www.innerbody.com/htm/body.html

L-Lecture T-Tutorial P-Practical C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTFC1	GENERAL BIOLOGY	FC-1	I	2	2			2

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO2	PSO3	PSO 4	PSO 5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	M	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr. Jim Thomas	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

List of Elective Course (DSE) for B. Sc., Biotechnology SYLLABUS-LOCF-CBCS Pattern EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards			
S.NO	**SEM**	**COURSE_CODE**	**TITLE OF THE COURSE**
1	V	23M5UBTE01	Nano Biotechnology
2	V	23M5UBTE02	Bioinformatics, Bioethics, Biosafety and IPR
3	VI	23M6UBTE03	Food Science and Technology
4	VI	23M6UBTE04	Forensic Science and Technology

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTE01	**NANO BIOTECHNOLOGY**	**DSE THEORY - I**	**V**	**5**	**3**	2		**3**

Objective	Student will be provided with a basic knowledge and understanding about the fundamentals of nanoparticles and role of nanoparticles in biotechnology.

Unit	Course Content	Knowledge Levels	Sessions
I	**Glimpse of Nanotechnology based material in ancient India**: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.	K1	6
II	**Metals:** Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM	K2	7
III	**Nano-thin films**: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.	K3	8
IV	**Agriculture:** Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.	K4	9
V	**Nano biosensors** (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car). Optofluidic microsystems for application in biotechnology **Current Trends**-*Q**uantum dots: role in diagnosis and implication in drug delivery ***	K5	10
	…… Self Study.		
Course Outcome	**CO1:** Recite a fundamental knowledge of nanobiotechnology.	K1	
	CO2: Interpret the types of nanoparticle characterization techniques.	K2	
	CO3: Compile a fundamental knowledge of nanomaterials	K3	
	CO4: Comprehend the importance of nanoparticles and its application in Nano biotechnology	K4	
	CO5: Evaluate the of nano biosensors and their applications	K5	

Learning Resources	
Text Books	1. Madhuri sharon, (2012) Bionanotechnology, CRC press, India 2. Mark Ratner, (2002) Nanotechnolgy, Pearson,India 3. S.Shanmugam (2011) Nanotechnology, MJP publication.
Reference Books	1. Kurt E. Geckeler, Hiroyuki Nishide, (2010) Advanced nanomaterials, Wiley VHC. 2. T.Laurencin, Lakshmi S. Nair, (2012) Nanotechnology and tissue engineering. CRC press. 3. Jo Anne Shatkin, (2013) Nanotechnology: Health and Environmental Risks, CRC Press

Website Link	http://www.zyvex.com/nano www.nature.com/nnano/ https://www.frontiersin.org/articles/10.3389/fchem.2022.1063152 https://www.biologydiscussion.com/essay/essay-on-nano-biotechnology-with-diagrams/24845			
Self-Study Material	1. https://youtu.be/0B1MWl7xwq0?t=4 2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=t5vt4STquHRj94mcOBMr5g==			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTE01	**NANO BIOTECHNOLOGY**			**DSE THEORY - I**		**V**	**5**	3	2		**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	M	M	S	M	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	M	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTE02	**BIOINFORMATICS, BIOETHICS, BIOSAFETY AND IPR**	**DSE THEORY - II**	**V**	**5**	**3**	2		**3**
Objective	The students will understand the concepts of bioethics and biosafety and realise the impact of gene cloning in societal problems, get knowledge about patents rights in the field of research.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Human Rights:** Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.	K1	7
II	**Impact of gene cloning & Bioethics**-Issues concerning reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion).	K2	7
III	**Bioethics of IPR** - ethical criteria in biotechnology- animal ethics; Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects.	K3	8
IV	**Patents** - Introduction -Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability – Non Patentable Inventions - Patent Application Procedure in India. Other Forms of IP: Copyright - Trade Mark – Industrial designs – Farmer's Rights. Patenting of Biotechnology products and processes	K4	8
V	**Biosafety** - General guidelines - DBT guidelines on biosafety in conducting research in biology / biotechnology - Risk assessment studies- Hazardous materials used in Biotechnology- Handling and Disposal - Good manufacturing practices & Good Laboratory practices, Containment facilities and Biosafety practices - Regulation on field experiments and release of GMO's - Labelling of GM foods - Guidelines for research in transgenic plants and Animals. Bioinformatics applications in life and environmental sciences. **Current Trends-* Biosafety in the Laboratory : Prudent Practices for Handling and Disposal of Infectious Materials***	K5	10
	…… Self Study.		
Course Outcome	**CO1:** Recognize basics of human rights in biological sciences	K1	
	CO2: Summarise the various safety measures in cloning	K2	
	CO3: Demonstrate a list of Patenting in Biotechnology	K3	
	CO4: Associate the Patenting in Biotechnology	K4	
	CO5: Generate the rules in biosafety and bioethics and its impact on all the biological sciences and the quality of human life	K5	
Learning Resources			

Text Books	1. Ignacimuthu, S (2009), Bioethics, Narosa Publication house, ISBN: 978-81-7319-966-0 2. Rhona Smith. (2003), International Human rights, Blackstone Press.			
Reference Books	1. Trayer, P.C, Fredrick.R., and Koch, M. (2002), Biosafety. Michigan State University 2. Fredric & Koch. (2002). Biosafety, Traylor, Michigan state University pub., USA. 3. Beauchamp & Leroy (1999). Contemporary issues in Bioethics, Wardsworth Pub. Co. Belmont, California			
Website Link	https://rshrc.rajasthan.gov.in/writereaddata/Publications/202208290143461701052HUMAN-RIGHTS-ARTICLE-21.pdf https://www.diva-portal.org/smash/get/diva2:359860/fulltext01.pdf			
Self-Study Material	1. https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=3377177			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M5UBTE02	**BIOINFORMATICS, BIOETHICS,BIOSAFETY AND IPR**	**DSE THEORY - II**	**V**	**5**	**3**	2		**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M	S	M	S	S	S
CO2	S	S	M	S	S	S	M	S	M	S
CO3	S	M	M	M	S	S	M	S	M	S
CO4	S	S	M	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTE3	**FOOD SCIENCE AND TECHNOLOGY**	**DSE THEORY -III**	**VI**	**5**	**3**	**2**		**3**
Objective	To Know the basic concepts of the food industry, classification of food, fruits and vegetables and horticulture and non vegetarian food.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Biotechnology relating to the food industry**: Role of bioprocess engineering in biotechnology industry- Regulatory and social aspects of biotechnology in foods- Application of biotechnology in waste treatment of food industries. Historical evolution of food processing technology	K1	7
II	**Cereals and Millets**: Wheat- composition, types (hard, soft/ strong, weak). Malting, gelatinization of starch, types of browning- Maillard & caramelization. Structure and composition of pulses, toxic constituents in pulses, processing of pulses soaking, germination, decortications, cooking and fermentation. Fats and Oils. Refining of oils, types- steam refining, alkali refining, bleaching. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.	K2	8
III	**Classification of fruits and vegetables**: general composition, enzymatic browning, names and sources of pigments, Dietary fibre. Post-harvest changes in fruits and vegetables – Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.	K3	8
IV	**Concept of red meat and white meat**: composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. Composition and nutritive value of egg, characteristics of fresh egg, deterioration of egg quality. Milk and Milk Products. Chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization.	K4	8
V	**Types of food adulterants**: test to detect adulterants in foods – metal contaminants - contaminants of processed foods- Food products as analytical samples, general aspects of biosensors- biosensors for food contaminant analysis, commercially available biosensors for food analysis. Food additives, FSSAI regulations, Methods of fortifying and enriching foods. **Current Trends-* Agricultural Biotechnology and Transatlantic Trade : Regulatory Barriers to GM Crops***	K5	9
	…… Self Study.		
Course Outcome	**CO1:** Recognize the basic concepts of the food industry	K1	
	CO2: Interpret the basic composition & structure of food grain	K2	
	CO3: Predict current status of fruits and vegetables storage and processing	K3	
	CO4: Comprehend compositional and technological aspects of meat, milk, and fish	K4	
	CO5: Design the types of adulterants	K5	

Learning Resources	
Text Books	1. Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin(2005), Food Biotechnology, (2nd edition), CRC Press, ISBN 9780824753290
Reference Books	1. Joshi, V.K. and Singh, R.S., A. (2013), Food Biotechnology- Principles and practices, I.K. International Publishing House Pvt. Ltd., New Delhi,. 2. Ravishankar Rai, V,(2015), Advances in Food Biotechnology, (First edition), John Wiley & Sons, Inc, ISBN 9781118864555. 3. Perry Johnson-Green (2018), Introduction to Food Biotechnology, Special Indian Edition, CRC Press, ISBN 9781315275703. 4. Meyer, (2004). Food Chemistry, New Age
Website Link	1.https://ifst.onlinelibrary.wiley.com/journal/13652621 2.https://app.knovel.com/web/browse-a-subject-area.v/catid:216/cat_slug:food-science/subcatid:27 3. https://www.springer.com/journal/13197 4.https://www.sciencedirect.com/referencework/9780081005965/food-science 5. https://www.ift.org/news-and-publications/food-technology-magazine
Self-Study Material	1. https://ebookcentral.proquest.com/lib/inflibnet-ebooks/detail.action?docID=294749

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTE3	**FOOD SCIENCE AND TECHNOLOGY**	**DSE THEORY -III**	**VI**	**5**	**3**	**2**		**3**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	M	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	M	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTE4	**FORENSIC SCIENCE AND TECHNOLOGY**	**DSE THEORY - IV**	**VI**	**5**	**3**	**2**		**3**
Objective	Students will gain knowledge on blood related issues, molecular approaches and DNA finger printing							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Definition and scope of Forensic Biotechnology**, History and development, Forensic genetics, Forensic agriculture.	K1	10
II	**Crime scene investigation**; collection, preservation, packing and forwarding of physical and trace evidence. Biological Evidence: Nature, collection, identification, evaluation of hair and fibers. Questioned documents – identification of handwriting, signature and detection of forgery. Forensic Art Illustration: Introduction, Finding and identifying human face image. Post mortem drawing, methods of superimposition.	K2	10
III	**Definition and Classification of fingerprints** (Henry system). Taking fingerprints from living and dead persons. Automatic fingerprint identification system (AFIS). Serology - Fresh blood grouping and typing, stains of bloods. Identification of blood stains, collection and storage of allied body fluids (semen, saliva and blood). Case studies.	K3	10
IV	**Fatality Forensics**: Introduction, cause, manner and characteristics of death, Road traffic fatality (RTF) investigation. General classification of RTFs	K4	10
V	**DNA Fingerprinting (DFP) technology**: An overview, Applications of DFP in forensic investigations, paternity disputes. DNA Profiling practice in India with reference to criminal cases. **Current Trends: *Environmental forensics***	K4	10
	Environmental forensicsSelf Study		
Course Outcome	**CO1:** Understand the fundamental principles and functions of forensic science and its significance to human society.	K1	
	CO2: Explain the art of collecting, packaging and preserving	K2	
	CO3: justify the importance of biological fluids	K3	
	CO4: Explain the basic principle of DNA analysis and forensic significance of DNA typing.	K4	
	CO5: Criticise the importance of Markers in DNA technique	K4	

Learning Resources	
Text Books	1. Upadhyay and Upadhyay Nath (2009).Biophysical chemistry, Principles and Techniques. Himalaya Publishing House.
Reference Books	1. Keith Wilson, John Walker,(2010) Principles and techniques of Biochemistry and Molecular biology (7th edition). Cambridge University Press. 2. David L.Nelson, Michael M.cox. Lehninger(2008)"Principles of Biochemistry" Fifth edition W.H.Freeman, Newyork 3. Khandpur R S 2014 Handbook of Biomdical Instrumentaion 3rd edition, McGraw Hill Education(India).

Website Link	1. https://microbiologysociety.org/members-outreach-resources/links.html 2. https://www.isham.org/mycology-resources/mycological-links			
Self-Study Material	https://nlist.inflibnet.ac.in/search/Record/EBC1185493			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTE4	**FORENSIC SCIENCE AND TECHNOLOGY**			DSE THEORY - IV		VI	5	3	2		3

CO-PO Mapping

CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr. P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

List of Skill Based Elective Course (SEC) for B. Sc., Biotechnology SYLLABUS-LOCF-CBCS Pattern EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards			
S.NO	SEM	COURSE_CODE	TITLE OF THE COURSE
1	II	23M2UBTS01	Vermicompost technology
2	IV	23M4UBTS02	Marine Biotechnology
3	IV	23M4UBTS03	Cryogenics and Cryobiology
4	V	23M5UBTS04	Quality Control in Industries
5	VI	23M6UBTS05	Pharmaceutical Biotechnology

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTS01	**Vermicomposting technology**	**SEC-I**	**II**	**2**	**2**			**2**
Objective	Students can able to understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Types, Collection and Preservation of earthworms** - Types and basic characteristics of species suitable for vermicomposting; Role of earth worms in soil fertility, Biology of Lampitomaruitti; Collection and Preservation of Earthworms; Flow sheet for vermi technology	K1	6
II	**Culturing techniques of earthworms** and composting materials General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.	K1	6
III	**Small scale techniques of Vermicomposting** - Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost	K2	6
IV	**Large scale techniques of Vermicomposting** Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan.	K3	6
V	**Vermiwash and Economics** - Chemical composition of vermiwash; Techniques of vermi wash production: Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.	K3	6
Course Outcome	**CO1:** Find out that Vermicomposting is an eco-friendly, economically and socially acceptable technology	K1	
	CO2: Illustrate that Vermitechnology is useful for stabilization and recycling of both industrial and domestic organic waste.	K1	
	CO3: Utilize Vermitechnology to improve the soil texture, soil aeration, improve the water retention capacity in the soil	K2	
	CO4: Improve Vermitechnology to manufacture the vermicompost in small scale industry by which the economy of the farmer is improved. It provides the employment opportunity in rural and urban areas.	K3	
	CO5: Justify and prove that the Earthworms are having the capacity to observe heavy metals into their body tissues and converting the soil without heavy metals.	K3	
Learning Resources			

Text Books	1.The Earthworm book,Ismail,S.A.,other India Press,Goa 2.Somani, L.L. 2008. Vermicomposting and vermiwash. AgrotechPublishing Academy, Udaipur.
Reference Books	1.Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur 2.Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.
Website Link	http;//vermicompost/onlinenotes.in

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2UBTS01	**Vermicomposting technology**	**SEC-I**	**II**	**2**	**2**			**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	S	S	S	M	M
CO2	S	L	M	M	S	S	S	M	M	S
CO3	M	S	M	M	S	S	S	M	M	S
CO4	M	S	M	S	S	M	M	L	L	M
CO5	S	S	S	M	M	S	S	S	M	M

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Rajasekran	Dr. P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4UBTS02	**MARINE BIOTECHNOLOGY**	**SEC-II**	**IV**	**2**	**2**			**2**
Objective	Students can acquire the knowledge about marine ecosystem and their habitats							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Marine Ecosystems & Its functioning:** Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea- Euphotic- Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.	K1	5
II	**Marine microbial habitats-** Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.	K2	5
III	**Compound extraction**- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.	K3	5
IV	**Culture aspect**-Seaweed (*Kappaphycus alvarezii*), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Trangenesis and Cryopreservation.	K4	5
V	**Application:** Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.**Current Trends:** ***Extraction of metabolites in aquatic organism***	K5	5
	* **….** * Self Study.		
Course Outcome	**CO1:** Recite the functioning of marine ecosystem	K1	
	CO2: Analyze the habitat of marine microbial habitat	K2	
	CO3: Simulations of compound extraction and its uses	K3	
	CO4: Comprehend the marine culture aspect	K4	
	CO5: Evaluate the byproducts of marine organism	K5	

Learning Resources	
Text Books	1 Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp. 2 Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.

Reference Books	1 Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York 2 Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp 3 Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford Universitypress, New York Inc., 231pp 4 Gloria Sanchez, Elizabeth Hernandez,(2019), Environmental Biotechnology and cleaner Bioprocess, (1st edition), CRC Press, ISBN 9780367455552 5 Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3rdedition), Wiley –Blackwell.
Website Link	http://www.bcb.iastate.edu/ http://www.nwfsc.noaa.gov/protocols/bioinformatics.html http://www.ebi.ac.uk/ ExPASy.org/ http://www.expasy.org/
Self-Study Material	1. https://onlinecourses.swayam2.ac.in/cec23_bt22/preview

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4UBTS02	**MARINE SCIENCE AND TECHNOLOGY**			**SEC-II**		**IV**	**2**	**2**			**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	S	M	S	M	S	S	S	M	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	M	S	M	S	S	M	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.K. Revathi	Dr. P. Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M4UBTS03	**CRYOGENICS AND CRYOBIOLOGY**	**SEC - III**	**IV**	**2**	**2**			**2**

Objective	On successful completion of the course, students will be able to understand the importance of cryopreservation, factors that influence the cryopreservation outcome and fundamental principles of cryobiology to improve current cryopreservation procedures.		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction**: Cryobiology, cryopreservation - natural cryopreservation, temperature, risks, slow, permeable freezing, vitrification, uses freezable tissues, equipment, limitations.	K1	5
II	**Cryopreservation Materials**:Liquid nitrogen – uses, safety, production; glass transition- introduction, transition temperature Tg, kauzmann's paradox, the glass transition, specific materials, silica, polymers, mechanism of vitrification, electronic structures; ex-situ conservation; cryoprotectants; cryostasis; neuropreservation.	K2	7
III	**Cryopreservation in nature** – antifreeze protein, antifreeze, psychrophile, insect winter ecology, cryogenic treatment, cryogenic seal, cryogenic fuel, energy storage, crystal, cryotank, absolute zero, target temperature management.	K3	6
IV	**Adaptive strategy of mammals-** Hibernation, heterothermy, hibernaculum, hypothermia, chilblains, frost bite, trench feet, thermoregulation.	K4	6
V	**Application of Cryobiology** - cloning, molecular cloning, organ transplantation, sperm bank, semen extender, in-vitro fertilization, embryo transfer, cryosurgery, cryoablation. **Current Trends-*The freezing of mammalian embryos***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Remember about the latest cold preservation techniques. and understand the detailed concept of cryopreservation.	K1	
	CO2: Relate the methods of cryopreservation procedures involving freezing of biological materials.	K2	
	CO3: Organize methods of investigation of ice binding proteins, their structure and their use in cryobiological applications.	K3	
	CO4: Compare and contrast adaptive strategies of mammals	K4	
	CO5:Assess current cryopreservation practices in ART	K5	

Learning Resources	
Text Books	1. G.P.Garg, Understanding cryobiology,2010 Discovery publishing Pvt. Ltd. India 2. Yadav Manju, Textbook of cryobiology, 2010 Discovery publishing house, United Kingdom 3. Julian White,Cryobiology,2022 Syrawood publishing house, USA

Reference Books	1. Colby Gunn, A comprehensive introduction to Cryobiology, 2017 library press publishing, New York. 2. Marianne Wilde, Cryopreservation: Modern insights, 2015 CallistroReference,USA.			
Website Link	1. https://www.societyforcryobiology.org/ 2.https://www.cambridge.org/core/books/fertility-cryopreservation/cryobiology/82EBC84FD8E299A440B14BFA0156559F 3.https://bmcbiol.biomedcentral.com/articles/10.1186/s12915-021-00976-8			
Self-Study Material	1. https://www.fertstert.org/article/S0015-0282(16)60085-7/fulltext 2.https://www.hindawi.com/journals/vmi/2011/146405/			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4UBTS03	**CRYOGENICS AND CRYOBIOLOGY**	**SEC - III**	**IV**	**2**	**2**			**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	L	L	S	L	L	L	L
CO2	S	S	L	S	M	S	L	S	S	S
CO3	M	M	M	S	S	S	S	S	M	M
CO4	L	S	S	M	S	S	S	S	S	S
CO5	L	S	S	S	S	M	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr..D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTS04	**QUALITY CONTROL IN INDUSTRIES**	**SEC-IV**	**V**	**2**	**2**			**2**
Objective	Student will acquire basic knowledge in pharmaceutical quality control, audits, hospital microbial control, and manufacturing operations.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Industrial quality control**-Process of quality control- sterile and non-sterile preparations – raw materials, purity check, quality check of finished products - Pharmaceutical products and their quality control-drugs and vaccines. Environmental Monitoring – Pharmaceutical industry.	K1	7
II	**Food safety and Food Quality**-Microbiological criteria of food, food products, Monitoring of factory hygiene and sanitation, Food Safety and Standards. Food contaminants and diseases.	K2	6
III	**Microbial quality control in Hospitals**-Control of Healthcare associated infections - Monitoring water quality in hospitals, healthcare infrastructures.	K3	5
IV	**Manufacturing operations and controls**-Sanitation of manufacturing premises, cross contamination, processing of bulk products, packaging operations, release of finished product.	K4	6
V	**Manufacturing operations and controls**- Expiry date calculation, calculation of yields, production record review, and handling of waste and scrap disposal. **Current Trends-*Food safety in the seafood industry***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Relate quality control in pharmaceutical industry	K1	
	CO2: Interpret the quality control audits in industries	K2	
	CO3: Identify quality control in hospitals	K3	
	CO4: Organize manufacturing operation in industries	K4	
	CO5: Deduct manufacturing operations and controls	K5	

Learning Resources	
Text Books	1. F. Aylward., Food Technology Processing And Laboratory Control. Agrobios (India), 2010. ISBN, 8177540335, 9788177540338. 2. Giriraj Sahu ., Food biotechnology (2017) Crescent publishing Corporation.

Reference Books	1.Knorr Dietrich., Food biotechnology(1993).,CRC press 2. V. K. Joshi, Ashok Pandey.1999. Food fermentation, Educational Publishers & Distributors.
Website Link	1. https://www.atcc.org/microbe-products/applications/quality-control 2.https://www.deskera.com/blog/food-manufacturing-process-how-food-is-made/
Self-Study Material	1.https://www.food-safety.com/topics/351-seafood 2.https://www.fao.org/3/y5924e/y5924e06.htm

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTS04	**QUALITY CONTROL IN INDUSTRIES**	**SEC-IV**	**V**	**2**	**2**			**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr..D.Kavitha	Dr.P. Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc -Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTS05	**PHARMACEUTICAL BIOTECHNOLOGY**	**SEC-V**	**VI**	**3**	**3**			**2**
Objective	Students will understand the series of processes involved in drug development, patenting and drug approval.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Objectives of Pharmaceutical Biotechnology** - Generic and Biogeneric drugs. Stages in the drug development process -Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials.	K1	5
II	**Production of recombinant proteins** - Development of Nucleic acid based therapies - Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy	K2	5
III	**Human Insulin (Humulin),** Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab	K3	6
IV	**Drug toxicity analysis** - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management	K4	7
V	**National and International Drug approval agencies** - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors. **Current Trends**: ***Modern medicine in life sciences***	K5	7
	……. Self study		
Course Outcome	**CO1:** Relate the specific pharmacology of the major classes of drugs important distinctions among members of each class	K1	
	CO2: Describe the knowledge for the biotech protein products	K2	
	CO3: Apply the knowledge on the biological important products	K3	
	CO4: Criticize the medicinal and pharmaceutical importance of drug compounds	K4	

	CO5: Recognize the Scope and career opportunities in pharmaceutical sectors	K5	

Learning Resources				
Text Books	1. Ashish Dixit, Pawan Tiwari and Vivekanand Kishan Chatap (2015), Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd 2. Chandrakant Kokate and Pramod H.J 1st Edition (2011), Text Book of Pharmaceutical Biotechnology, Elsevier			
Reference Books	1. Gary Walsh (2003), Biopharmaceuticals ; biochemistry and Biotechnology, John Wiley & Sons Ltd. 2. Oliver Kayser and Heribert Warzecha (2012), Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, Wiley - Blackwell. 3. Simon Wills, 2nd Edition (2005), Drugs of abuse, Pharmaceutical Press 4. Hiten J. Gutka, Harry Yang, Shefali Kakar (2018). Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development, (1st ed), USA: Springer, ISBN: 978-3-319-99679-0.			
Website Link	https://nlist.inflibnet.ac.in/search/Record/EBC3407949 https://www.patentdocs.org/biotech_news/ https://www.pharmamanufacturing.com/			
Self-Study Material	https://nlist.inflibnet.ac.in/search/Record/978-3-540-79116-4			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTS05	**PHARMACEUTICAL BIOTECHNOLOGY**			**SEC-V**		**VI**	**3**	**3**			**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Rajasekaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

List of Non-Major Elective Course (SEC) for B. Sc., Biotechnology SYLLABUS-LOCF-CBCS Pattern EFFECTIVE FROM THE ACADEMIC YEAR 2023-2024 Onwards			
S.NO	SEM	COURSE_CODE	TITLE OF THE COURSE
1	I	23M1UBTN01	Food and Nutrition
2	I	23M1UBTN02	Public Health and Hygiene
3	II	23M2UBTN03	Organic Farming and Health Management
4	II	23M2UBTN04	Good Laboratory Practices
5	II	23M2UBTN05	Biotechnology for Society

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTN01	**FOOD AND NUTRITION**	**NME- I**	**I**	**2**	**2**		**-**	**2**
Objective	The student can determine the relationship between food , health and immunity							

Unit	Course Content	Knowledge Levels	Sessions
I	**Definition of food and Nutrition**: Nutrient, Nutritional status, Dietetics, Balance diet, Malnutrition, Energy (Unit of energy-Joule, Kilocalorie). Health, Immunity by food and function of food.	K1	6
II	**Biomolecules:**Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine) - Sources, Classification, Function and Deficiencies of these nutrients. Function of water and dietary fiber.	K2	6
III	**BMR**: Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals)	K3	6
IV	**Basic five food groups:** nutritional significance of cereals, pulses, milk, meat, fish, vegetables, egg, nuts, oils and sugars. Food toxins, Food additives, Food quality, Safety measures in food handling, Food adulteration, food Preservatives and food Packaging.	K4	6
V	**Principles and Objectives of meal planning.** Diet planning for different age groups (infant, school children, adults and old age)**Current Trends- *Gluten free foods***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Understand the basics of nutrition and their importance	K1	
	CO2: Apply the knowledge about the classification of nutrients and its deficiency	K2	
	CO3: Acquire adequate knowledge in the BMR	K3	
	CO4: Evaluate the basic food groups and adulteration	K4	
	CO5: Analyze the importance of principles and objectives of meal planning	K5	

Learning Resources	
Text Books	1. Vidya & D.B. Rao, 2010. A textbook of nutrition by, Discovery Publishing house 2. Carolyn D.Berdanier, 2010. Handbook of Nutrition & Food, third edition, CRC Press (Taylor and Francis group)

Reference Books	1. Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press. 2. Janet D Ward & Larry T Ward, Principles of food science by, Good heart-Wilcox publishing.			
Website Link	1. https://ddceutkal.ac.in/Syllabus/MBA-BOOK/FND.pdf 2. https://ncert.nic.in/textbook/pdf/kehe103.pdf 3. https://www.jaypeedigital.com/eReader/chapter/9789385891526/ch1			
Self-Study Material	1. https://fooddigital.com/articles/top-10-nutrition-trends-for-2023			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Microbiology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTN01	**FOOD AND NUTRITION**		**NME- I**		**I**	**2**	**2**		**-**	**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO2	PSO3	PSO 4	PSO 5
CO1	S	S	S	S	S	S	M	S	M	S
CO2	S	M	M	S	S	S	M	S	M	S
CO3	S	S	M	S	S	S	M	S	M	S
CO4	S	S	S	M	S	S	M	S	M	S
CO5	S	S	S	S	S	S	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Google classroom
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTN02	**PUBLIC HEALTH AND HYGIENE**	**NME- II**	**I**	**2**	**2**	**-**	**-**	**2**
Objective	Students will be able to understand the importance of health and hygiene and various health services organizations							

Unit	Course Content	Knowledge Levels	Sessions
I	**Scope -health and hygiene** – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronics. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.	K1	6
II	**Classification of food into micro and macro nutrients**. Balanced diet, Importance of dietary fibers. Significance of breastfeeding. Malnutrition anomalies – Anaemia, Kwashiorkor, Marasmus, Rickets, Goiter (cause, symptoms, precaution and treatment).	K2	5
III	**Communicable viral diseases-** measles, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis, COVID. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus, plague, whooping cough, diphtheria, leprosy. Sexually Transmitted Diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.	K3	6
IV	**Non-communicable diseases** -hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis and rheumatoid arthritis- cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, (Gastrointestinal reflex disorder-GIRD), peptic ulcer, constipation,. (cause, symptoms, precaution and treatment) Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral cancer and their preventive measures.	K4	7
V	**Health Services Organizations:** World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and Indian Red Cross (IRC).**Current trends** ***Communicable disease treatment***	K5	6
Course Outcome	*Self study*		
	CO1: Relate about public health and hygiene	K1	
	CO2: Compare the wider determinants of health and ill-health	K2	
	CO3: Identify communicable viral disease and make use of health education	K3	
	CO4: Categorize non communicable diseases	K4	
	CO5: Evaluate the health problems and recommend health service organization	K5	
Learning Resources			

Text Books	1. Muthu, V.K. A Short Book of Public Health. (2014) 2. Detels, R. (2017) Oxford Textbook of Public Health (6th edition).			
Reference Books	1. Mary-Jane Schneider (2016), Introduction to Public Health, (5th Edition), Jones & Bartlett Learning, ISBN-13: 978-1284197594 2. Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), Handbook of Nutrition and Food, (3rd Edition), CRC Press, ISBN 9781466505711			
Website Link	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1808522/ 2. https://www.physio-pedia.com/Communicable_Diseases 3. https://www.paho.org/en/topics/noncommunicable-diseases			
Self-Study Material	1.https://nlist.inflibnet.ac.in/search/Record/EBC18149582.http://www.agritech.tnau.ac.in/org_farm/orgfarm_pestanddisease.html 2.https://www.medicalnewstoday.com/articles/communicable-diseases			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1UBTN02	**PUBLIC HEALTH AND HYGIENE**			**NME-II**		**I**	**2**	**2**	**-**	**-**	**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	S	S	S	S
CO2	S	S	M	M	S	S	S	S	S	M
CO3	S	S	L	M	S	S	S	S	S	S
CO4	S	S	L	M	S	S	S	S	M	S
CO5	M	S	M	S	S	M	M	S	S	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTN03	**ORGANIC FARMING AND HEALTH MANAGEMENT**	**NME-III**	**II**	**2**	**2**			**2**
Objective	Student will value the concepts of ecology and environment, techniques of Vermicomposting and importance of well-being.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction:** Ecology and Environment – Principles of ecology , Ecosystem- Biotic and abiotic components and interaction, Energy flow –Nutrient cycle, Biodiversity – Endemic and Exotic Interrelationships.	K1	6
II	**Composting** – Microbial Compost – Vermicompost , Setup for vermicompost unit, Nutrition Garden – Ring Garden, Double digging. Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.	K2	5
III	**Organic farming** – Principles and Policies – Certification agencies – AGMARK, FSSAI, Halal certification – Participatory grading system (PGS) – Storage – Packing– Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability.	K3	7
IV	**Health**: Concept of Health, changing concepts, definitions of health, dimensions of health, concept of well-being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.	K4	6
V	**Exercise and Health related fitness:** Health related fitness, health promotion and physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance. **Current trends -*Pest and disease management in organic farming***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Relate concept of ecosystem and conservation of biodiversity	K1	
	CO2: Classify the types of composting and garden	K2	
	CO3: Develop organic farming and identify certification agencies	K3	
	CO4: Analyze and learn public health care system in India	K4	
	CO5: Compare health promotion and physical activity for health benefits	K5	

Learning Resources	
Text Books	1. Peter Stiling, Ecology-Theory and applications, 2002, Englewood Cliffs Publisher 2. Eugene Odum, Fundamentals of Ecology. 5th Edition , 2017. Cengage Learning Publisher, India.
Reference Books	1. G.K. Veeresh, 2006. Organic farming, First edition, New Delhi, India Foundation Books in association with Centre for Environment Education

Website Link	1. https://www.britannica.com/topic/organic-farming 2. https://www.nrdc.org/stories/composting-101 3. https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-022-07702-2			
Self-Study Material	1.https://nlist.inflibnet.ac.in/search/Record/EBC822556 2.http://www.agritech.tnau.ac.in/org_farm/orgfarm_pestanddisease.html			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTN03	**ORGANIC FARMING AND HEALTH MANAGEMENT**		**NME-III**		**II**	**2**	**2**			**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	S	S	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	L	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTN04	**GOOD LABORATORY PRACTICES**	**NME - IV**	2	**2**				**2**
Objective	Student will know the types of labs associated with Biotechnology.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Types of labs associated with Biotechnology** (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.	K1-K2	6
II	**Methods and types of documentation** (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gm and vice -versa).	K2-K3	6
III	**Laboratory instruments:**Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation.	K2-K3	6
IV	**Good Laboratory guidelines,** Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.	K3-K4	6
V	**Definition of waste, types of waste:** Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel. **Current Trends-** ***Good Laboratory Practice For Nonclinical Laboratory Studies** *	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Recognize basics of human rights in biological sciences	K1	

	CO2: Summarize the various safety measures in cloning	K2	
	CO3: Demonstrate a list of Patenting in Biotechnology	K3	
	CO4: Associate the Patenting in Biotechnology	K4	
	CO5: Generate the rules in biosafety and bioethics and its impact on all the biological sciences and the quality of human life	K5	

Learning Resources				
Text Books	1. Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.			
Reference Books	1. WHO training manual on Good Laboratory Practices, 2nd Edition. 2. Pradeep Deshmukh, 2020. Principles of Good Laboratory Practice: Accreditation Process Requirements. Adhyyan Books.			
Website Link	1. https://fssai.gov.in/upload/uploadfiles/files/Manual_GFLP_06_09_2018.pdf 2. https://www.keene.edu/administration/policy/detail/hazardous-waste/download/			
Self-Study Material	1. https://www.ecfr.gov/current/title-21/chapter-I/subchapter-A/part-58			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTN04	**GOOD LABORATORY PRACTICES**			**NME - IV**		**2**	**2**				**2**
CO-PO Mapping											
CO Number	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	S	S	S	S	M	S	M	S	S	S	
CO2	S	S	M	S	S	S	M	S	M	S	
CO3	S	M	M	M	S	S	M	S	M	S	
CO4	S	S	M	M	S	S	M	S	M	S	
CO5	S	S	S	S	S	S	S	S	S	S	
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG		

Tutorial Schedule	Interactive session
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2UBTN05	**BIOTECHNOLOGY FOR SOCIETY**	**NMEC**	**2**	**2**				**2**

Objective	Students can acquire knowledge about f Biotechnology in Sericulture, Apiculture and Mushroom Cultivation		
Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction to Biotechnology**- Role of Biotechnology in sericultureRearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtainedMushroom farming stages- Cultivation of paddy straw mushroomImportance of mushroom cultivatio	K1	6
II	**Biofertilizer**- Definition- Mass production of Rhizobium-Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- Bacillus thuringiensis- Single cell protein- Introduction- history- production of Spirulina SCP- Applications- Advantages & disadvantages.	K2	6
III	**Biodegradation**- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages- Bio weaponsintroduction- history- potential agents- delivery methods- harmful effects	K3	6
IV	**Antibiotics**- Definition- Introduction and history of antibiotics- sourcesclassification- spectrum- production of penicillin- definition of antibiotic resistance.	K4	6
V	**Transgenic plants** – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.**Current Trends-Importance of Biotechnology in human welfare**	K5	6
	* **Importance of Biotechnology in human welfare*** **Self Study.**		
Course Outcome	**CO1:** Recite the importance of apiculture and farming	K1	
	CO2: Interpret the various bacterial applications in agriculture	K2	
	CO3: Compile the degradation process	K3	
	CO4: Comprehend antibiotic production	K4	
	CO5: Evaluate the transgenic plants	K5	

Learning Resources	
Text Books	1. Sathyanarayana, U., Chakrapani, U., (2008). Biotechnology, First edition, Books and allied (P) Ltd, Kolkata 2. A.K. Chatterji, (2011).Introduction to Environmental Biotechnology, Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9

Reference Books	1. 1. Basics of Biotechnology Paperback – 1 January 2004by A.J. Nair (Author) PublisherLaxmi Publications 2. Basic Biotechnology Paperback – 2 February 2008 by Ratledge Colin (Author) Publisher Cambridge University Press			
Website Link	1. https://www.sciencelearn.org.nz/resources/1209-impacts-of-biotechnology-on-society 2. https://byjus.com/biology/what-is-biotechnology/			
Self-Study Material	1. https://byjus.com/biology/why-is-biotechnology-important-to-humans/			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2UBTN05	**BIOTECHNOLOGY FOR SOCIETY**	**NMEC**	**2**	**2**				**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Quiz program, Model preparation and Kahoot app,
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Assignment, PPT Presentation and Video presentation
Assessment Methods	Class Test, Unit Test, Assignment, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.K.Revathi	Dr. P. Selvamalesswaran	Dr.S.Shahitha Member Secretary

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M5UBTIS1	**INTERNSHIP**	**INTERNSHIP**	**V**	**-**	**-**	**-**	**-**	**2**
Objective	Main purpose of this internship program is to particularly provide exposure to the working environment of various industries and research institutions/Company. During this period, the Students will get hands on training in the diverse areas of biotechnology.							

Unit	Course Content	Knowledge Levels	Sessions
1	Duration of the Internship Programme is 15 Days During the Vacation which falls at the end of the 4th Semester	K1	
2	Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ Government organizations/ Micro/ Small/ Medium enterprises to make them ready for the industry. The students will select the institutions, industries and trainer like Clinical Lab/ Programme Effluent Treatment Plant/ Sugarcane Industry/ Fruit and Beverage Industries/ Diary/ Horticulture Research Station/ Soil Testing Organic Farming/ Medical Coding/ TNAU/ Veterinary University/ Plant Tissue culture Lab/ Molecular Biology Lab/Hospitals/ Bio Fertilizer Unit/ Mushroom Production Unit and Biotechnology relevant company/Industries.	K1	
3	A staff member of a department (guide) will be monitoring the performance of the candidate	K2	
4	Students request letter/profile/ interest areas may be submitted to the particular industries/Companies for their willingness for providing the internship program.	K2	
5	After Getting the willingness from the internship provider, the student must submit the Joining Report/ Letters / Email to the department by in person.	K3	
6	Student will maintain the work diary and attendance properly.	K3	
7	Every student is required to prepare a file containing documentary proofs of the activities done by them like Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed by the industry to the Institute immediately after the completion of the training.		
8	After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period with original Training Certificate to be obtained from the industry/company.	K4	
9	The Internship report should be soft cover book bound, the cover of the repot should be of white color printed with black ink and the text for printing should be identical as prescribed for the title page. The Internship Training	K4	

	Certificate also included in the report.		
10	The evaluation of these activities will be done by Head of the Department/ Project Head/ faculty mentor with External Examiner.	K5	
Course Outcome	**CO1:** Remember the primary objective of internship training program	K1	
	CO2: Understand the working environment in an organized manner	K2	
	CO3: Interpret the main functions of Internships providing institutes	K3	
	CO4: Analyze and appreciate the roles and responsibilities of various industries	K4	
	CO5: Assess the professional acumen of the industrialists.	K5	

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M5UBTIS1	**INTERNSHIP**	**INTERNSHIP**	**V**	**-**	**-**	**-**	**-**	**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	L	S	S	S	M	M
CO2	S	S	M	S	L	S	M	S	M	M
CO3	S	M	S	S	S	S	S	S	S	M
CO4	S	M	S	S	S	S	S	S	S	M
CO5	S	L	S	S	L	S	S	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	Group Discussion, Field Visit
Teaching and Learning Methods	Work Diary, PPT Presentation and Video presentation
Assessment Methods	1. Work Diary- 25% 2. Internship Training report preparation: 50% 3. Viva Voce: 25%

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTPR1	**PROJECT WORK**	**PROJECT WORK**	**VI**	**7**				**5**
Objective	● To inculcate/impart skills on project design, experimental execution and research reporting ● To enhance their skills as on writing thesis dissertation							

Details	**Course Content**	**Knowledge Levels**	**Details**
Format for the preparation of the Project Report	The final stage of work consists of the 1. Title Page 2. Bonafide Certificate 3. Acknowledgement 4. Table of contents 5. List of tables and figures 6. Abbreviation	K2	
Text of the Project	The following structure of project work should be followed to maintain the uniformity in preparation and presentation. **Chapter 1 – Introduction** This chapter explains the selection of the topic and its relevance, definitions of related aspects, characteristics, different concepts pertaining to the topic etc can be covered by the candidate. **Chapter 2 –Aim and Objectives** This chapter describes the primary goal of the project, how it intends to accomplish it. **Chapter 3 - Review of Literature** This chapter gives clear cut information about studies done on the respective topic/research. This would assist students to undertake further study on the same topic/research. **Chapter 4 –Materials and Methods** This chapter is the vital component of the topic/research. It describes all the procedures and methods used for their work in detail with flow charts. **Chapter 5- Result and Discussion** This chapter presents the Research Findings and Interpret their work with the previous research findings. Results tables and figures to be in colour. **Chapter 6- Summary** The chapter provides as the overview of the key research findings **If required, more chapters of data analysis could be added.** **7. Bibliography** **8. Appendix**	K3	

	Typing Instruction: **Paper:** 8 ½ * 11 inches in size. Only one side of the sheet should be typed. **Margin:** The left side margin should not be less than 1.5 inches (or 40 mm) the right, top and Bottom Margin one inch (or 25 mm). **Font:** Times New Roman, subject matter -12 font size in running format, Heading and Section headings should be capitalized – 14 font size.	K4	
Headings and Titles	1. Heading and Section headings should be capitalized and centered– 14 font sizes with Bold. 2. Subdivision headings should be typed from the left hand margin sentence case -12 font sizes with Bold. 3. Paragraphs should be indented seven space for pica type and nine for elite type.	K5	
Tables and Figures	**1.** The table number (E.g. Table 1/ Figure 1/Graph 1) typed in capitals should be separated from the text by two or three spaces. 2. An asterisk should be used if an explanatory note to a time is necessary. 3. The note should be placed immediately below the table.	K5	
	Line Spacing: The text of the thesis should be 1.5 lines spacing **Pagination:** Pages of the text are numbered continuously in Arabic numerals.	K5	
	Bibliography Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the report/thesis. The citation may assume any one of the following forms. APA Style. APA in-text citation style uses the author's last name and the year of publication, for example: Kuby, 2005/Verma and Agarwal, 2005/Verma et al., 2005. **For citing Books** Fuller,C. (2019) Platelets. Cambridge: Biostate Publishing. p 33-39. **Citing Journal** Abdullah, M., Atta, A., and Allohedan, H. 2018. Green synthesis of hydrophobic magnetite nanoparticles coated with plant extract and their application as petroleum oil spill collectors. *Nanomaterials*, 8(1):855-859. **Citing Thesis or Dissertation** Saranya A, A study of Nanoparticle Synthesis, unpublished Ph.D Thesis, Chennai: Indian Institute of Technology, 2020.	K6	
Binding specification	The thesis should be hardcover book bound, the cover of the thesis should be of in color printed with black ink and the text for printing should be identical as prescribed for the title page.	K6	
SCHEDULE	**IV Semester:** 1. November- Selection of topic 2.December – Literature Collection & Design the project 3. January – Execution of their designed work 4. February – Report Preparation, First & Second draft, and Final draft Correction. 5. March-Review Presentation & Submission of Project.	K6	

Course Outcome	**CO1:** Provide the opportunity to do research in reputed Institutes/Laboratories	K2
	CO2: Understand the experimental design and execution of their research	K3
	CO3: Interpret the research work/topic with the previous findings	K4
	CO4: Analyze their research work and its importance	K5
	CO5: Design their project and enhance the thesis writing skill	K6

	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTPR1	**PROJECT WORK**		**PROJECT WORK**		**VI**	**7**				**5**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	M	L	L	L	M	S	S	S
CO2	S	S	S	S	L	M	S	S	S	S
CO3	S	S	S	S	L	S	S	S	M	M
CO4	S	S	S	M	L	S	S	S	M	M
CO5	M	M	M	S	L	M	M	S	L	S

Level of Correlation between CO and PO	L-LOW	M-MEDIUM	S-STRONG

Tutorial Schedule	-
Teaching and Learning Methods	
Assessment Methods	1.Review Meeting I- 15 Marks,2. Review Meeting II- 15 Marks,3. Attendance- 5 Marks,4. Student Work Diary - 5 Marks
	1. Project Presentation - 40 Marks 2. Viva-Voce - 20 Marks

Designed By	Verified By	Approved By
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTOE1	**Biotechnology for Competitive Examinations**	**Self study Online - Competitive Examination**	**IV**					**2**
Objective	Creating awareness on competitive examinations among the students. Imparting knowledge about the appearing for Competitive Examinations and it impacts on developing an attitude of appearing for such exams.							

Unit	Course Content	Knowledge Levels	Sessions
I	Objective Biotechnology MCQ comes under the Biotechnology courses like cell Biology, Biological chemistry, Microbiology, Environmental and Nano Biotechnology, Genetics and Molecular Biology, Immunology & Immunotechnology, Genetic Engineering, Genomics, Proteomics, Bioinformatics, Plant and Animal Biotechnology, Bioprocess technology, Research methodology, Biostatistics etc. Major emphasis has been put forth to include recent developments in the subjects. This course helpful for students who prepare for competitive and entrance examinations. **Rules for creating MCQ pattern** 1. Objective type online examination will be conducted at the end of the 4th semester. 2. Questions must be taken from all previous question papers of CSIR-NET, SET, NEET, UPSC, IBPS and Common Entrance Test for Ph.D. 3. **Test critical thinking** Multiple choice questions to test the superficial knowledge. Learners to interpret facts, evaluate situations, explain cause and effect, make inferences, and predict results. 4. **Emphasize Higher-Level Thinking** Use memory-plus application oriented questions. These questions require students to recall principles, rules or facts in a real life context. Example 1: Ability to Justify Methods and Procedures **Which is correct regarding the peptides in the Ramachandran Plot?** a. The sequence of the peptide can be deduced b. It is not possible to conclude whether a peptide adopts entirely helix or entirely beta-sheet conformation c. Peptides that are unstructured will have all the backbone dihedral angles in the disallowed regions d. The occurrence of a beta-turn conformation in a peptide can be deduced. Example 2: Ability to Interpret Cause-and-Effect Relationships	K5	

	Which of the following statements is true about cell theory? a. The Cell theory does not apply to fungi b. The Cell theory does not apply to virus c. The Cell theory does not apply to algae d. The Cell theory does not apply to microbes. 5. Mix up the order of the correct answers Keep correct answers in random positions and don't let them fall into a pattern that can be detected 6. **Use a Question Format** Multiple-choice items to be prepared as questions (rather than incomplete statements) Incomplete Statement Format: • The capital of California is in Direct Question Format____ Less effective. • In which of the following cities is the capital of California? - This is Best format. 7. **Keep Option Lengths Similar** Avoid making your correct answer the long or short answer 8. **Avoid the "All the Above" and "None of the Above" Options** Students merely need to recognize two correct options to get the answer correct 9. HOD instructs the faculty members to prepare minimum 500 questions booklet with solutions and circulate among the students. 10. Each Department to prepare the Questions (MCQ pattern with four answers) and submit to ICT.		
Course Outcome	**CO1:** Learn the subject at MCQ Level	K2	
	CO2: Understand how to appear for an interviews where subject knowledge will be examined	K3	
	CO3: Comprehensive understanding of current technologies, skills, and tools necessary for career	K4	
	CO4: Interpret the different types of questions for Competency developed	K4	
	CO5: Evaluate and prepare the students to meet the challenges of modern competitive world.	K5	

Learning Resources				
Text Books	1. Kapoor H C, UGC - CSIR - Life Sciences, Cosmos Publication. 2. Ritambhara Richharia, UGC/CSIR-NET Life Science, Rama Publication.			
Website Link	1. https://www.sanfoundry.com/1000-life-sciences-questions-answers/ 2. https://www.examtiger.com/biology-general-science-mcq/ 3. https://mcq.jobsandhan.com/life-science/ 4. https://www.eurekaselect.com/ebook_volume/1539			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

B.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M6UBTOE1	**Biotechnology for Competitive Examinations**		**Self study Online - Competitive Examination**		**IV**					**2**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	L	M	M	S
CO2	S	S	S	M	M	L	S	S	M	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	S	S	M	M	M	S	S	S
Level of Correlation between CO and PO	L-LOW					M-MEDIUM			S-STRONG	

Tutorial Schedule	-
Teaching and Learning Methods	Audio Video lecture, Chalk and Board class, Demonstration PPT Presentation and Video presentation
Assessment Methods	Model Practical and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	Dr.S.Shahitha Member Secretary