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)

MUTHAYAMMAL
COLLEGE OF ARTS
AND SCIENCE
(Autonomous)
A UNIT OF VANETRA GROUP
Learn. Lead

ESTD-1994

DEGREE OF MASTER OF SCIENCE

Learning Outcomes - Based Curriculum Framework
- Choice Based Credit System

Syllabus for M.Sc., Biotechnology

(Semester Pattern)

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

Regulation and Syllabus for

M.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 sprite 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. M.Sc., Biotechnology is a four 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 Two-year M.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 M.Sc. Biotechnology programme is of two years duration. Each year is divided into two semesters. Each semester will be of sixteen weeks duration. The teaching and learning in the M.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 Disciplinary Knowledge
GA 2 Self-directed Learning
GA 3 Multi-cultural Competency
GA 4 Research-related Skill
GA 5 Analytical Reasoning
GA 6 Moral and Ethical Reasoning
GA 7 Communication Skill

Disciplinary Knowledge:

a) ability to identify, speak and write about different literary genres, forms, periods and movements
b) ability to understand and engage with various literary and critical concepts and categories
c) ability to read texts closely, paying attention to themes, generic conventions, historical contexts, and linguistic and stylistic variations and innovations
d) ability to understand appreciate, analyse, and use different theoretical frameworks
e) ability to locate in and engage with relevant scholarly works in order to develop one's own critical position and present one's views coherently and persuasively
f) ability to situate one's own reading, to be aware of one's position in terms of society, religion, caste, region, gender, politics, and sexuality to be self-reflexive and self-questioning

g) ability to understand the world, to think critically and clearly about the local and the global through a reading of literatures in translation and in the original, to be a located Indian citizen of the world

h) ability to see and respect difference and to transcend binaries

Self-Directing Learning:

a) ability to work independently in terms of reading literary and critical texts

b) ability to carry out personal research, postulate questions and search for answers

Multicultural Competence:

a) ability to engage with and understand literature from various nations and reasons and languages

b) ability to respect and transcend differences

Research-Related Skills:

a) ability to problematize; to formulate hypothesis and research questions, and to identify and consult relevant sources to find answers

b) ability to plan and write a research paper

Analytical Reasoning:

a) ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments

b) ability to use critics and theorists to create a framework and to substantiate one's argument in one's reading of literary texts

Moral and Ethical Reasoning:

a) ability to interrogate one's own ethical values, and to be aware of ethical issues

b) ability to read values inherited in literary texts and criticism vis, the environment, religion and spirituality, as also structures of power

Communication Skills:

a) ability to speak and write clearly in standard, academic English

b) ability to listen to and read carefully various viewpoints and engage with them.

c) ability to use critical concepts

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

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

PROGRAMME OUTCOMES (POs)

PO1 : Post graduates will attain profound proficiency and expertise

PO2 : Post graduates will be ensured with corporative self – directed learning

PO3 : Post graduates will acquires acumen to handle diverse contexts and function in domains of multiplicity

PO4 : Post graduates will exercise intelligence in research Investigations and Introducing innovations.

PO5 : Post graduates will learn ethical values and commit to Professional ethics

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Upon completion of the program,

PSO1 : Acquire knowledge on the fundamentals of biotechnology to enable the students to analyze the emerging advancements in the field of biotechnology

PSO2 : Understand the importance of professionalism in a vast range of employability options to Industries.

PSO3 : Students realize personal and social responsibilities related to modern biotechnological research, environmental safety, ethical issues and intellectual property and develop entrepreneurship skills.

PSO4 : Biotechnology courses to evaluate real life problems and promote a sense of social, ethical, environmental and professional responsibility

PSO5 : Graduates enhance creative thinking and research culture in various realm of Biotechnology

REGULATIONS (2023-2024)

1. DURATION OF THE PROGRAME

1.1 Two years (Four 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 A candidate who has passed a Bachelor degree in Science with Biotechnology / Botany / Zoology / Biology / Microbiology / Microbial Gene technology / Bioinstrumentation / Bioinformatics / Biochemistry / Chemistry / Agriculture / Marine Biology / Home Science / Farm Science / Nutrition and Dietetics / Integrated Biology / Plant Science / Animal Science / Fisheries Science / Aquaculture / Mathematics with Physics, Chemistry as Ancillary / Medical Lab Technology / MBBS / BDS / B. Pharm / BSMS of this University or any of the above degree of any other University accepted by the Syndicate of the Periyar University as equivalent there to, shall be permitted to appear and qualify for the M.Sc., Degree examination in this Branch at Muthayammal college of arts and science (Autonomous), Rasipuram.

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 two academic years and passed the examinations of all the four Semesters prescribed earning a minimum of 91 credits as per the distribution given in Regulation fulfilled such other conditions as have been prescribed thereof.

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)

S.No	Study Components	Credit Distribution
01	Core, Elective, EDC, and Project Courses	**84**
02	Internship	**02**
03	Human Rights	**02**
04	Professional Competency Skills	**02**
	Extension Activity	**01**
Total Credits		**91**

4.1.1 Extension Activity:

Students shall be awarded a maximum of 1 Credit for Compulsory Extension Service. All the Students shall have to enroll for clubs / 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.

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

4.2.1 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

5.1 Eligibility: Students shall be eligible to go to subsequent semester only if they earn 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 NOT ELIGIBLE 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 take next 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 of final 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 PG 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

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	**10**
Attendance	**5**
Assignment/Quiz	**5**
Seminar	**5**
Total	**25**

6.4. Awarding Marks for Attendance (out of 5)

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

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

Internship/Industrial Training		Project Work		
	Marks	**Components**		**Marks**
CIA*[1]		**CIA**		
Work Diary	25	a) Attendance	20 Marks	**50**
Report	50			
Viva–voce	25	**b)** Review / Work Diary***[1]**	30 Marks	
Examination				
Total	**100**	**ESE*[2]**		
		a) Final Report b) Viva-voce	120 Marks 30 Marks	**150**
		Total		**200**

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

6.8. Guidelines for Professional Competency Skill- Online Mode - Online Exam 3 hours

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

Objective type Questions from Question Bank.

- The passing minimum for this paper is 50%
- In case, the candidate fails to secure 50% passing minimum, he/ she may have to reappear for the same in the subsequent semesters.

6.9 Components for Human Rights Course (CIA Only)

The Course Human Rights is to be treated as 100% CIA course which is offered in II Semester for I year PG students.

Total Marks for the Course =100

Components	Marks
Two Tests	75
Assignments	25
Total	**100**

- In case the candidate fails to secure 50 marks, which is the passing minimum, he/she may have to reappear for the same in the subsequent semesters

QUESTION PAPER PATTERN FOR CIA I, II AND ESE	
(3 HOURS)	MAXIMUM:75Marks
SECTION-A (Objective Type)	
Answer ALL Questions	
ALL Questions Carry EQUAL Marks	**(10 x1=10 marks)**
SECTION-B (Analytical Type)	
Answer any THREE Questions out of FIVE Questions	
ALL Questions Carry EQUAL Marks	**(3 x 5 = 15 marks)**
SECTION-C (Either or Type)	
Answer ALL Questions	
ALL Questions Carry EQUAL Marks	**(5 x 10 = 50 marks)**

(Syllabus for CIA-I 2.5 Unit ,Syllabus for CIA-II All 5 Unit)

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 50% [Fifty 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 50%.

6.10.4 He / She shall be declared to 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 90 CREDITS. 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 PG 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

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	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 I 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	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class -Exemplary*
9.0 and above but below9.5	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	
0.0 and above but below 5.0	**U**	Re-appear

*The Students who have passed in the first appearance and within the prescribed semester of the PG Program 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 A DEGREE

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 backlog to be qualified for the degree. (Time Span =N+2years for the completion of programme.)

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M.Sc.,-BIOTECHNOLOGY Abstract under LOCF-CBCS Pattern with effect from 2023-2024 onwards

Structure of Credit Distribution as per the TANSCHE / UGC Guidelines

S.No.	Study Components	Sem I		Sem II		Sem III		Sem IV		No.of Paper	Total Credit
		No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit	No.of Paper	Credit		
1	DISCIPLINE SPECIFIC CORESES(DSC)-THEORY	3	**12**	3	**12**	3	**12**	2	**10**	**11**	**46**
2	DSC-PRACTICAL	1	**4**	1	**4**	1	**4**			**3**	**12**
3	DISCIPLINE SPECIFIC ELECTIVE COURSES(DSE)	2	**6**	1	**3**	1	**3**			**4**	**12**
4	PROJECT WORK							1	**6**	**1**	**6**
5	INTERNSHIP					1	**2**			**1**	**2**
6	GENERIC ELECTIVE COURSES(GEC)-EDC			1	**2**	1	**2**			**2**	**4**
7	HUMAN RIGHTS					1	**2**			**1**	**2**
8	ONLINE - COMPETITIVE EXAMINATION							1	**2**	**1**	**2**
9	ABILITY ENHANCEMENT COURSE (AEC)	1	**2**	1	**2**					**2**	**4**
10	EXTENSION ACTIVITY							1	**1**	**1**	**1**
	Cumulative Credits	**7**	**24**	**7**	**23**	**8**	**25**	**6**	**19**	**27**	**91**

Total No. of Subjects	27
Marks	**2700**

TOTAL CREDIT	91
Extra Credit	4
Total Credits	**95**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE(Autonomous) - Rasipuram - 637 408
Scheme of Examinations - LOCF-CBCS Pattern
(for the Students Addmited from the Academic Year:2023-2024 Onwards)
Programme : M.Sc. BIOTECHNOLOGY

S.No.	STUDY COMPONENTS	COURSE_ CODE	TITLE OF THE COURSE	Hrs./W		CREDIT POINTS	MAX.MARKS		
				Lect.	Lab.		CIA	ESE	TOT AL
SEMESTER - I									
1	DSC THEORY- I	23M1PBTC01	Biochemistry	5		4	25	75	100
2	DSC THEORY-II	23M1PBTC02	Molecular Genetics	5		4	25	75	100
3	DSC THEORY-III	23M1PBTC03	Molecular Cell Biology	6		4	25	75	100
4	DSC PRACTICAL - I	23M1PBTP01	PRACTICAL: Biochemistry, Molecular Genetics and Molecular Cell biology		6	4	40	60	100
5	DSE THEORY-I			3		3	25	75	100
6	DSE THEORY-II			3		3	25	75	100
7	SOFT SKILL PRACTICAL- I	23M1PBTSP1	Communicative skill		2	2	40	60	100
			TOTAL	22	8	24	205	495	700
SEMESTER - II									
1	DSC THEORY - IV	23M2PBTC04	Microbiology	5		4	25	75	100
2	DSC THEORY - V	23M2PBTC05	Plant and Animal Biotechnology	6		4	25	75	100
3	DSC THEORY - VI	23M2PBTC06	Genetic Engineering	5		4	25	75	100
4	DSC PRACTICAL - II	23M2PBTP02	PRACTICAL : Microbiology, Plant and Animal Biotechnology and Genetic Engineering		6	4	40	60	100
5	DSE THEORY-III			3	-	3	25	75	100
6	EDC THEORY-I	23M2PBCED1	Clinical Nutrition	3		2	25	75	100
7	HUMAN RIGHTS	23M2PHUR01	Human Rights	2		2	100		100
8	SOFT SKILL PRACTICAL- II	23M2PBTSP2	Interview Skills		2	2	40	60	100
			TOTAL	24	8	25	305	495	800
SEMESTER - III									
1	DSC THEORY - VII	23M3PBTC07	Bioinformatics	6		4	25	75	100
2	DSC THEORY - VIII	23M3PBTC08	Immunology	5		4	25	75	100
3	DSC THEORY - IX	23M3PBTC09	Bioprocess Technology	5		4	25	75	100
4	DSC PRACTICAL - III	23M3PBTP03	PRACTICAL: Bioinformatics, Immunology and Bioprocess Technology		6	4	40	60	100
5	DSE THEORY-IV			3		3	25	75	100
6	EDC THEORY-II	23M2PBCED2	Human Physiology and Nutrition	3		2	25	75	100
7	INTERNSHIP	21M3PBTIS1	Internship	-		2	100		100
			TOTAL	22	6	23	265	435	700

SEMESTER - IV									
1	DSC THEORY - X	23M4PBTC10	Research Methodology and Biostatistics	6		5	25	75	100
2	DSC THEORY - XI	23M4PBTC11	Environmental Biotechnology	6		5	25	75	100
3	PROJECT WORK	23M4PBTPR1	Project Work	-	18	6	50	150	200
4	ONLINE - COMPETITIVE EXAMINATION	23M4PBTOE1	Biotechnology for Competitive Examination	-	-	2	100		100
6	Extension activity	23M4PEXA01	Extension activity			1			
			TOTAL	12	18	19	240	360	500
			OVERALL TOTAL	80	40	91	1015	1785	2700
1	EXTRA CREDIT COURSE			-	-	2	-	-	-
2	VALUE ADDED COURSE			-	-	2	-	-	-

HOD **Academic Council- Member Secretary** **Principal**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTC01	**Biochemistry**	**DSC THEORY-I**	**I**	**5**	**3**	**2**		**4**
Objective	Students have a strong foundation in chemical biology, metabolic pathways and hormones of living organism.							

Unit	Course Content	Knowledge levels	Sessions
I	**pH,** pK . Acid, base. Buffers- Henderson- Haselbach equation, biological buffer system –Phosphate buffer system, protein buffer system, bicarbonate buffer system, amino acid buffer system and Hb buffer system. Water, Carbohydrates: Nomenclature, classification, structure, chemical and physical properties of carbohydrates. Metabolisms: glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway	K1	12
II	**Lipids:** Nomenclature, classification, structure, chemical and physical properties of fatty acids. Metabolisms: biosynthesis of fatty acids, triglycerols, phospholipids, glycol lipids. Cholesterol biosynthesis, bile acids and salt formation. Eicosanoids, sphingolipids and steroid hormones.	K2	12

III	**Bioenergetics –** Concept of energy, Principle of thermodynamics, Relationship between standard free energy and Equilibrium constant, ATP ads universal unit of free energy in Biological systems. Biological oxidation: Electron transport chain, oxidative phosphorylation, glycolysis, citric acid cycle, cori cycle, glyoxalate pathway. Oxidation of fatty acids- mitochondrial and peroxisomal ß-oxidation, alpha and beta oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies. Photosynthesis, urea cycle, hormonal regulation of fatty acids and carbohydrates metabolisms, Mineral metabolism	K3	12
IV	**Amino acids and Protein**: Nomenclature, Classification, structure, chemical and physical properties of amino acids and proteins. Metabolisms: Biosynthesis of amino acids. Degradation of proteins, nitrogen metabolisms and carbon skeleton of amino acids. Over all in born error metabolisms	K4	12
V	**Nucleic acids**: Nomenclature, Classification, structure, chemical and physical properties of purine and pyrimidines. In de novo and salvage synthesis of purines, pyrimidine bases, nucleosides and nucleotides. Catabolisms of purines and pyrimidines bases. Synthetic analogues of nitrogenous bases	K5	12
Course Outcome	CO1: Relate the basics of pH and related principles and carbohydrate	K1	
	CO2: Acquire basic knowledge about lipid metabolism and related significance	K2	
	CO3: Gain knowledge about Bio-energetics and Biological oxidation	K3	
	CO4: Update their knowledge on Amino acids and Protein.	K4	
	CO5: Assess and appraise the role of Nucleic acids.	K5	
Learning Resources			

Text Book	1. Sathyanarayana.U and U.Chakrapani., 2011. Biochemistry. Books and Allied private limited, Kolkata 2. Philip Kuchel, Simon Easterbrook-Smith, Vanessa Gysbers, Jacqui M. Matthews, 2011. Schaum.s Outline of Biochemistry, Third Edition (Schaum.s Outline Series), McGraw-Hill.			
Reference Book	1. Albert Lehninger, David L. Nelson Voet Donald, Judith G. Voet and Charlotte W. Pratt., 2008. Principles of Biochemistry. John Wiley and sons, Inc., New Jersey. 2. Murray *et al.*, (2003) Harper's biochemistry 26th edition Appleton and Lange Publishers Florida USA 3. Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition. 4. Lubert Stryer (2007) Biochemistry –Stanford University 5th Edition-W H Freemann and company San Francisco			
Website	1. mcdb-webarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm 2. www.biochemweb.org/ 3. http://golgi.harvard.edu/biopages.html 4. webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTC01	**Biochemistry**	**DSC THEORY- I**	**I**	**5**	**3**	**2**		**4**

CO-PO Mapping

CO Number	P01	P02	P03	P04	P05	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**M**	**M**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**L**	**S**	**M**	**S**	**S**	**M**	**S**	**S**	**S**
CO3	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**M**	**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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Ms.K.Chitra	**Dr. P. Selvamaleeswaran**	**(DR. S. SHAHITHA)** **MEMBER SECRETARY**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M1PBTC02	**MOLECULAR GENETICS**	**DSC THEORY II**	**I**	**5**	**3**	**2**		**4**
Objective	Students impart a thorough knowledge on the basics of all the Genetics concepts, molecules and its regulation**.**							

Unit	Course Content	Knowledge Levels	Sessions
I	**Genes and chromosomes**, Colinearity of Genes and Proteins, Genetic code, Identification of DNA as the genetic material. The complexity of eukaryotic genome (introns, exons, repetitive DNA sequence, gene duplication and pseudogenes). DNA markers - VNTR, STR, microsatellite, SNP and their detection techniques	K1	12
II	**Replication** of DNA, Gene expression and regulation in prokaryotes and eukaryotes. Mutation: Spontaneous and virus induced mutation, Radiation induced mutation. Ionizing radiation, UV radiation. Chromosomal Abnormalities and associated genetic diseases, Techniques in the study of chromosomes and their applications, Recombination – models	K2	12

III	**DNA Damage and Repair**-Internal and external agents causing DNA damages 3.2. DNA damages (Oxidative damages, Depurinations, Depyrimidinations, O6-methylguanines, Cytosine deamination, single and double strand breaks) 3.3. Mechanisms of DNA damage (transition, transversion, frameshift, nonsense mutations) 3.4. Repair mechanisms (Photo reactivation, excision repair, mismatch repair, post replication repair, SOS repair) 3.5. Discovery: Early experiments of McClintock in maize. Insertion sequences in prokaryotes. Complex transposons (ex. Tn3, Tn5, Tn9 and Tn10). Mechanisms, control consequences and application of transposition by simple and complex elements	K3	12
IV	**Allele frequencies** and genotype frequencies, Random mating population, Hardy-Weinberg principle, complications of dominance, special cases of random mating – multiple alleles, different frequencies between sexes (Autosomal and X-linked) inbreeding, genetics and evolution, random genetic drift, Karyotyping and usefulness of chromosomes in understanding Genetic variation, Genetics of eukaryotes gene linkage and chromosome mapping.	K4	12
V	**Extrachromosomal heredity**: Biology of Plasmids, their discovery, types and structure of F.RTH. cofactors and Ti – Replication and partitioning, Incompatibility and copy number control-natural and artificial plasmid transfer and their applications-Human Genome Project, Genomics and Modern methodologies in understanding genome.	K5	12
Course Outcome	**CO1:** Acquire knowledge about the molecular mechanisms of gene expression	K1	
	CO2: Distinguish genetic regulatory mechanisms at different levels.	K2	
	CO3: Different range of DNA damage and range of their tools for their detection.	K3	

	CO4: Detect the Allele frequencies and genotype frequencies in populations	K4	
	CO5: Compare the transposons and their applications.	K5	

Learning Resources				
Text Books	1. Principles of Genetics- 8th Edition, Gardner, Simmons and Snustad, 2002. 2. The Cell- A Molecular Approach. 3rd Edition. Geoffrey M. Cooper, Robert E. Hausman, 2003. 3. Genetics- Kavitha B. Ahluwalia, New Age International Pvt Ltd and Publishers, New Delhi, 2010 4. Genetics – P.S Verma and A.K Agarwal (Rack 3, Central Library)			
Reference Books	1. RastogiSmita and Neelam Pathak.,2010. Genetic Engineering, Oxford University Press, New Delhi. (Rack 3, Central Library) 2. Watson, Hopkins, Roberts, Steitz, Weiner, 2004. Molecular Biology of Genes, 4th Edition. 3. DNA markers Protocols, applications and overviews Anolles G. C. &Gresshoff P. M. Wiley-Liss 4. Molecular markers in Plant Genetics and Biotechnology Vienne De. D. Science Publishers			
Website Link	**https://bit.ly/3RCC3x4**			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTC02	**MOLECULAR GENETICS**	**DSC THEORY - II**	**I**	**5**	**3**	**2**		**4**

CO-PO Mapping

CO Number	P01	P02	P03	P04	P05	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**S**	**S**	**S**	**L**	**S**	**S**	**M**
CO2	**S**	**M**	**M**	**S**	**L**	**S**	**L**	**S**	**M**	**S**
CO3	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**M**	**S**	**M**
CO4	**S**	**L**	**S**	**S**	**L**	**S**	**L**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**L**	**M**	**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
Assesment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. K. Revathi	**Dr. P. Selvamaleeswaran**	**(DR. S. SHAHITHA)** **MEMBER SECRETARY**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTC03	**MOLECULAR CELL BIOLOGY**	**DSC THEORY III**	**I**	**6**	**4**	**2**		**4**
Objective	Students impart a thorough knowledge on the basics of all the molecular biology concepts and its function.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to cell Biology**- Basic properties of cells-Cellular dimension-Size of cells and their composition-Cell origin and Evolution (Endosymbiotic theory)–Microscopy- Light Microscopy, Electron Microscopy, Application of Electron Microscopy in cell biology, Phase Contrast Microscopy, Fluorescence Microscopy, Flow Cytometry and FRET .Organelles of the eukaryotic cell and its functions; Biomembranes - structural organization, transport across membrane (Passive, Active and Bulk transport); Cell-Cell adhesion-Cell junctions (Tight junctions, gap junctions, desmosomes, adherens); Extra cellular matrix (ECM)- components and role of ECM in growth	K1	12
II	**Structure of Nucleic acids**, Genome organization in Eukaryotes, DNA Replication, Transcription, Translation and post translational Modification. Synthesis, sorting and trafficking of proteins: site of synthesis of organelle and membrane proteins – transport of secretary and membrane proteins across ER – post-translational modification in RER – transport to mitochondria, nucleus, chloroplast and peroxisome - protein glycosylation – mechanism and regulation of vesicular transport – golgi and post-golgi sorting and processing – receptor mediated endocytosis; Synthesis of membrane lipids.	K2	12

III	**Nucleus:** Nuclear envelope – Nuclear pore complexes-nuclear matrix – organization of chromatin – supercoiling, linking number, twist - nucleosome and high order of folding and organization of chromosome(Solenoid and Zigzag model)-Global structure of chromosome –(Lamp brush and polytene chromosomes).	K3	12
IV	**Molecular basis of eukaryotic cell cycle**, Regulation and cell cycle check points; Programmed cell death (Apoptosis); Cell-Cell signaling-signaling molecules, types of signaling, signal transduction pathways (GPCR-cAMP, IP3 , RTK, MAP Kinase, JAK-STAT, Wnt Pathway).	K4	12
V	**Cancer Biology**: Multistage cancer development Mitogens, carcinogens, oncogenes and proto-oncogenes, tumor suppressor genes-Rb, p 53, Apoptosis and significance of apoptosis	K5	12
Course Outcome	**CO1:** Understand molecular machinery of living cells and the principles that govern the structures of macromolecules and their participation in molecular recognition.	K1	
	CO2: Impact structures and purposes of basic components in prokaryotic and eukaryotic cells and their molecular mechanism	K2	
	CO3: Mechanisms of nuclear envelope and its functions.	K3	
	CO4: Metabolic pathways and the process of transmission of extracellular signals	K4	
	CO5: Operation of various microscopes and microtomy in the laboratory	K5	

Learning Resources	
Text Books	1. Karp, G., 2009, Cell and Molecular Biology, Sixth edition, John Wiley & Sons, New York. 2. David E.Sadva., 2009. Cell biology organelles structure and function, CBS publishers and distributors, New Delhi. 3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, 2007. Molecular Biology of the Cell, Fifth edition. Garland Science.

Reference Books	1. Lodish,H., Berk, A., Zipursky, S.L., Matsudaira, P., Kaiser, A., Krieger, Scott and Darnell, J. 2007. Molecular Cell Biology. Media Connected, sixth edition. W.H.Freeman and Company Geoffrey.M.Cooper, Robert.E.Hausman. 2007. The Cell-A Molecular Approach, Fourth edition. Sinauer Associates. 2. Luiz Carlos Uchoa, Janqueira, Jose, Carneiro. 2005. Basic HistologyText and Atlas. McGraw-Hill Professional. 3. Paul A, 2001, Text Book Of Cell And Molecular Biology, Second edition, Niyogi Books			
Website Link	https://bit.ly/3RCC3x4			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23PBTCT03	**MOLECULAR AND CELL BIOLOGY**	**DSC THEORY - III**	**I**	**6**	**4**	**2**		**4**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**S**	**S**	**S**	**L**	**S**	**S**	**M**
CO2	**S**	**M**	**M**	**S**	**L**	**S**	**L**	**S**	**M**	**S**
CO3	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**M**	**S**	**M**
CO4	**S**	**L**	**S**	**S**	**L**	**S**	**L**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**L**	**M**	**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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. D. Kavitha	**Dr. P. Selvamaleeswaran**	**(DR. S. SHAHITHA) MEMBER SECRETARY**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC04	**MICROBIOLOGY**	**DSC THEORY-IV**	**II**	**5**	**3**	**2**		**4**
Objective	Students impact a comprehensive knowledge on taxonomy and microbial diversity, growth, their harmful effects and beneficial role of microorganisms in agriculture and environment							

Unit	Course Content	Knowledge Levels	Sessions
I	**History and microbial taxonomy**: Major discoveries related to the field of microbiology: Antony Von Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner. Microbial taxonomy: Bacteria, viruses, fungi, algae and protozoa, Microbial diversity: Biovars, Serovars and Prions, Microbial growth and metabolism: Microbial growth: Growth curve, factors affecting growth, Microbial metabolism Methanogenesis, acetogenesis and auxotrophs	K1	12
II	**Microbial culture**, identification, and control: Nutritional requirements for growth - Growth media and types, Pure culture techniques: Serial dilution and plating methods, Staining methods - Principles and types of staining (simple and differential), Identification of bacteria – Biochemical – IMViC, 16s rRNA sequencing. Microscopy: principles and applications of Bright field, florescent and Scanning electron microscopes, Microbial growth control: Physical Methods – Heat, Filtration, Low Temperatures, High Pressure, Desiccation, Osmotic Pressure, Radiation; Chemical Methods	K2	12

III	**Host microbe interaction** and Epidemiology: Human microbiome; Skin, Gastrointestinal tract, Oral cavity, Lung. Symbiotic relationship of microbes: Symbiosis, Mutualism, Parasitism, Commensalism and endophyte. Epidemiology of microbes: causes, types and transmission of epidemic, endemic and pandemic diseases	K3	11
IV	**Microbial Diseases**: Microbial diseases - General characteristics, pathogenesis, laboratory diagnosis and control measures of Pandemic and Epidemic diseases: Tuberculosis, Leprosy, Cholera, Typhoid, COVID-19, Yellow Fever, Flu, AIDS, Ebola, Zika Virus, Small Pox, Dengue, Chickungunya, Malaria, filariasis, Candidiasis, superficial mycosis	K4	14
V	**Agricultural and Environmental Microbiology:** Biological nitrogen fixation, free living, symbiotic nitrogen fixation, mechanism of Nitrogen, Biofertilizers- types and applications; Rhizosphere effect. Biogeochemical cycles-Carbon, Nitrogen, Sulphur and Phosphorous; Methanogenic bacteria Extremphiles- Thermophiles Acidophiles, Halophiles and alkalophiles; Biotechnological application of extremophiles	K5	11
Course Outcome	**CO1:** Receipt the major discoveries of microbiology and describe microbial diversity, Microbial growth and metabolism	K1	
	CO2: Acquire basic knowledge about microbial culture, identification of microbes, principle and working of microscopes and sterilization techniques	K2	
	CO3: Aware of host microbe interaction and Epidemiology of microbial disease	K3	
	CO4: Apply knowledge on epidemic and pandemic diseases.	K4	
	CO5: Assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches.	K5	
Learning Resources			
Text Books	1. Maheshwari D K, Dubey R C 2013. A Textbook of Microbiology. 4th Edn. S Chand Publishing India 2. Joanne Willey, Linda Sherwood, Christopher J. Woolverton, (2017). Prescott's Microbiology, (10th edition), McGraw-Hill Education		

Reference Books	1. Ananthanarayan and Paniker's (2017) Textbook of Microbiology, (10th edition), The Orient Blackswan, ISBN: 978-9386235251 2. Benson HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiology, 7th Edition, McGraw Hill 3. Agriculture Microbiology, 2016. E-Course Developed By TNAU (ICAR)			
Website Link	1. https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf ISBN 978-92- 4-156553-0. https://doi.org/10.3389/fmicb.2020.631736 2.https://www.agrimoon.com/wp-content/uploads/AGRICULTURAL-Microbiology.pdf.			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC04	**MICROBIOLOGY**	**DSC THEORY-IV**	**II**	**5**	**3**	**2**		**4**

CO-PO Mapping

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

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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. Raghu Chandrasekaran	**Dr. P. Selvamaleeswaran**	**(DR. S. SHAHITHA)** **MEMBER SECRETARY**

M.Sc. -Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC05	**PLANT AND ANIMAL BIOTECHNOLOGY**	**DSE THEORY - V**	**II**	**6**	**4**	**2**		**4**
Objective	Students impart a thorough knowledge on the basics of all the biotechnological application on plant and animals.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction** of plant tissue culture, composition of media, Micropropagation, organogenesis, somatic embryogenesis, haploid and triploid production, protoplast isolation and fusion, hybrid and cybrid, synthetic seed production. Secondary metabolites in plants - Phytochemicals- Glycosides and Flavonoids; Anthocyanins and Coumarins - Lignans, Terpenes, Volatile oils and Saponins; Carotenoids and Alkaloids: biogenesis, therapeutic applications	K1	15
II	**Plant Transformation** Direct transformation by electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to biotic and abiotic. Plant engineering towards the development of enriched food products, plant growth regulators; Molecular Marker aided breeding: RFLP maps, Linkage analysis, RAPD markers, STS Mirco satellite, SCAR, SSCP, QTL, Map based cloning and Molecular marker assisted selection.	K2	15
III	**Animal health disease diagnosis**, hybridoma technique, monoclonal antibodies, application of probes for disease diagnosis of existing and emerging animal diseases. Prophylaxis - Vaccines, Oral vaccines DNA Vaccines in animal disease. Cell culture: primary and established culture; organ culture; tissue culture	K3	14

IV	**Disaggregation** of tissue and primary culture; cell separation, Slide and coverslip cultures, flask culture, test tube culture techniques, cell synchronization, cryo preservation. Scaling up of animal cell culture, cell line and cloning micromanipulation and cloning,somatic cell cloning. Karyotyping; measuring parameters for growth, measurement of cell death, apoptosis and its determination, cytotoxicity assays	K4	13
V	**Nuclear magnetic resonance** methods of monitoring cell metabolism culturing animal cells in fluidised bed reactors. Application of animal cell culture for in vitro testing of drugs, in production of human and animal viral vaccines and pharmaceutical proteins. Culture Scale up and mass production of biologically important compounds. Harvesting of products, purification and assays. Transgenic animals: Production and application; transgenic animals in livestock improvement, transgenic animals as model for human diseases; Stem Cells-Properties, Types, Therapy, Prospects and Ethics in stem cell research.	K4	15
Course Outcome	**CO1:** Gain theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation and their application in industries	K2	
	CO2: Receipt the importance of secondary metabolites and production in plants	K2	
	CO3: Develop concepts, principles and processes in animal Biotechnology	K3	
	CO4: Conceive the concept and different types in Animal Cell Culture and animal cell lines	K4	
	CO5: Use molecular biology techniques genetically in engineering the animals to improve sustainability, productivity and suitability for pharmaceutical and industrial applications.	K5	
Learning Resources			

Text Books	1. Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd, New Delhi. 2. Chawla. H. S., 2010.Introduction to plant biotechnology. Oxford and IBH publishing company pvt. Ltd, New Delhi. 3. Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, Oxford University Press, USA.
Reference Books	1. Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers. 2. W.H.Freeman. 26 K. Dass. 2005, Text book of Biotechnology, Second Edition, Wiley Dreamtech, India (P) Ltd 3. H.Kreuzer&A.Massey. 2001. Recombinant DNA and Biotechnology: A guide for teachers Second Edition. ASM press, Washington. 4. M.Sudhir. 2000. Applied Biotechnology & Plant Genetics. Dominant publishers & Distributors. 5. R.W.Masters. 2004. Animal Cell culture Practical approach., Oxford. 6. D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman . 1996. Concepts in Biotechnology Univ. Press.
Website Link	**https://pravara.in/wp-content/themes/twentyseventeen/essentials/pdf/elearn/Principles-of-Plant-Biotechnology.pdf** **https://biologyreader.com/anther-culture.html** **https://edurev.in/search/PLANT%20BIOTECHNOLOGY**

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

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC05	**PLANT AND ANIMAL BIOTECHNOLOGY**	**DSE THEORY - V**	**II**	**6**	**4**	**2**		**4**

CO-PO Mapping

CO Number	P01	P02	P03	P04	P05	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**M**	**S**
CO3	**M**	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**M**	**M**	**S**	**M**	**M**	**M**	**M**
CO5	**S**	**S**	**M**	**M**	**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 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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. P. Selvamaleeswaran	**Dr. P. Selvamaleeswaran**	**(DR. S. SHAHITHA) MEMBER SECRETARY**

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
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M.Sc. -Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC06	**GENETIC ENGINEERING**	**DSC THEORY-VI**	**II**	**5**	**3**	**2**		**4**
Objective	Students impart a thorough knowledge on the basics of all the biotechnological application on recombinant technology.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Gene cloning**. Genetic engineering tools. Nucleic acid manipulating enzymes. Promoters, Selectable markers and reporters used in rDNA technology. Restriction digestion, Ligation, Transformation, Selection of Recombinants. Construction of gene libraries	K1	12
II	**E.Coli vectors** - pBR322 and its derivatives; Cloning vectors for gram negative bacteria - ColE1, p15A, R1, IncPa, pSC101; Lambda bacteriophage vectors, filamentous phages, Cosmids, Phasmids, Phagemids. Cloning in gram-positive bacteria (Bacillus subtilis)	K2	12
III	**Cloning** in yeast Saccharomyces cerevisae. Life cycle and types of vectors; Eukaryotic vectors. SV40 (molecular genetics and expression); Specialized cloning vector for cDNA; Synthesis of specific RNA in vitro; Vectors for cloning promoters and terminators; vectors with adjustable copy number	K3	12
IV	**Nucleic acid hybridization techniques;** Molecular probes (Types of probes and its construction); probe labeling. Nick translation, End labeling and Random primer labeling. Polymerase chain reaction and its variants; DNA fingerprinting; DNA sequencing first generation sequencing methods (Maxam and Gilbert sequencing, Sangers Dideoxy sequencing, Pyrosequencing, PCR based sequencing and hybridization sequencing).Second generation sequencing methods	K4	12

V	**Site directed mutagenesis**; DNA microarray; chromosome walking and jumping.Molecular techniques in prenatal diagnosis gene therapy, Transgenic animals (knockout mice) and plants (Flavrsavr tomato), Pharmaceutical products (Vaccine,Humulin, etc), Crop improvement. Pesticide resistance, herbicide resistance, transgenic animals and GM foods; Modern Concepts in Genetic Analysis.	K5	12
Course Outcome	**CO1:** Receipt the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.	\K1	
	CO2: Detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.	K2	
	CO3: Acquire theoretical knowledge in the techniques, tools, and application and safety measures of genetic engineering	K3	
	CO4: Describe the genome mapping and sequencing and methods for gene therapy.	K4	
	CO5: Elucidate different techniques involved in genetic engineering	K5	

Learning Resources	
Text Books	1. T.A. Brown, 2010. Gene cloning and DNA analysis: An introduction, 6th edition, Wiley-Blackwell. 2. Sandy B.Primrose and Richard Twyman, 2006. Principles of Gene Manipulation and genomics, 7th edition, Wiley-Blackwell. 3. Lewin, 2009. Genes X, 10th edition, Jones &Barlett Publishers
Reference Books	1. Raymond Rodriguez and David T.Denhart 2003.Vectors, A survey of molecular cloning vectors and their uses 2. Errst-L. Winnacker 1987. From genes to clones. Introduction to Gene Technology. Wiley VCH 3. David V. Geoddel . 2002.Gene Expression technologies. Methods in enzymology (Vol.185). Academic Press Inc. 4. William Wu, Michael J.Welsh, Peter B.Kaufrmar, Helen H.Zhang. 2003. Methods in Gene Biotechnology. Gene Biotechnology, Second Edition (2nd ed.). CRC Press.
Website Link	https://microbenotes.com/animal-cell-culture/

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

M.Sc-Biotechnology Syllabus LOCF-CBCS with effect from 2023-2024 Onwards								
Course Code	Course Title	Course Type	Sem	Hours	L	T	P	C
23M2PBTC06	**GENETIC ENGINEERING**	**DSC THEORY- VI**	**II**	**5**	**3**	**2**		**4**

CO-PO Mapping

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

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
Assesment Methods	Class Test, Unit Test, Assignment, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. K. Revathi	**Dr. P. Selvamaleeswaran**	**(Dr. S. Shahitha)** **MEMBER SECRETARY**

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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC07	**BIOINFORMATICS**	**DSC THEORY - VII**	**III**	**6**	**4**	**2**		**4**
Objective	Students impart a thorough knowledge of the basics of bioinformatics tools. The student will get to understand the core concepts of In-Silico biological research.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Database concepts:** Introduction to the internet and its application, Introduction to bioinformatics, Protein and nucleotide databases, Information retrieval from biological databases, Sequence alignment and database searching-similarity searches using BLAST and FASTA. Artificial Intelligence: Introduction to biological neural network, motivation for artificial neural network (ANN), Big data analysis - DNA/RNA/protein sequence or structure data, gene expression data, protein-protein interaction (PPI) data, pathway data and gene ontology (GO) data	**K1**	**12**
II	**Sequence alignment:** basics, match, mismatch, similarity, scoring an alignment, gap penalty, protein vs DNA alignments, Dot-matrix alignment, pairwise alignment. Global and local alignment algorithms, multiple sequence alignment-progressive alignment and Iterative alignment algorithms, consensus sequence, patterns and profiles, Database searching: Pairwise alignment based rigorous algorithm (Smith and Waterman) and Heuristic algorithms (FASTA and Blast). Multiple sequence alignment based database searching. PSI- Blast, PAM and Blosum matrices.	**K2**	**12**

III	**Bioinformatics for genome sequencing:**EST Clustering and analyses, Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis, Bioinformatics for Genome maps and markers, Bioinformatics for understanding Genome Variation. protein databank and the PDB Sum-SCOP, CATH, DALI and HSSP ;Visualization of molecular structuresRasMol and Pymol; Protein secondary structure prediction, Fold Recognition; Transmembrane topology prediction	**K3**	**12**
IV	**Molecular visualization tools**: Rasmol, Chime and Spdb viewer. Structure analysis tools. VAST and DALI, Structural biology - Homology modeling, Bioinformatics for microarray designing and transcriptional profiling, Bioinformatics for metabolic reconstruction, Bioinformatics for phylogenetic analysis	**K4**	**12**
V	**Medical application of Bioinformatics:** Disease genes, Drug Discovery. History. Steps in drug discovery. Target Identification. Target Validation. QSAR. Lead Identification. Preclinical pharmacology and toxicology. ADME. Drug designing. Rational drug design. Computer aided drug design. Ligand based approach. Target based approach. **Current Trends: *Bioinformatics applications in life and environmental sciences***	**K5**	**12**
	*……*self study		
Course Outcome	**CO1:** Recite to the basic concepts of Bioinformatics and its significance in Biological data analysis.	**K1**	
	CO2: Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.	**K2**	
	CO3: Explain about the methods to characterize and manage the different types of Biological data.	**K3**	
	CO4: Classify different types of Biological Databases.	**K4**	
	CO5: Elucidate the basics of sequence alignment and analysis	**K5**	
Learning Resources			

Text Books	1. Dassanayake S.Ranil, Y.I.N. Silva Gunawardene, 2011. Genomic and Proteomic Techniques, Narosa Publishing House Pvt. Ltd, New Delhi. 2. Thiagarajan B, Rajalakshmi.P.A. 2009. Computational Biology, MJP publishers, Chennai.
Reference Books	1. Bosu Orpita, Simminder Kaur Thukral, 2007. Bioinformatics Databases, Tools and Algorithms, Oxford University press, New Delhi. 2. Rastogi.S.C, Mendiratta.N, Rastogi.P, 2004. Bioinformatics methods and applications, Prentice-Hall of India private limited, New Delhi. 3. Stephen Misener and Stephen A. Krawetz., 2000. Bioinformatics methods and protocols, Humana press Inc, New Jersey. 4. Durbin.R, S.Eddy, A.Krogh and G.Mitchison, 1998. Biological sequence analysis, Cambridge university press, Cambridge.
Website Link	1. https://www.vedantu.com/biology/bioinformatics 2. https://www.biologydiscussion.com/biodiversity/bioinformatics/notes-on-bioinformatics-genetics/38224
Self-Study Material	1. https://ocw.mit.edu/courses/6-092-bioinformatics-and-proteomics-january-iap-2005/pages/lecture-notes/

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC07	**BIOINFORMATICS**	**DSC THEORY - VII**	**III**	**6**	**4**	**2**		**4**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S	S	S	M
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 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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	**Dr.P. Selvamaleeswaran**	**(Dr. S. SHAHITHA) ber Secretary**

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC08	**IMMUNOLOGY**	DSC THEORY-VIII	III	**5**	**3**	2		**4**
Objective	Student will get to understand the core concepts of immune systems and their non-specific and specific mechanisms, vaccines, etc.							

Unit	Course Content	Knowledge Levels	Sessions
I	**History and overview of the immune system.** Types of immunity - innate, acquired, passive and active, self vs non-self-discrimination. Physiology of immune response: HI and CMI specificity and memory. Cells and organs of the immune system .Lymphoid tissue, origin and development. Hematopoiesis and differentiation of lymphocytes	K1	12
II	**Lymphocyte-subpopulations of mouse and man.** APC cells, lymphokines, Phagocytic cells, macrophage, dendritic cells, K and NK Cells. Nature and biology of antigens, epitopes, haptens, adjuvants. Immunoglobulins- structure, distribution and function. Immunoglobulin super family Isotypic, Allotypic and Idiotypic variants, generation of antibody diversity	K2	12
III	**Monoclonal antibody production and its applications**. Types of vaccine and vaccination schedule. Role of MHC antigens in immune responses, Structure and function of class I and class II MHC molecules. MHC antigens in transplantation and HLA tissue typing. Transplantation immunology- immunological basis of graft rejection, clinical transplantation and Immunosuppressive therapy. Tumor Immunology - Tumor antigen, Immune response to tumors	K3	12
IV	**Effectors mechanisms in immunity** - macrophage activation, cell mediated cytotoxicity, cytotoxicity assay. Hypersensitivity reactions and types. The complement system, mode of activation, classical and alternate pathway, biological functions of C proteins	K4	12
V	**Immunotechniques-** Principle and Applications: Immunodiffusion, Immunofluorescence, In Situ localization technique - FISH and GISH. RIA and ELISA, FACS, Western blot, ELISPOT assay. Agglutination tests. VDRL test. Purification of antibodies, Quantification of immunoglobulin by RID, EID and nephelometry, CMI techniques and Immunotherapy. **Transplantation and transfusion***	K5	12

	-------- Self study	K5	
Course Outcome	**CO1:** Demonstrate various mechanisms of innate and acquired immunity	K1	
	CO2: Illustrate the sub classes of immunoglobulin's and their uses	K2	
	CO3: Produce monoclonal antibodies and its application	K3	
	CO4: Compare the classical and alternative pathways in compliments	K4	
	CO5: Summarize immunotechniques and its applications	K5	

Learning Resources	
Text Books	1. Nandini Shetty, 1996, Immunology: introductory textbook - I. New Age International, New Delhi 2. Kannan. I., 2010. Immunology. MJP Publishers, Chennai
Reference Books	1. Kuby J. (2000). Immunology, 4 th Edition, WH Freeman & Co. New York. 2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt,2011. Roitt.s Essential Immunology, 12 edition, Wiley-Blackwell. USA. 3. Abbas, A.K., A.H.L. Lichtman and S.Pillai, 2010. Cellular and Molecular Immunology. 6thEdition. Saunders Elsevier Publications, Philadelphia 4. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby, 2006.Kuby Immunology, 6thedition, W. H. Freeman & Company
Website Link	1.www.immunologylink.com 2. http://www.wiley.com/college/bio/karp12791/weblinks.html
Self-Study Material	https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-immunology

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC08	**IMMUNOLOGY**	DSC THEORY-VIII	III	5	3	2		4

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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr.D.Rajasekaran	**Dr.P.Selvamaleeswaran**	(Dr. S. SHAHITHA) Member Secretary

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Rasipuram - 637408.

M.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC09	**BIOPROCESS TECHNOLOGY**	**DSC THEORY-1X**	**III**	**5**	**3**	2		**4**
Objective	Students imparts a thorough knowledge on the basics of bioprocess and industrial fermentation							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction to fermentation**. General requirements of fermentation. Microbial growth kinetics of batch and continuous culture. Solid substrate, slurry fermentation and its application. Microbial cell culture. Immobilization of cells and enzymes.	K1	12
II	**Types of bioreactors**: Submerged reactors, surface reactors, mechanically agitated reactors, nonmechanically agitated reactors. Design of fermenters, body construction. Production of citric acid, penicillin and insulin. Isolation and improvement ofIndustrially important Microorganisms, Media for Industrial fermentation and Sterilization.	K2	12
III	**Bioproducts and bioseparation**. Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis. Flocculation by electrolysis; polymorphic flocculation. Precipitation methods. Filtration: Principles, Conventional, Crossflow filtration. Sedimentation: Principles, Sedimentation coefficients. Extraction Principles, Liquid liquid extraction, aqueous two phase extraction, supercritical fluid extraction	K3	12

IV	**Down Stream Processing:** Chromatography Techniques, Membrane separation, ultrafiltration.Drying .Principles and operation of vacuum dryer, shelf dryer, rotary dryer, freezer and spray dryer. Crystallization and Whole broth processing.	K4	12
V	**Aerobic and anaerobic**: Fermentation processes and their application in the field of biotechnology industry. Production of commercially important primary and secondary metabolites, Effluent Treatment and Fermentation Economics .**Current Trends-*Rate of mass transfer***	K5	12
	***…….** * Self Study.		
Course Outcome	**CO1:** Outline the basis of bioprocess engineering	K1	
	CO2: Relate the bioreactor in fermentation process	K2	
	CO3: Differentiate fermentation processes	K3	
	CO4: Assess Scale up and Scale down	K4	
	CO5: Compile the output of fermentation processes	K5	

Learning Resources	
Text Books	1. Min-tzeLiong, 2011. Bioprocess Sciences and Technology. NovaScience Pub Inc. 2. Michael L.Shuler, FikretKargi. 2003. Bioprocess Engineering. PHIpublishers.
Reference Books	1. P.A.Belter, E.L.Cursler, and W.S.Hu. 1988.Bioseparation: Downstream processing· For Biotechnology. John Wiley and sons. 2. R.G. Harrison, P.Todd, SR.Rudge and D.P. Petrides. 2003. Bioseparation science and engineering. Oxford Press. 3. Priti Patel, Khushbu Panchal. 2020. Bioprocess Technology. Scholars' Press
Website Link	1. www.wildfermentation.com/John Schollar and BenedikteWatmore, PracticalFermentation-a technical guide 2. web.mit.edu/professional/short.../fermentation_technology.html·
Self-Study Material	1. https://www.sciencedirect.com/science/article/abs/pii/S0734975008001079

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTC09	**BIOPROCESS TECHNOLOGY**		**DSC THEORY-1X**		**III**	**5**	**3**	2		**4**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	M	S	S	S	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	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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.K. Revathi	Dr. P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTC10	**RESEARCH METHODOLOGY AND BIOSTATISTICS**	**DSC THEORY - X**	**IV**	**6**	**4**	**2**		**5**
Objective	Students impart a thorough knowledge on the basics of academic research.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Research Methodology - An Introduction:** Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Importance of knowing how research is done, Research Process, Criteria of good research. Defining the Research Problem; Research Design; Sampling Design; Methods of Data Collection; Processing and Analysis of Data; Sampling Fundamentals	K1	15
II	**Research Report:** Review of literature, Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgement and Bibliography	K2	15
III	**Statistical Tool:** Standard Deviation-T test. Analysis of Variance components (ANOVA) for fixed effect model: Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking. Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two factor factorial design	K3	12

IV	**Spreadsheet Tool:** Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Presentation Tool: Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool	K4	15
V	**Web Search:** Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo, Pubmed, Science direct, Scopus etc, and Using advanced search techniques. **Current Trends-*Advances in nature of science research concepts and methodologies***	K5	15
	…… Self Study.		
Course Outcome	**CO1:** Receipt the basics of research	K1	
	CO2: Analyze about research proposal and dissertation writing.	K2	
	CO3: Assess and utilize the statistical tools in research	K3	
	CO4: Evaluate office tools used in research	K4	
	CO5: Interpret about search engines.	K5	

Learning Resources	
Text Books	1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India). 2. Kothari C.K. (2004), 2/e, Research Methodology- Methods and Techniques (New Age International, New Delhi).
Reference Books	1. Gurumani. N., Research Methodology for Biological Sciences, MJP Publishers (2019) 2. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi).
Website Link	1.https://ebooks.inflibnet.ac.in/liscp10/chapter/basics-of-research-methodology/ 2.www.qmethod.org/ 3.https://adphealth.org/irtoolkit/research-methods-and-data-management/research-tools-and-techniques.html

Self-Study Material	1. https://online.stat.psu.edu/stat500/book/export/html/606 2. https://web.njit.edu/~dhar/math661/IPS7e_LecturePowerPointSlides_ch12.pdf			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTC10	**RESEARCH METHODOLOGY AND BIOSTATISTICS**	**DSC THEORY -X**	**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	S	S	S	S
CO2	S	S	S	S	S	S	S	M	M	M
CO3	S	M	S	S	S	S	M	M	M	M
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**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTC11	ENVIRONMENTAL BIOTECHNOLOGY	DSC THEORY - XI	IV	6	4	2		5
Objective	Student will be provided with a basic knowledge and understanding about the functions of ecosystem and reduction of pollution by biotechnological tools.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Environment:** Basic concepts and issues; Environmental management and Conservation, Environmental Laws & Agencies involved in conservation. Environmental Pollution: Types of pollution & its control strategies -Air pollution, Soil pollution, Water pollution, Oil pollution & Radioactive pollution	K1	15
II	**Biofilm Kinetics**: Completely mixed biofilm reactor-Soluble microbial products and inert biomass-Special-case biofilm solution. Reactor types:- batch reactor - continuous-flow stirred-tank reactor-Plug-flow reactor. Engineering design of reactors- Reactors in series	K2	15
III	**Waste water management**- Source of waste water, Waste water treatment- physical, chemical and biological treatment. Microbiology of Waste water; Aerobic and anaerobic process, BOD and COD.	K3	12
IV	**Toxicity:** Types and Test for evaluating Toxicity. Biosensors, Biomonitoring of toxic materials. Biomagnification, Biomining and Biofuels	K4	15

V	**Bioremediation:** In-situ and Ex-situ Bioremediation of contaminated soils and waste land; Microbiology of degradation of Xenobiotics in environment; Pesticides, Surfactants, Degradative plasmids. Solid waste: Composting, Vermiculture and methane production. **Current Trends: *Chlorine chemistry and Disinfection ***	K5	15
	…… Self Study.		
Course Outcome	**CO1:** Explain various waste management methods	K1	
	CO2: Classify potential methods of biodegrading organic pollutants.	K2	
	CO3: Examine the techniques involved in waste management	K3	
	CO4: Assess types of evaluating Toxicity	K4	
	CO5: Compile biotechnological approaches to bioremediation	K5	

Learning Resources	
Text Books	1. M. H. Fulekar, 2010 Environmental Biotechnology, by Science Publishers Department of Life Sciences, University of Mumbai, India, 2. Bruce E. Rittmann and Perry L. McCarty. 2001. Environmental Biotechnology:Principles and applications. McGraw Hill, Newyork.
Reference Books	1. Ahmed N, Qureshi, F.M. and Khan, O.Y. 2001.Industrial and Environmental Biotechnology. Horizon Press. 2. Gareth M. Evans, Gareth G. Evans, Judy Furlong 2011. Environmental biotechnology: theory and application John Wiley & Sons, Ltd. West Sussex, UK
Website Link	1. https://archive.nptel.ac.in/courses/102/105/102105087/ 2. https://www.sciencelearn.org.nz/resources/1209-impacts-of-biotechnology-on-society
Self-Study Material	1. https://youtu.be/nkRoV1pjwmE

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTC11	**ENVIRONMENTAL BIOTECHNOLOGY**	**DSC THEORY - XI**	**IV**	**6**	**4**	**2**		**5**

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	M	M	S	S	S	M
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	S	M	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 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.Kavitha	Dr.P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTP01	PRACTICAL: Biochemistry, molecular genetics and molecular cell biology	DSC PRACTICAL- I	1	6			6	4
Objective	Students establish a basic study skills on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.							
A	**A. Biochemistry Practical** Protein separation methods:- Ammonium sulphate Precipitation Membrane Dialysis SDS PAGE Estimation of Proteins by Lowry's method Estimation of RNA by orcinol method Estimation of DNA by diphenylamine method **Minor Experiments** Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v). Calibration of pH meter Transition interval of commonly used pH indicators Preparation of biological buffer - phosphate buffer Separation of amino acids by Paper Chromatography Separation of sugars by Paper Chromatography Separation of amino acids by Thin layer chromatography Separation of sugars by Thin layer chromatography					K2		15

	Demo Experiments Gel permeation chromatography Affinity chromatography Ion. Exchange chromatography		15
B	**B. Molecular Genetics** Agarose gel electrophoresis of DNA Isolation of RNA Formaldehyde denatured Agarose gel electrophoresis of RNA Urea denatured Agarose gel electrophoresis of RNA Giant chromosome studies in Chironomous larvae Cell counting and cell viability Meiotic study in flower bud sand cockroach or grasshopper	K3	15
	Minor Radiation induced genetic damage assessment. Chemical induced genetic damage assessment Preparation of metaphase chromosomes form blood Histochemical staining to localize proteins Histochemical staining to localize carbohydrates Histochemical staining to localize lipids.	K4	12
C	**C. Molecular Cell Biology – Practical** **Demo Experiments** Introduction to Microtome and type **Microtomy- Fixation of tissue** **Microtomy – Embedding** Microtomy- Sectioning of tissue H&E Staining of tissues	K5	15
Course Outcome	**CO1:** Illustrate the basic biochemistry procedures	K2	
	CO2: Receipt the methods of estimation of biomolecules	K3	
	CO3: Isolate & analyze DNA, RNA & protein	K4	

	CO4: Critically analyze the isolated biomolecules	K5	
	CO5: Evaluate the quality and purity of DNA, RNA & Protein	K5	

Learning Resources				
Text Books	1. S. Rajan, R. Selvi Christy. (2015). Experimental Procedures in Life Sciences, Anjanaa Publications.			
Reference Books	1. Jyoti Saxena, Mamta Baunthiyal and Indu Ravi, (2019). Comprehensive Laboratory Manual of Life Sciences, Scientific Publishers. 2. Keith Wilson& John Walker, (2005). Principles and techniques of practical biochemistry and molecular biology, Cambridge Publication			
Website Link	1. https://praxilabs.com/en/blog/2023/05/24/what-is-molecular-biology/ 2. https://youtu.be/WzBP2MAe4tE?t=114			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**		
23M1PBTP01	**Practical: Biochemistry, Molecular Genetics and Molecular Cell biology**	**DSC-PRACTICAL**	**I**	**6**			**6**	**4**		

CO-PO Mapping

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

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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTP02	Practical: Microbiology, Plant and Animal Biotechnology and Genetic Engineering	DSE PRACTICAL - II	II	6			6	4
Objective	Students establish a basic study skill on the subject and will improve the student's ability to have a hands on experience on the above core subjects.							

UNIT	**List of Experiments / Programmes**	**Knowledge Levels**	**Sessions**
A	(**A) Microbiology**-Practical Minor experiments: 1. Sterilization of glassware using dry heat- hot air oven 2. Sterilization of media using moist heat – autoclave 3. Filter sterilization 4. Liquid media preparation – nutrient broth 5. Solid media preparation – SDA plates 6. Preparation of Agar slants 7. Streak plate method 8. Pour plate method 9. Spread plate method	K2	30

	Major experiments: 10. Enumeration of total count of the bacteria 11. Isolation of microbes from soil 12. Isolation of microbes from water 13. Isolation of microbes from air 14. Isolation of microbes from plant surface. 15. Isolation of pure culture of E.coli, 16. Isolation of pure culture of Aspergillus niger, 17. Isolation of pure culture of Streptomyces. 18. Gram staining and morphological characterization of microbes. 19. Negative staining of bacteria 20. Determination of growth curve of bacteria – E.coli 21. IMViC test of enteric bacteria **Demonstration** 16srRNA sequencing		
B	**(B) Plant and Animal Biotechnology -** Practical: Plant Biotechnology 1. Plant tissue culture media preparation 2. Plant tissue culture sterilization techniques. 3. Generation of Callus from leaf 4. Maintenance of callus culture. 5. Anther culture 6. Pollen culture 7. Embryo culture. 8. Isolation of plant protoplast 9. Culture of plant protoplast. 10. Protoplast viability test.	K3	30

	Practical:Animal Biotechnology 1. Introduction to Animal Cell culture: Procedure for handling cells and medium. 2. Cleaning and sterilization of glassware and plastic tissue culture flasks 3. Preparation of tissue culture media 4. Preparation of sera for animal cell culture 5. Preparation of single cell suspension from chicken liver (Primary cell culture). 6. Trypsinization of established cell culture. 7. Cell counting and viability - staining of cells (a) Vital Staining (Trypan blue, Erythrosin (b) Giemsa staining. 8. MTT Assay		
C	**(C) Genetic Engineering** - Practical 1. Preparation of plasmid DNA by alkaline lysis method. 2. Agarose gel electrophoresis 3. Silver staining of gels 4. Restriction enzyme digestion. 5. Ligation. 6. Transformation and selection of recombinants. 7. Amplification of DNA - PCR 8. Determination of molecular weight of DNA Demonstration: RT-PCR for COVID-19	K5	12
COURSE OUTCOME	**CO 1:** Isolate and identify microbes from various sources.	**K1**	
	CO 2: Characterize microbes.	**K2**	
	CO 3: Examine Plant and Animal cells and their functions	**K3**	
	CO4: Assess extracted DNA, RNA and protein for rDNA technology	**K4**	
	CO5: To acquire knowledge about cloning tools	**K5**	
Learning Resources			

Text Books	R. Vinodhini, Punitha, Saranya and K. Revathi, 2023. A laboratory Manual on Microbioloy. Lodrine Novo Publication			
Reference Books	Arora B, Microbiology practical, 2023. CBS Publishers & Distributors Plant Biotechnology Practical Manual by C C Giri and Archana Giri, Wiley India			
Website Link	1. https://bit.ly/3ekSj7r 2. https://indiabioscience.org/media/articles/DBT-Life-Science-Protocol-Manual.pdf			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTP02	PRACTICAL: Microbiology, Plant and Animal Biotechnology and Genetic Engineering	DSC PRACTICAL - II	II	6			6	4

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	M	S	M	S	M	S
CO2	M	M	M	M	S	M	M	S	M	S
CO3	M	S	S	M	M	S	M	S	S	M
CO4	S	M	M	S	L	M	M	S	M	S
CO5	M	M	M	M	S	S	M	S	M	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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. K. Revathi	Dr. P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTP03	**PRACTICAL: BIOINFORMATICS, IMMUNOLOGY AND BIOPROCESS TECHNOLOGY**	**DSC PRACTICAL- III**	**III**	**6**			**6**	**4**
Objective	Students establish a basic study skill on the subject and will improve the students ability to calculate and improve their practical skill in immunology and bioinformatics.							

Unit	Course Content	Knowledge Levels	Sessions
I	1. Prediction of signal sequence using SignalP online tool 2. Pattern Search (Domains & Motifs) using Pfam 3. ORF gene Search - Genscan 4. Sequence translation using ExPASy translate tool 5. Characterization of retrieved protein sequence by ProtParam tool.	K2	15
II	1. Sequence retrieval from Genbank 2. Sequence retrieval from Uniprot. 3. Sequence identity search- Sequence similarity search using BLAST 4. Sequence similarity search using FASTA 5. Sequence similarity search using PSI BLAST **DEMONSTRATION** 1. Molecular visualization of proteins using RASMOL. 2. Docking of small molecule with protein structure Using Hex software. 3. Docking of two proteins using Patch Dock (Protein Protein docking) tool.	K3	15

III	1. Identification of various immune cells from human peripheral blood. 2. Determination of lymphocyte viability by trypan blue method 3. Radial Immunodiffusion 4. Ouchterlony Immunodiffusion 5. Immunoelectrophoresis 6. Counter current immunoelectrophoresis. 7. Immunodiagnostics: CRP 8. Immunodiagnostics: ASO 9. Immunodiagnostics: Widal 10. Immunodiagnostics: RA 11. Immunodiagnostics: Blood grouping and typing 12. Immunodiagnostics: hCG 13. Preparation of serum and plasma DEMONSTRATION 1. Lymphocyte separation and identification 2. Bioassays for cytokines 3. ELISA 4.Radioimmunoassays	K4	12
IV	1. Isolation of industrially important microorganisms for microbial processes. 2. Production and estimation of protease 3. Production and estimation of amylase. 4. Production of wine using grapes 5. Production of penicillin 6. Determination of penicillin activity 7. Citric acid production 8. Use of alginate for cell immobilization.	K4	15

V	1. Solid state and Submerged fermentation 2. Media preparation and sterilization DEMONSTRATION 1. Parts and design of fermenter 2. Media standardization (C:N ratio) for maximum Biomass production of an industrially important microorganism	K5	15
Course Outcome	**CO1:** Demonstrate Bioinformatics tools for sequence retrieval and alignment	K2	
	CO2: Interpret about immobilization and production of Wine, Biogas and compost	K3	
	CO3: Develop immune cells and its applications	K4	
	CO4: Elucidate technique of immunodiagnostics	K4	
	CO5: Evaluate upstream & downstream techniques	K5	

Learning Resources				
Text Books	Harrison R.G., P.Todd, SR.Rudge and D.P. Petrides. 2003.Bioseparation science and engineering. Oxford Press.			
Reference Books	Belter P.A., E.L.Cussler, and W.S.Hu. 1988.Bioseparation: Downstream processing for Biotechnology. John Wiley and sons			
Website Link	https://www.wildfermentation.com/wild-fermentation/			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTP03	**PRACTICAL: BIOINFORMATICS, IMMUNOLOGY AND BIOPROCESS TECHNOLOGY**			**DSC PRACTICAL- III**	**III**	**6**			**6**	**4**

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	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	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, 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 Elective Course (DSE) for M. 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	23M1PBTE01	BIOINSTRUMENTATION
2	I	23M4PBTE02	STEM CELL BIOLOGY
3	I	23M1PBTE03	FOOD TECHNOLOGY
4	I	23M1PBTE04	ENZYMOLOGY
5	II	23M2PBTE05	PHARMACEUTICAL BIOTECHNOLOGY
6	II	23M2PBTE06	REGULATORY AFFAIRS AND INDUSTRIAL STANDARDS
7	III	23M3PBTE07	MOLECULAR DEVELOPMENTAL BIOLOGY
8	III	23M3PBTE08	NANO BIOTECHNOLOGY

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE01	Bioinstrumentation	DSE THEORY-1	1	3	3			3
Objective	Student will get to understand the core concepts of biological instruments and their principles.							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Microscopic Techniques**: Principles and Applications: Compound, Light, Stereo, Phase Contrast, Fluorescent Microscopy, Scanning and Transmission Electron Microscopy, Scanning Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy, FRET and Flow Cytometry.	K1	7
II	**Centrifugation**: pH meter, Principle and Applications of various types of centrifugation, Sedimentation Coefficient, Svedberg unit, RCF, Density Gradient Centrifugation. Chromatography Techniques: Principle and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GC & HPLC	K2	7
III	**Electrophoretic Techniques:** Principle and Application of Agarose Gel Electrophoresis, 2D-gel Electrophoresis, PAGE-NATIVE & SDS PAGE, Iso electric Focusing, High resolution Electrophoresis, Immuno Electrophoresis (Immunofixation EP,)ELISA, RIA, Southern, Northern and Western Blotting. Electro blotting, PCR and RT-PCR, Microarray (DNA, Proteins)	K3	7

IV	**Spectroscopic Techniques:** Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, Mass Spectroscopy, IR Spectroscopy NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy, Laser Spectroscopy and Raman Spectroscopy	K4	7
V	**Radio-isotopic Techniques:** Introduction to Radioisotopes, Uses and their Biological Applications, Radioactive Decay – Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, utoradiography, RIA, Radiation Dosimetry, Health effects of Radiations.	K5	7
COURSE OUTCOME	**CO1:** Describe the various types of Microscopic techniques	K1	
	CO2: Recognize the centrifugation process	K2	
	CO3: Prepare the Separation of Biomolecules	K3	
	CO4: Analyze the analytical methods on Spectroscopic Analysis	K4	
	CO5: Design the Bioinstrumentation application in environment	K5	

Learning Resources

Text Books	1. Fulekar M.H. and Bhawana Pandey. 2000. Bioinstrumentation. Wiley Publication 2. Keith Wilson, John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology (7th Edition), Cambridge University Press 3. David L. Nelson, Michael M. Cox. Menninger, 2008. Principles of Biochemistry, Fifth edition W. H. Freeman, New York
Reference Books	1. Shawn O. Farrell, Ryan T. Ranallo, 2000. Experiments in Biochemistry: A Hands-On Approach. Brooks Cole 2. Metzler D.E. 2001, the chemical reactions of living cells –Academic Press. 2nd edition 3.Stryer L, 1999, Biochemistry- 4th edition W.H. Freeman & Company, New York.
Website Link	1. https://www.researchgate.net/publication/322208919_Microscopy 2.https://en.wikipedia.org/wiki/Centrifuge

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE01	Bioinstrumentation			DSE THEORY-1		I	3	3			3

CO-PO Mapping

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

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE02	**STEM CELL BIOLOGY**	DSC THEORY - I	**IV**	**3**	**3**			**3**
Objective	The subject imparts knowledge on the fundamentals of stem cells. The student will be provided with a basic knowledge and understanding about the application of stem cell biology.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction:** Stem cells - Definition, Characterization, Pluripotency, Self-renewal and differentiation. Types of stem cells- Embryonic stem cells, Adult stem cells and mesenchymal stem Cells, Adipose stem cells	K1	9
II	**Stem cell specification**: Stem cell niche, Niche specification - Drosophila germ line stem cells. Receptors, genes and markers of stem cells	K2	8
III	**Stem cell culture methods:** Stem cell isolation and culture techniques. Characterization of stem cells	K3	7
IV	**Stem cell cycle.** Chromatin modification and transcriptional regulation, chromatin modifying factors, Chromosomal inactivation. JAK -STAT pathway, Ras\Raf pathway, PI3K cell signaling, p53 check points, Role of LIF pathway in cell cycle control	K4	8
V	**Applications of stem cells:** Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells. Ethics in human stem cell research. **Current Trends- *Stem cell biology and regenerative medicine***	K5	7
	…… Self Study.		
Course Outcome	**CO1:** Receipt the major discoveries of stem cell biology	K1	
	CO2: Relate about stem cell niche and functions	K2	
	CO3: Organize stem cell isolation and culture techniques	K3	
	CO4: Classify pathways in cell cycle control	K4	
	CO5: Assess and appraise Applications of Embryonic stem cells.	K5	

Learning Resources	
Text Books	1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press 2. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003 3. Human Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Chad A Cowan.

Reference Books	1. Progress in gene therapy, Volume 2,Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiya Ozawa and H. Kirk Hammond, VSP international science publishers 2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
Website Link	1. http://irp.nih.gov/our-research/scientific-focus-areas/stem-cell-biology 2.https://stemcellres.biomedcentral.com/articles/10.1186/s13287-019-1165-5 3. https://www.medicalnewstoday.com/articles/323343
Self-Study Material	1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4969512/ 2. https://www.mayoclinic.org/tests-procedures/bone-marrow-transplant/in-depth/stem-cells/art-20048117

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PBTE02	**STEM CELL BIOLOGY**	DSC THEORY - I	**IV**	**3**	**3**			**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	M	M	S	S	S	M
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	S	M	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.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE03	FOOD TECHNOLOGY	DSC THEORY - II	I	3	3			3
Objective	Students impart knowledge on the fundamentals of food preservatives and additives.							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	Introduction, scope and important of food biotechnology. Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage- types. Canning of foods.	K1	7
II	Food borne diseases and prevention – infection, in toxification– Salmonellosis, poliomyelitis. Food colors (natural and artificial food colorants), Food flavoring agents.	K2	7
III	Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.	K3	7
IV	Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plant - Cleaning and sanitation methods.	K4	7
V	General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.	K5	7
COURSE OUTCOME	**CO1:** Explain the scope and important of food biotechnology,	K1	
	CO2: Summarize the food borne disease, food colour and flavoring agents	K2	
	CO3: Examine the steps involved in food industries process.	K3	

	CO4: Assess the food safety standard and food quality	K4	
	CO5: Compile the uses of food and design the packages for Industrial and public	K5	

Learning Resources	
Text Books	1. William C.Frazier, Dennis C. Westhoff .2017. Food Microbiology , McGraw Hill Publications 2. Rao D.G. 2010. Fundamentals of Food Engineering, PHI Learning Pvt. Ltd.
Reference Books	1. Yiu Hui and G. Khachatourians. 1995. Food Biotechnology, Wiley-Inter science 2. Bibek, Laramie and Bhunia. 2004. Fundamentals of Food Microbiology, CRC Press 3. Siva. B. 2011. Food Processing & Preservation, PHI Learning Pvt. Ltd.
Website Link	1. https://www.healthline.com/health/food-borne-illness 2. https://felixinstruments.com/blog/the-importance-of-food-quality-testing/

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**			**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE03	FOOD TECHNOLOGY			DSC THEORY - II		I	3	3			3

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S	S	M	S	M	S
CO2	S	L	S	M	S	S	S	S	M	S
CO3	S	M	S	S	M	S	M	S	M	S
CO4	S	M	S	M	S	S	S	S	M	S
CO5	S	M	M	M	S	S	M	M	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.Kavitha	Dr.P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
Rasipuram - 637408.

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTE04	ENZYMOLOGY	DSC THEORY - II	I	3	3			3
Objective	The subject imparts knowledge on the fundamentals of enzyme structure and its kinetics.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to enzymes**, Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalysed reactions. Extraction Isolation and purification of enzymes by precipitation, centrifugation, chromatography and electrophoresis and liquid-liquid extraction methods	K1	12
II	**Kinetics of catalysed reaction** : Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, line weaver burk plot, Hanes wolf equation, Eadiehoofstee equation ,Inhibition of enzyme activity	K2	12
III	**Enzyme catalysis:** enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis	K3	12
IV	**Theories on mechanism of catalysis.**-Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Multienzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex	K4	12

V	**Coenzyme action.** Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, Immobilized enzymes and their industrial applications.Clinical and industrial applications of enzymes, Enzyme Engineering . **Current trends-Biotransformation**	K5	12
	***Biotransformation* Self Study.**		
Course Outcome	**CO1**:Explain the basics of enzyme nomenclature and properties	K1	
	CO2: Classify and Cognize the native and immobilized enzyme	K2	
	CO3: Examine the equations of steady state kinetics	K3	
	CO4:Assess extraction and downstream processing of enzymes	K4	
	CO5:Compile the uses of enzymes and design enzymes for Industrial and Clinical application	K5	

Learning Resources

Text Books	1.Nicholas C.Price and Lewis Stevens., 2010. Fundamentals of Enzymology. Oxford University Press, New Delhi 2. Lehninger, Nelson and Cox, 2005, Principles of Biochemistry - 4th edition, WH Freeman and Company, New York, USA
Reference Books	1. Principles of Biochemistry with human focus - Garrett and Grisham, 2002, Harcourt College Publishers, Orlando, Florida, USA. 2. Geoffrey L, Zubay, Biochemistry -, 1998, 4th edition. 23 3. Donald Voet, Judith Voet and Pratt, 1995, Fundamentals of Biochemistry, 2nd edition. 4. Harper.s Biochemistry - Murray et al, 2000, 25th edition, Appleton and Lange Publishers.
Website Link	1.www.lsbu.ac.uk/biology/enztech/ 2.www. lsbu.ac.uk/biology/enzyme/ 3.http://www.aetlted.com/tech/applications.html
Self-Study Material	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/enzymology

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PBTE04	ENZYMOLOGY		DSE THEORY- I	**I**	**3**	**3**			**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	S	M	S	S	S	S	M	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	M	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										
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

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
Rasipuram - 637408.

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTE05	PHARMACEUTICAL BIOTECHNOLOGY	DSE THEORY-III	2	3	3			3
Objective	Student will be provided with a basic knowledge pharmacology and Ethno pharmacology							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Introduction** to concepts and technologies in pharmaceutical biotechnology and industrial applications, Biosensors- Working and applications of biosensors in pharmaceutical Industries; Pharmacology and Ethno pharmacology: Scope, applications and Importance.	K1	7
II	**Scientific**, technical and economic aspects of vaccine research and development, Preparation of bacterial vaccines, toxoids, viral vaccine and antitoxins, Storage conditions and stability of vaccines, Recombinant DNA technology, Application of rDNA technology and genetic engineering in the production of: (i) Interferon (ii) Vaccines - hepatitis- B (iii) Hormones – Insulin, Brief introduction to Protein Engineering, Therapeutic proteins, Production of Enzymes- General consideration – Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase, Methods of enzyme immobilization and applications	K2	7

III	**Hybridoma technology** - Production, Purification and Applications, Formulation of biotech products - Rituximab, Introduction to Microbial biotransformation and applications, Study of the production of – penicillins, citric acid, Vitamin B12, Glutamic acid and Griseofulvin Somatic gene therapy, Xenotransplantation in pharmaceutical biotechnology, Large scale production fermenter design and its various controls, Bio safety in pharmaceutical industry	K3	7
IV	**Pharmacological** activity of Plant drugs, Plant Chemicals in modern pharmacology; biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, vinca alkaloids, synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and biotransformation. Criteria for pharmacological evaluation of drugs.	K4	7
V	**Clinical Pharmacology**, Drug therapy, therapeutic situation, benefits and risk of use of drugs, Mechanism of drug action, Therapeutic efficacy, Therapeutic index, tolerance, dosage forms and routes of drug action, factors affecting drug action; Adverse Drug reactions and drug poisoning-classification and causes of ADR; principle clinical manifestations and treatment of ADR, General principles of management of drug poisoning; antidotes, classifications of drugs.	K5	7
COURSE OUTCOME	**CO1:** Receipt pharmaceutical biotechnology and industrial applications	K1	
	CO2: Learn about Perceive scientific, technical and economic aspects of vaccine research and development	K4	
	CO3: Produce the antibodies through hybridoma technology	K3	
	CO4: Analyze pharmacological activity of Plant drugs	K4	
	CO5: Criticize the clinical Pharmacology benefits and risk of use of drugs.	K5	
Learning Resources			

Text Books	1. Harbanslal, 2011. Pharmaceuticals biochemistry. CBS Publishers and distributors Pvt. Ltd. 2. Carlos A. Guzman and Giora Z. Feuerstein, 2009. Pharmaceutical Biotechnology, 1st edition, Springer.
Reference Books	1. Daniel Figeys (Ed.). 2005. Industrial Proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley, John & Sons, Incorporated. 2. Kayser, O and Muller R.H. 2004. Pharmaceutical Biotechnology Drug Discovery and Clinical Applications. WILEY-VCH 3. Leon Shargel, Andrew B. C. Yu, Susanna Wu-Pong, and Yu Andrew B. C. 2004. Applied Biopharmaceutics & Pharmacokinetics. McGraw-Hill Companies.
Website	https://tugasakhirsttifbogor.files.wordpress.com/2018/08/pharmaceutical-biotechnology.pdf http://library.nuft.edu.ua/ebook/file/Gad2007.pdf https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

		T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTE05	PHARMACEUTICAL BIOTECHNOLOGY		DSE THEORY-III		2	3	3			3

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	M	S	M	S	M	S
CO2	S	L	S	M	S	S	M	S	M	S
CO3	S	M	S	S	M	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	M	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 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, Seminar, CIA-I, CIA-II and ESE

Designed By	Verified By	Approved By
Dr. Jim Thomas	Dr.P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
Rasipuram - 637408.

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTE06	**REGULATORY AFFAIRS AND INDUSTRIAL STANDARDS**	DSE THEORY-III	2	3	3			3
Objective	The subject imparts knowledge on the fundamentals of regulatory requirement in industries. The student will be provided with a basic knowledge and understanding about the regulatory affairs based on biotechnological industry requirements.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Planning, Organization and setting of Food testing laboratory and laboratory safety** Understand the requirements for setting up a laboratory for the legal defensibility of analytical data. The ideal structure design, environment, layout for microbiological testing and Air handling etc., Introduction about accreditation, Different accreditation bodies (NABL, APLAC, ILAC), Requirements for ISO/IEC 17025:2017, documentation, pre-requisites for accreditation, management requirements, technical requirements, measurement of traceability.	K1	8
II	**Principles of Food Preservation technology** Heat: Principles of Heat transfer, Blanching, Pasteurization, Heat sterilization, thermal extrusion, cooking. Water Removal: Forms of Water in Foods, Sorption of water in foods, Water activity, drying and evaporation technology. Temperature reduction: Chilling, Freezing, Radiation: Ionizing Radiation, Microwave,Use of chemicals: Class-I & Class-II preservatives, smoke other chemical additives.	K2	7

III	**Principles of Food Packaging technology** Effect of environment on food stability: light, oxygen, water, temperature, sensitivity to mechanical damage and attack by biological agents, Different packaging materials used for food packaging and their properties including barrier properties, strength properties, optical properties: Glass, metals, paper, plastics, biodegradable and edible films and coatings aseptic packaging and combinations, Selection of packaging material and design for various food commodities including fresh produce (Fruits and vegetables), milk and milk products (dairy), cereal, pulses, oil, meat, fish, poultry, water and processed foods, Evaluation of quality and safety of packaging materials.	K3	8
IV	**Food Microbiology and testing** Introduction of Food microbiology: Classification and nomenclature of microorganisms. Morphology and structure of microorganisms in foods (yeast and Molds, Bacterial cells viruses), Important genera of mold, yeast, bacteria (Gram positive and Gram negative, facultative aerobic and anaerobic, endospore forming bacteria and non-sporulating bacteria), Bacterial groups (lactic acid, acetic acid, butyric acid etc.,), thermophilic, proteolytic, saccharomyticetes, coliforms, faecal coliforms, enteric pathogens and emerging microbes, Sources of microorganisms in food chain (raw materials, water, air, equipment etc) and microbiological quality of foods.	K4	9
V	**HACCP and Food safety management systems:** ISO 22000: Importance of implementing a HACCP system and how it can be applied to various products. Prerequisite programs, HACCP principles, some limitation of HACCP food safety objective (FSO). Food safety audits: Management review, audit certification and importance. Good manufacturing practices (GMP), Good hygienic practices (GHP), Food safety plan, food safety	K5	7

	management risk analysis. Traceability food products recall and sanitation. **Current Trends-*Food safety in the seafood industry***		
	…… Self Study.		
Course Outcome	**CO1:** Receipt the basic requirements of establish laboratory for testing samples as per the regulatory body's requirements	K1	
	CO2: Organize various food preservation techniques	K2	
	CO3: Assess the basic concepts of packing of food materials, various parameters observed during packaging	K3	
	CO4: Analyze the methods of testing of food materials and identifying microbial food contaminant	K4	
	CO5: Evaluate basic of food safety management system, good manufacturing practice and good hygienic practices	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) Cresent publishing Corporation.			
Reference Books	1. Knorr Dietrich., Food biotechnology(1993).,CRC press 2. V. K. Joshi, Ashok Pandey ., Food fermentation ,Educational Publishers & Distributors, 1999			
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	3. https://www.food-safety.com/topics/351-seafood 4. https://www.fao.org/3/y5924e/y5924e06.htm			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTE06	**REGULATORY AFFAIRS AND INDUSTRIAL STANDARDS**	DSE THEORY-III	2	3	3			3

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	M	M	S	S	S	M
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	S	M	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.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
Rasipuram - 637408.

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTE07	**MOLECULAR DEVELOPMENTAL BIOLOGY**	**DSE THEORY - III**	**III**	**3**	**3**			**3**
Objective	The student will be provided with a basic knowledge and understanding about the molecular aspects of developmental biology.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction:**Definition and scope of developmental biology. Gametogenesis - Spermatogenesis and Oogenesis. Structure of Sperm and oocyte. Instructive and permissive interactions, competence, epithelial - mesenchymal interactions. Important signaling pathways in vertebrate development.	K1	8
II	**Fertilization** - Definition, mechanism of fertilization in mammal & sea urchin. Types of fertilization. Nieuwkoop center, Molecular role of organizer.	K2	6
III	**Cleavage :**Cleavage in Xenopus, Chick and mammals, Regulation of cleavage cycle. Morphogenetic movements, Gastrulation in Xenopus, Chick and mammals. Fate Maps.	K3	7
IV	**Vertebrate Development:** Formation of the neuraltube, myogenesis, and hematopoiesis. Mechanism of vertebrate eye development.	K3	7
V	**Drosophila Maternal effect genes-** induction at single cell level - differentiation of photoreceptors in ommatidia. Developmental disorders Spina bifida, Anenecephaly, and craniorachischisis, Cyclopia, Thanotrophic dysplasia. **Current Trends- *The spectrum of SOX2 mutations in ocular malformation and related anomalies***	K5	8
	…… Self Study.		

Course Outcome	**CO1:** Illustrate the structure and function of developmental biology, Gametogenesis	K1	
	CO2: Discuss basic fertilization process of animals	K2	
	CO3: Demonstrate the functions of embryonic development process	K3	
	CO4: Categorize the organ development of vertebrate animals	K3	
	CO5: Evaluate the impact of gene in developmental biology and developmental disorders	K5	

Learning Resources	
Text Books	1. Scott F.Gilbert, 2010. Developmental Biology, 9th edition, Sinauer Associates Inc. 2. Subramaniam, T. 2002. Developmental Biology. 1st edition. Narosa publications.
Reference Books	1. Molecular Biology, Verma P.S, Agarwal V.K. S Chand Publishing.2009. 2. Richard M.Twynman, 2001 Developmental Biology. (2 nd edition), Viva Publications, NewDelhi.
Website Link	1. https://www.biologydiscussion.com/molecular-biology/understanding-the-concept-of-molecular-biology-with-diagram/2619 2.https://www.pnas.org/doi/full/10.1073/pnas.94.17.9220
Self-Study Material	https://nlist.inflibnet.ac.in/search/Record/EBC2192076

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTE07	**MOLECULAR DEVELOPMENTAL BIOLOGY**	**DSE THEORY - III**	**III**	**3**	**3**			**3**

CO-PO Mapping

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

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Rasipuram - 637408.

M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTE08	**NANO BIOTECHNOLOGY**	**DSE THEORY - IV**	**III**	**3**	**3**			**3**
Objective	Students impart a basic knowledge on nanoparticles and understanding about the role of nanoparticles in biotechnology.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to Nanotechnology** - Scientific revolution, Feynman's vision, Classification of nanobiomaterials -Types of nanomaterials – nanoparticles, nanotubes, nanowires, Nanofibers, Size dependent variation in the properties of Nanomaterials.	K1	7
II	**Preparation of Nanomaterials-** Top down and bottom up approaches, Biosynthesis, Nanobiomaterials-Polymer, Ceramic, Metal based Nanobiomaterials, Carbon based Nanomaterials, DNA based Nanostructures, Protein based Nanostructures, Quantum dots, Magnetic Nanoparticles, Nanofibres, Hydrogels, Films and Scaffolds.	K2	7
III	**Application of Nanomaterials -** Bone substitutes and Dentistry, Food and Cosmetic applications, Bio-sensors and Lab-on-a-chip, Bio-devices and implantable devices, Bioremediation, Nanomaterials for anti-microbial coating – medical implants and paints, Application of Nanotechnology in textile industry.	K3	7
IV	**Nanomaterials for diagnosis and therapy -** Implications of drug delivery, Nano-carriers for application in medicine, polymeric nanoparticles as drug carriers, Drug release mechanism, Targeted Drug Delivery using nanocarriers, Nanoparticle technologies for cancer therapy and diagnosis, Point of Care and Personalized medicine, Magnetic nanoparticles for imaging and Hyperthermia.	K4	8

V	**Nanotoxicology -** Portals of Entry of the nanoparticles into the Human Body, Bio-toxicity of Nanoparticles. Nanoparticles in Mammalian systems and Health threats, Biological response and cellular interaction of implant materials and scaffolds, Risk assessment and Safety Regulation of nanoparticles. **Current Trends-*Medical applications of novel biomaterials and nano biotechnology***	K5	8
	…… Self Study.		
Course Outcome	**CO1:** Receipt the basics of Nanotechnology	K1	
	CO2: Organize the nanomaterials preparation method	K2	
	CO3: Assess the importance of nanomaterials and application of Nanotechnology	K3	
	CO4: Analyze the methods of Nanoparticle based Drug Delivery.	K4	
	CO5: Evaluate the application of Nanotechnology	K5	

Learning Resources	
Text Books	1. Madhuri sharon, Bionanotechnology, 2012. CRC press , India 2. Mark Ratner, 2002. Nanotechnolgy. Pearson, India 3. Shanmugam S. 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	1. https://www.frontiersin.org/articles/10.3389/fchem.2022.1063152 2. https://www.biologydiscussion.com/essay/essay-on-nano-biotechnology-with-diagrams/24845
Self-Study Material	https://nlist.inflibnet.ac.in/search/Record/EBC1872483

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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PBTE08	**NANO BIOTECHNOLOGY**	**DSE THEORY - IV**	**III**	**3**	**3**			**3**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	M	M	S	S	S	M
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	S	M	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 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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

List of Extradisciplinary Course (EDC) for M. 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	23M2PBTED1	TISSUE ENGINEERING
2	II	23M2PBTED2	BIOENTREPRENEURSHIP
3	III	23M3PBTED3	PRINCIPLES OF GENE MANIPULATION TECHNOLOGY
4	III	23M3PBTED4	CLINICAL BIOTECHNOLOGY

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTED1	**TISSUE ENGINEERING**	**EDC THEORY - I**	**II**	**3**	**3**			**2**
Objective	Students imparts knowledge on the fundamentals of tissue engineering and biomedical applications							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Basic biology of tissue engineering:** The basis of growth and differentiation-morphogenesis and tissue engineering	K1	6
II	**In vitro control of tissue development**: Growth factors-Tissue engineering bioreactors- In vitro synthesis of Tissue and organs- Organotypic and histotypic engineered tissues. 3D cell culture-Tissue assembly in microgravity	K2	6
III	**Biomaterials in tissue Engineering:** Scaffolds, extracellular matrix, polymers and nanocomposites. Approaches to transplanting engineered cells	K3	6
IV	**Bioartificial Organs:** Bioartificial Pancreas, HepatAssist liver support system, Artificial Womb, Heamatopoietic system: Red blood cell substitutes, Renal replacement devices	K4	6
V	**Structural tissue engineering:** Bone regeneration through cellular engineering, Skin tissue engineering, Brain implants-Neural stem cells, Periodontal applications **Current Trends-* Animal Forensics and Applications***	K5	6
	…… Self Study.		
Course Outcome	**CO1:** Receipt the basics of Basics of Tissue Engineering	K1	
	CO2: Apply the knowledge to create tissue culture methods	K2	
	CO3: Acquire adequate knowledge in the use of tissue in medical application	K3	
	CO4: Evaluate the benefits of Tissue Engineering and Pharmaceutical Products	K4	

	CO5: Analyze the importance of applications of tissue engineering	K5	

Learning Resources				
Text Books	1. Sylvia, S. Mader, 2011, Human Biology, Twelfth edition, Mc Graw Hill, USA. 2. Robert P. Lanaza, Robert Langer and Joseph Vacanti, 2007. Principles of Tissue Engineering. Third edition Academic Press.			
Reference Books	1. Micklem. H.S., Loutit John. F., 2004. Tissue grafting and radiation, Academic Press, New York. 2. Penso. G., Balducci.D., 2004.Tissue cultures in biological research,Elsevier, Amsterdam 3. Cecie Starr, 1996. Biology, Third edition, Wordsworth, America.			
Website Link	1. https://youtu.be/unqiPHe_KqA?t=2 2. https://www.nature.com/articles/nbt.2958 3. https://www.nature.com/articles/nbt.2958			
Self-Study Material	1. https://youtu.be/5IlH21N8zi4?t=3			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PBTED1	**TISSUE ENGINEERING**	**EDC THEORY - I**	**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	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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
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M.Sc – Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTED2	**BIOENTREPRENEURSHIP**	**EDC THEORY-II**	**II**	**3**	**3**			**2**
Objective	Students imparts a thorough knowledge of the sources of innovation opportunities and development of the skills to identify and analyze these opportunities for bioentrepreneurship and innovation.							

Unit	Course Content	Knowledge Levels	Sessions
I	**Introduction to bioentrepreneurship**: Biotechnology on a global scale, Scope in Bioentrepreneurship, Importance of entrepreneurship. Meaning of entrepreneur, function of an entrepreneur, types of entrepreneur, and advantages of being entrepreneur. Innovation – types, out of box thinking, opportunities for Bioentrepreneurship. Entreprenuership development programs of public and private agencies (MSME, DBT, BIRAC, Startup and Make in India)	K1	6
II	**Business plan preparation:** business feasibility analysis by SWOT, socio-economic costs benefit analysis, Sources of financial assistance – making a business proposal, approaching loans from banks and other financial institutions, budget planning and cash flow management. Collaborations and partnerships, information technology for business administration and expansion	K2	6
III	**Knowledge centers**: Universities, innovation centers, research institutions and business incubators. R&D - technology development and up gradation, assessment of technology development, managing technology transfer, industry visits to successful bio-enterprises, regulations for transfer of foreign technologies, quality control, technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO,NBA, GLP, GCP & GMP)	K3	6
IV	Definition, characteristics, need and rationale, objectives, scope and advantages of small scale industries. Types of bioindustries – Pharma, Agri and Industry. Biofertilizers production - Azospirillium, Azolla, Cyanobacteria and its applications. Biopecticides production - Bacterial, fungal, viral and plant insecticides. Sericulture. Apiculture. Dairy farming. Single Cell Protein Production and applications. Vermicomposting and its applications. Mushroom cultivation and its application. Ancillary and tiny industries	K4	6

V	Assessment of market demand for potential product(s) of interest, Market conditions, segments, prediction of market changes, identifying needs of customers. Branding issues, developing distribution channels – franchising policies, promotion, advertising, and branding and market linkages. Marketing of agro products. Recruitment and selection process, leadership skills, managerial skills, organization structure, training, team building and teamwork. **Current Trends-*Entrepreneur DNA Profile: The Hustler***	K5	6
	* **.....*** Self Study.		
Course Outcome	**CO1: Receipt** the w the legal and financial conditions for starting a business venture	K1	
	CO2: Acquirethe importance of marketing and management in small businesses	K2	
	CO3: Identify the elements of success of bioentrepreneurial scheme and projects	K3	
	CO4: Demonstrate the indicators of various entrepreneurial activities	K4	
	CO5: Analyzes the business environment in order to identify business Opportunities	K5	

Learning Resources				
Text Books	1. S S Khanka , Entrepreneurship Development, S Chand & Co Publishing, 2006. 2. Robert Lusier, Management Fundamentals– Concepts, Application and Skill Development, SAGE Publications**,** Inc			
Reference Books	1. Vasant Desai, Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House 2. PC Tripati, Principles of Management‖, PN Reddy, Tata Mc Graw Hill			
Website Link	1. https://www.biotech.co.in/sites/default/files/2020-01/Bioentrepreneurship-Development.pdf 2. https://ncert.nic.in/textbook/pdf/lebt113.pdf			
Self-Study Material	1. https://fi.co/contents/thehustler			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**		**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTED2	**BIOENTREPRENEURSHIP**		**EDC THEORY-II**		**II**	**3**	**3**			**2**

CO-PO Mapping

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

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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr. P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**0Course Title**	**Course Type**	**Sem**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTED3	**PRINCIPLES OF GENE MANIPULATION TECHNOLOGY**	**EDC THEORY- III**	**III**	**3**	**3**			**2**
Objective	Students will be able to understand the development of genetically modified organisms and gene transfer							

Unit	**Course Content**	**Knowledge Levels**	**Sessions**
I	**Basics of Gene Manipulation Technology-** Restriction Enzymes-Cutting and Joining Reactions, Vectors, Selection of Recombinants- Agarose Gel Electrophoresis, Southern Blotting-Hybridization-Autoradiography, PCR- Native Page, SDS-Page, 2D Gel Electrophoresis, Western Blotting.	K1	8
II	**Constructions of DNA Libraries-** Vectors Used In the Construction of cDNA and Genomic DNA Libraries, Chromosome Walking, Positive Selection and Subtractive Hybridization. Preparation of BAC and YAC Library.	K2	6
III	**Genome Sequencing and Transcriptomics-** Sanger's Sequencing, Whole Genome Shotgun Sequencing, Comparative Genome Sequencing. Transcriptome Analysis- DNA Microarray. Expression of Recombinant Proteins.	K3	7
IV	**Protein Engineering & Pharmaceutical Products-** Site Directed Mutagenesis, Protein Analysis, Therapeutic Protein and Vaccines.	K4	7
V	**Applications of Gene Cloning-** Creating Transgenic Animals and Plants, Reporter Genes , Animal Cloning, Gene expression in plants, Biosafety and Bioethics. **Current Trends**: ***Gene expression and manipulation in aquatic organisms***	K5	8
	…… Self Study.		
Course Outcome	**CO1:** Relate the Basics of Gene Manipulation Technology	K1	
	CO2: Apply the knowledge to create Constructions of DNA Libraries	K2	
	CO3: Acquire adequate knowledge in the use of Genome Sequencing and Transcriptomics	K3	
	CO4: Interpret benefits of Protein Engineering & Pharmaceutical Products	K4	
	CO5: Predict the impact of Gene Cloning & Applications of Gene Cloning	K5	
Learning Resources			

Text Books	1. Brown T.A. 1995. Gene Cloning and Introduction. 2. Old R. W. and S.B. Primrose, 1997. Principles Of Gene Manipulation, Fifth Edition, Blackwell Science			
Reference Books	1. Molecular Biology, Verma P.S, Agarwal V.K. 2009. S Chand Publishing. 2. Desmond S. T. Nicholl, 2008. An Introduction to Genetic Engineering 3rd Edition. Cambridge University Press.			
Website Link	1. https://www.ksdb.org/archive/view_article?pid=dr-27-1-9 2. https://sapac.illumina.com/techniques/multiomics/transcriptomics.html			
Self-Study Material	1.https://nlist.inflibnet.ac.in/search/Record/CR9780511758713 2. https://openknowledge.fao.org/server/api/core/bitstreams/23be296b-607b-4017-98d8-7664c511a627/content			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PBTED3	**PRINCIPLES OF GENE MANIPULATION TECHNOLOGY**	**EDC THEORY- III**	**III**	**3**	**3**			**2**	

CO-PO Mapping

CO Number	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M	S	S	M	S	M
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	S	M	S	S	S
CO4	S	S	S	S	M	S	S	M	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 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, Seminar, CIA-I, CIA-II and ESE

Designed By	**Verified By**	**Approved By**
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE (Autonomous)
Rasipuram - 637408.

B.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTED4	**CLINICAL BIOTECHNOLOGY**	**EDC- IV**	**III**	**5**	**3**	**2**		**2**
Objective	To envisage thorough knowledge in genetic diseases							

Unit	Course Content	Knowledge Levels	Sessions
I	**Classification of genetic diseases**. Chromosomal disorders-numerical disorders e.g. trisomers and monosomes, structural disorders e.g. deletions, duplications, translocations and inversions, chromosomal instability syndromes.	K1	12
II	**Gene controlled diseases**-autosomal and X-linked disorder, mitochondrial disorders, Fragile X syndrome, myotonic dystrophy. Mitochondrial diseases. Microarray technology application in diseases.	K2	12
III	**Huntington's disease**- sickle cell diseases, AAT (alpha-1 antitrypsin deficiency), Alzhemiers disease, cystic fibrosis**,** infection of nervous system.	K3	12
IV	**Clinical management & metabolic manipulation** – PKU, Familial hyper cholesterolemia, Rickets, ADA, Congenital hypothyroidism.	K4	12
V	**Clinical Enzymes:** Enzymes as thrombolytic agents, anti inflammatory agents, Streptokinase & Asparaginase. Catalytic antibodies.**Current Trends-Immunotheraphies**	K5	12
	* **Immunotheraphies** * Self Study.		
Course Outcome	**CO1:** Recite the the inheritance pattern of the genes and genetic diseases	K1	

	CO2: Interpret the on numerical and structural changes of chromosomal	K2	
	CO3: Compile the modern molecular techniques for genetic disease diagnosis	K3	
	CO4: Comprehend the inheritance pattern of genes which cause genetic diseases in humans	K4	
	CO5: Evaluate on clinical management and clinical enzymes	K5	

Learning Resources				
Text Books	1. Betty Forbes, Danial SAHM Alics Weinfield, Bailey 2007. Scott's diagnostic microbiology, 12th edition Mosby.			
Reference Books	1. Gerald collee, J, Andrew G. Fraser, Barri P Marmion, Mackie and Mc Cartney's Pratical medical microbiology, Elesiver 2006. 2. Elmer W Koneman. 2005. Color Atlas and Textbook of diagnostic microbiology, 6th edition. Lippincott Williams and Wilkins			
Website Link	1. http://biotka.mol.uj.edu.pl/zbm/handouts/2015/JD/01_Medical_biotechnology_2015.pdf 2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB3101.pdf			
Self-Study Material	https://www.cancer.net/navigating-cancer-care/how-cancer-treated/immunotherapy-and-vaccines/what-immunotherapy			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PBTED4	**CLINICAL BIOTECHNOLOGY**		**EDC-4**	**III**	**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	S	S	M	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	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 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, Seminar, CIA-I, CIA-II and ESE									
Designed By	**Verified By**								**Approved By**	
Dr. K. Revathi	Dr. P. Selvamaleeswaran								(Dr. S. SHAHITHA) Member Secretary	

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Rasipuram - 637408.

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M1PBTSP1	**Communicative Skills**	**SOFT SKILL PRACTICAL - I**	**I**	**2**			**2**	**2**
Objective	The students can learn a comprehensive knowledge on Communicative skills							

Unit	Course Content	Knowledge Levels	Sessions
I	GRAMMAR 1. Singular and plural nouns 2. Verbs – regular and irregular verbs 3. Auxiliary verbs – ―be‖, ―do‖ and ―have‖ 4. Modals 5. Articles 6. Prepositions 7. 12 – tenses	K2	5
II	ORAL COMMUNICATION 1. Greeting and introduction 2. Inviting a person 3. Persuading 4. Asking questions 5. Speaking abut oneself 6. Inviting a personality 7. Honoring persons 8. Role – play 9. Offering a suggestion and giving an advice 10. Brain storming	K3	5
III	ESSAYS WRITING 1. How to write an essay? 2. Various topics 3. Practice with shamble essays	K4	5

IV	COMPREHENSION 1. Long passage 2. Short passage 3. Speed reading 4. Pick out the correct answers 5. Identify the correct meanings	K4	5
V	VERBAL ABILITY 1. Identify the same meaning 2. Identify the opposite meaning 3. Common English errors 4. Homonyms 5. Odd words	K5	4
Course Outcome	**CO1:** Demonstrate the usage of grammar	K1	
	CO2: Interpret about about the oral communication through various applications	K2	
	CO3: Develop their knowledge on essay writing	K3	
	CO4: Elucidate their skills in the area of comprehension	K4	
	CO5: Evaluate the verbs and their functions	K5	

Learning Resources				
Text Books	1. Nira Konar. 2002. Communication Skills for Professionals. PHI Learning			
Reference Books	1. Sanjay Kumar . 2015. Communication Skills. Oxford University Press			
Website Link	https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf ISBN 978-92- 4-156553-0. https://doi.org/10.3389/fmicb.2020.631736			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M1PBTSP1	**Communicative Skills**		**SOFT SKILL PRACTICAL - I**	**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	M	M	M	S
CO2	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	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, and Video presentation
Assessment Methods	CIA-I, CIA-II

Designed By	Verified By	Approved By
Dr. P. Selvamaleeswaran	Dr. P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M2PBTSP2	**Interview Skills**	**SOFT SKILL PRACTICAL - II**	**II**	**2**			**2**	**2**
Objective	Students can learn about the knowledge on attending interviews							

Unit	Course Content	Knowledge Levels	Sessions
I	**JAM** 1. What is JAM? 2. 10 tips to crack JAM 3. How to speak in JAM session interview 4. JAM topics	K1	5
II	**Group Discussion** 1. What is GD? 2. GD preparation 3. DO's&DON'Ts of GD 4. How to face GD?	K2	5
III	**Resume Building** 1. Basics of writing a resume 2. Resume preparation guidelines 3. Resume tips 4. Basics resume preparation tips	K3	5
IV	**Interview** 1. HR interview tips 2. 4 simple steps for an interview 3. Tell me about yourself 4. Common interview questions	K4	5
V	**Basic Computer Skills** 1. MS Office applications 2. Functions of MS Office 3. Email writing 4. Email writing format	K5	4
Course Outcome	**CO1:** Demonstrate the usage of JAM	K1	
	CO2: Interpret about the oral communication through various applications	K2	
	CO3: Develop their knowledge on Resume writing	K3	
	CO4: Elucidate their skills in the area of interview skills	K4	
	CO5: Evaluate the computer skills	K5	

Learning Resources				
Text Books	1. Adair, John. 2003. Effective Communication. London: Pan Macmillan Ltd. 2. Collins, Patrick. 2009. Speak with Power and Confidence. New York: Sterling.			
Reference Books	1. Kratz, Abby Robinson. 1995. Effective Listening Skills. Toronto: ON: Irwin Professional Publishing. 2. Kroehnert, Gary. Basic Presentation Skills. Sidney: McGraw Hill, 2010.			
Website Link	1. https://brotechnologyx.com/jam-topics/ 2. https://learn.microsoft.com/en-us/office365/servicedescriptions/office-applications-service description/office-applications			
	L-Lecture	T-Tutorial	P-Practical	C-Credit

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards										
Course Code	**Course Title**		**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M2PBTSP2	**Interview Skills**		**SOFT SKILL PRACTICAL - II**	**II**	**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	M	M	M	S
CO2	S	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	M	S
CO5	S	M	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, and Video presentation
Assessment Methods	CIA-I, CIA-II

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Dr. P. Selvamaleeswaran	Dr. P. Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

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M.Sc - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M3PBTIS1	**INTERNSHIP**	**INTERNSHIP**	**III**					**2**
Objective	Students gain hands on training and expertise in handling sophisticated instruments and acquire in depth knowledge in their applications.							

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 2rd Semester. Viva takes place at the end of the third semester.	K2	
2	Students have the freedom to 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.	K2	
3	A staff member of a department (Advisor) will be assessing the performance of the candidate	K2	
4	Students should submit their request letter/profile/ areas to the particular industry/Company for their willingness for providing the internship program.	K2	
5	After getting the acceptance/permission from the institutions, the student must submit the Joining Report/ Letters / Email to the department in person.	K2	

6	Student will maintain the work diary and undertake internship suitably in the selected Institute/company/Lab.	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. After the successful completion of their training, Students should collect the Internship training certificate, Attendance and work diary duly signed by the internship programme in-charge of the institute.	K3	
8	Student should prepare a comprehensive report in order to point out what he has observed gained and learnt in the training period. The format is like 1. Front Page 2. Certificate Page 3. Certificate from the Institution 4. Acknowledgement 5. Abstract 6. Organization Information 7. Programs and Opportunities 8. Benefit of the Company/institution through our report 9. Learning Objectives/ Internship Objectives 10. Work Diary 11. Introduction 12. Objectives 13. Methodology	K4	
9	Internship report should be soft cover book bound, the cover of the report should be of white colour printed with black ink and the text for printing should be identical as prescribed for the title page. The Internship Training Certificate is also included in the report.	K5	
10	The evaluation of these activities will be done by Internship advisor of the department/ Head of the Department/Industrial experts/Subject experts	K6	

Course Outcome	**CO1:** Remember the primary objective of internship training program			K2	
	CO2: Receipt the working environment in an organized manner			K3	
	CO3: Interpret the main functions of Internships providing institutes			K4	
	CO4: Analyze and appreciate the roles and responsibilities of various industries			K5	
	CO5: Assess the professional acumen of the industrialists.			K6	
	L-Lecture	T-Tutorial	P-Practical	C-Credit	

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M3PBTIS1	**INTERNSHIP**	**INTERNSHIP**	**III**	**-**	**-**	**-**	**-**	**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	Field Visit
Teaching and Learning Methods	
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

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(Autonomous)
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M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTPR1	**PROJECT WORK**	**PROJECT WORK**	**IV**	**18**				**6**
Objective	Students inculcate/impart skills on project design, experimental execution and research reporting							

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.	K3	

	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**		
	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.	K3	
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: Receipt 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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PBTPR1	**PROJECT WORK**	**PROJECT WORK**	**IV**	**18**				**6**	

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	1.Review Meeting I- 15 Marks 2. Review Meeting II- 15 Marks 3. Attendance- 10 Marks 4. Student Work Diary - 10 Marks
Assessment Methods	1. Internal Assessment – 50 Marks 2. Project Presentation - 130 Marks 3. Viva-Voce - 20 Marks

Designed By	**Verified By**	**Approved By**
Dr.D.Kavitha	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary

MUTHAYAMMAL COLLEGE OF ARTS AND SCIENCE
(Autonomous)
Rasipuram - 637408.

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards								
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**
23M4PBTOE1	**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	K2 K3 K4	

	. Example 1: <u>Ability to Justify Methods and Procedures</u> **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: <u>Ability to Interpret Cause-and-Effect Relationships</u> **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.	K5	
Course Outcome	**CO1:** Learn the subject at MCQ Level	K2	
	CO2: Receipt 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

M.Sc. - Biotechnology Syllabus LOCF - CBCS with effect from 2023-2024 Onwards									
Course Code	**Course Title**	**Course Type**	**Sem.**	**Hours**	**L**	**T**	**P**	**C**	
23M4PBTOE1	**Biotechnology for Competitive Examinations**	**Self study Online - Competitive Examination**	**IV**	**-**	**-**		**0**	**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	
Assessment Methods	CIA-I and CIA-II

Designed By	Verified By	Approved By
Dr.P.Selvamaleeswaran	Dr.P.Selvamaleeswaran	(Dr. S. SHAHITHA) Member Secretary