

SadakathullahAppa College

(Autonomous)

(Reaccredited by NAAC at an 'A' Grade. An ISO 90012015 Certified Institution)

Rahmath Nagar, Tirunelveli- 11.

Tamil Nadu.

DEPARTMENT OF MICROBIOLOGY



CBCS SYLLABUS

For

B.Sc. Microbiology

(Applicable for students admitted in June 2021 and onwards)

(As per the Resolutions of the Academic Council Meetings

held on 15.03.2021)

SADAKATHULLAH APPA COLLEGE (AUTONOMOUS)
(REACCREDITED BY NAAC WITH 'A' GRADE AND ISO 9001:2008
CERTIFIED INSTITUTION)
RAHMATH NAGAR, TIRUNELVELI – 627 011.
DEPARTMENT OF MICROBIOLOGY
SYLLABUS (CBCS)
B.Sc. (MICROBIOLOGY) (2021-2024)
For those who join the course from June 2021 onwards.

1. Objectives of the Course

The objective of the course is to create awareness in the field of microbiology and cultivate scientific approach and research aptitude among the students in various subjects of microbiology and emerging extensions of research activities. The course involves the study of microorganisms with particular emphasis on the biology of bacteria, viruses, fungi and protozoan parasites. Group projects are included in the course so that the candidates know about the flavor of research methodology in science.

2. Eligibility for Admission

B.Sc. Microbiology is a 3-year full-time undergraduate course in Microbiology. Eligibility for the course is 10+2 or an equivalent examination in a science stream from a recognized board with a minimum aggregate of 55% of marks.

Knowledge

The candidate

- has substantial knowledge in biology.
- has advanced knowledge in relevant fields of microbiology
- familiar with contemporary research within various fields of microbiology.

Skills

The candidate

- has the background and experience required to model and analyze experimental methods in microbiology
- is able to apply advanced theoretical and/or experimental methods
- can combine and use knowledge from several disciplines.
- can critically and independently assess and evaluate research methods and results.
- has the ability to develop and renew scientific competence.

General competence

The candidate

- understands the role of microorganisms in environment and has the background to consider environmental problems.
- knows the historical development of microbiology, its possibilities and limitations, and understands the value of lifelong learning.
- is able to gather, assess, and make use of new information.
- has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines.

CONTENTS

Sl. No.	Course Title	Subject Code	Page No.
1	B.Sc. Microbiology Course Structure	–	
2	□□□□□□□□□□□□□□	21ULTA11	
3	Applied Grammar and Translation – I	21ULAR11	
4	Communicative English-I	21ULEN11	
5	Microbial World and Bacteriology	21UCMB11	
6	Virology, Mycology, Phycology, Parasitology	21UCMB12	
7	Aquatic Microbiology	21UAMB11	
8	Techniques in Microbiology	21UCMB1P1	
9	Techniques in Aquatic Microbiology	21UAMB1P1	
10	Value Education - I OR	21USVE2A	
11	Value Education – II	21USVE2B	
12	□□□□□□□□□□	21ULTA21	
13	Applied Grammar and Translation – II	21ULAR21	
14	Communicative English– II	21ULEN21	
15	Microbial Physiology and Metabolism	21UCMB21	
16	Biochemistry	21UCMB22	
17	Entrepreneur in Microbiology	21UAMB21	
18	Techniques in Microbial Physiology and Biochemistry	21UCMB2P1	
19	Techniques in Entrepreneur Microbiology	21UAMB2P1	
20	Environmental Studies	21UENS11	
21	□□□□□□□□□□□□□□	21ULTA31	
22	Applied Grammar and Translation – III	21ULAR31	
23	One-Act Plays and Writing Skill	21ULEN31	
24	Environmental Microbiology	21UCMB31	
25	Introduction to computers		
26	MOOC (NPTL)		
27	Bioinstrumentation	21UAMB31	
28	Techniques in Environmental Microbiology	21UCMB3P1	
29	Techniques in Bioinstrumentation	21UAMB3P1	

Sl. No.	Course Title	Subject Code	Page No.
30	Vermiculture and Mushroom technology	21UNMB31	
31	□□□□□□□□□□	21ULTA41	
32	<i>Classical Prose</i>	21ULAR41	
33	A Practical Course in Spoken English	21ULEN41	
34	Microbial Biotechnology	21UCMB41	
35	Soft Skills		
36	Food Processing And Quality Control		
37	Pharmaceutical Microbiology and Quality Assurance	21UAMB41	
38	Techniques in Biotechnology	21UCMB4P1	
39	Techniques in Pharmaceutical Microbiology	21UAMB4P1	
40	Aquaculture and Apiculture	21UNMB41	
41	Immunology	21UCMB51	
42	Microbial Genetics	21UCMB52	
43	Food and Dairy Microbiology	21UCMB53	
44	Microbial Nanotechnology/ Veterinary Microbiology /Biostatistics	21UEMB1A; 21UEMB1B ; 21UEMB1C	
45	Plant pathology and Disease Management /Genetic Engineering/Cell Biology	21UEMB2A ; 21UEMB2B; 21UEMB2C	
46	Techniques in Immunology and Microbial Genetics	21UCMB5P1	
47	Techniques in Food and Dairy Microbiology	21UCMB5P2	
48	Medical Microbiology	21UCMB61	
49	Industrial Microbiology	21UCMB62	
50	Agricultural Microbiology	21UCMB63	
51	Bioinformatics/ Herbal Technology /Public Health Microbiology	21UEMB3A; 21UEMB3B ; 21UEMB3C	
52	Project	21UEMB62	
53	Techniques in Medical Microbiology	21UCMB6P1	
54	Techniques in Industrial and Agriculture Microbiology	21UCMB6P2	
55	Basic Dietetics	21USMB	
56	Scheme of Examinations	-	

B.Sc. MICROBIOLOGY (2021 – 2024)
(Applicable for students admitted in June 2021 and onwards)
DISTRIBUTION OF CREDITS, NO. OF PAPERS and MARKS

Part	Course	Semester	Hours	Credits	Papers	Marks
I	Tamil / Arabic	I to IV	24	16	4	400
II	English	I to IV	24	12	5	400
III	Discipline Specific Core (DSC) + Project+ Practicals	I to VI	78	62	20	1800
	Discipline Specific Elective (DSE)	III to VI	16	16	4	400
	Allied Theory + Practical's	I to IV	24	16	8	600
IV	Non-major Elective (NME)	III and IV	4	4	2	200
	Skill Enhancement Course (SEC)	V and VI	4	4	2	200
	Skill Based Common (SBC)	VI	2	2	1	100
	Ability Enhancement Compulsory Course (AECC) Environmental Studies (EVS)	I	2	2	1	100
	Value Education (VE)	II	2	2	1	100
V	Extension Activities	I to IV+	--	1+1*	1	100
	MOOC [§]	I – V	-	2#		
TOTAL			180	141+1*+2#	49	4400

SEMESTER WISE DISTRIBUTION OF HOURS

Part	I	II	III				IV				Total
SEM	T/A	ENG	DSC	PRO/ FW	DSE	AL	NME	SEC	SBC	EVS/VE	
I	6	6	10	-	-	6	-	-	-	2	30
II	6	6	10	-	-	6	-	-	-	2	30
III	6	6	6	-	4	6	2	-	-	-	30
IV	6	6	6	-	4	6	2	-	-	-	30
V	-	-	24	-	4	-	-	2	-	-	30
VI	-	-	16	6	4	-	-	2	2	-	30
Total	24	24	72	6	16	24	4	4	2	4	180

+ Activities and evaluation are to be performed during Semesters I to IV and results to be declared at the end of the Semester IV along with those for other courses in the Mark Statement.

* Extra credit for Sadakath Outreach Programme (SOP)

§ As per the guidelines of the UGC all the UG and the PG students shall enrol for one Massive Open Online Course offered through SWAYAM, NPTEL, etc.

#Two extra credits will be given on completion of the course.

B.Sc. Microbiology (2021-2024) Course Structure
(With Aquatic Microbiology, Entrepreneur in Microbiology, Bioinstrumentation, and
Pharmaceutical Microbiology and Quality Assurance Allied)
(Applicable for students admitted in June 2021 and onwards)
TITLE OF THE PAPERS, CREDITS and MARKS

COURSE Pattern
CBCS Syllabus – B.Sc., Microbiology
(2021-22 onwards)

SEM	Part	P	Title of the paper	S. Code	H/W	L*	T*	P*	C	Marks		
										I	E	T
I	I	I L-I	,f;fhyj;jkpo;		6				3			
			Grammar and Translation - I									
	II	II L-I	Communicative English -I		4				4			
	III	DSC-I	Microbial world and Bacteriology		4	3	1		4			
	III	DSC-II	Virology , Mycology, Phycology and Parasitology		4	3	1		1			
	III	P-I	Techniques in Microbiology		2			2	3			
	III	A-I/1	Aquatic Microbiology		4	3		1	1			
	III	A-I/1P	Techniques in Aquatic Microbiology		2			2	2			
IV	AECC-I	Value Education-I										
		Value Education-II										
II	I	I L-II	rkaj;jkpo;		6				3			
			Grammar and Translation - I									
	II	II L-II	Communicative English II		6				3			
	III	DSC-III	Microbial Physiology and Metabolism		4	3	1		4			
	III	DSC-IV	Biochemistry		4	3	1		4			
	III	P-II	Techniques in Microbial Physiology and Metabolism		2			2	1			
	III	A-I/2	Entrepreneur in Microbiology		4	3	1		3			
	III	A-I/2P	Techniques in Entrepreneur in Microbiology		2			2	1			
IV	AECC-II	Enviromental Studies		2				2				
III	I	I L-III	gad;ghl;Lj;jkpo;		6				3			
	II	II L-III	Communicative English III		6				3			
III	DSC-V	Environmental		4	3	1		4				

			Microbiology											
	III	P-III	Techniques in Environmental Microbiology		2			2	1					
	III	A-II/1	Bioinstrumentation		4	3	1		3					
	III	A-II/1P	Techniques in Bioinstrumentation		2			2	1					
	IV	SEC-I	Introduction to computers		2	2			2					
	IV	SEC-II	(MOOC NPTEL Course)		2	2			2					
	IV	NME-I	Vermiculture and Mushroom technology		2	2			2					
IV	I	I L-IV	rq;fj;jkpo;		6				3					
	II	II L-IV	Communicative English IV		6				3					
	III	DSC-VI	Microbial Biotechnology		4	3	1		4					
	III	P-IV	Techniques in Biotechnology		2			2	1					
	III	A-II/1	Pharmaceutical Microbiology		4	3	1		3					
	III	A-II/2P	Techniques in Pharmaceutical Microbiology		2			2	1					
	IV	SEC-III	Soft skills-I		2	2			2					
	IV	SEC-IV	Food Processing and quality control		2	2			2					
	IV	NME-II	Aquaculture and Apiculture		2	2			2					
	V	ECA							1					
	V	SOP							1					
	IV	Filed work/ Internship							2					
V	III	Core VII	Immunology		5	4	1		4					
	III	Core VIII	Microbial Genetics		4	3	1		4					
	III	Core IX	Food and Dairy Microbiology		4	3	1		4					
	III	P-V	Techniques in Immunology and Microbial Genetics		4			4	2					
	III	P-VI	Techniques in Food and Dairy Microbiology		4			4	2					
	III	DSE I-A/B/C	Microbial Nanotechnology Primary		4	3	1		4					

			Microbiology Biostatistics										
	III	DSE II- A/B/C	Plant Pathology and Disease Management			1							
			Genetic Engineering/ Cell Biology		4	3			4				
	IV		Library Reading Hour	Library Reading Hour		1				-			
VI	III	Core X	Medical Microbiology		4	3	1		4				
	III	Core XI	Industrial Microbiology		4	3	1		4				
	III	Core XII	Agricultural Microbiology		4	3	1		4				
	III	P-VII	Techniques Medical Microbiology		4			4	2				
	III	P-VIII	Techniques in Industrial and Agriculture Microbiology		4			4	2				
	III	DSE III	Bioinformatics				1						
			Herbal technology		4	3			4				
			Public Health Microbiology										
III	DSE IV Project	Project		4			4	4					
IV	SEC-V	Basic Dietetics		2	2			2					

* L – Lecture hours

* T – Tutorial hours

* P – Practical hours

I SEMESTER								
P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
I	TA 1	□□□□□□□□□□□□	21ULTA11	6	4	25	75	100
	AR 1	Applied Grammar and Translation – I	21ULAR11					
II	EN 1	Communicative English -I	21ULEN11	6	3	25	75	100
III	DSC 1	Microbial World and Bacteriology	21UCMB11	4	4	25	75	100
	DSC 2	Virology, Mycology, Phycology and Parasitology	21UCMB12	4	4	25	75	100
	AI-1	Aquatic Microbiology	21UAMB11	4	3	25	75	100
	DSCP-1	Core Microbiology Practical-I	21UCMB1P1	2	1	40	60	100/2
	AI-P-1	Techniques in Aquatic Microbiology	21UAMB1P1	2	1	40	60	100/2
IV	EVS	Environmental Studies	21UENS11	2	2	25	75	100
TOTAL				30	23			700

II SEMESTER								
P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
I	TA 2	□□□□□□□□□□	21ULTA21	6	4	25	75	100
	AR 2	Applied Grammar and Translation – II	21ULAR21					
II	EN 2	Communicative English – II	21ULEN21	6	3	25	75	100
III	DSC 3	Microbial Physiology and Metabolism	21UCMB21	4	4	25	75	100
	DSC 4	Biochemistry	21UCMB22	4	4	25	75	100
	AI-2	Entrepreneur in Microbiology	21UAMB21	4	3	25	75	100
	DSCP-2	Core Microbiology Practicals-II	21UCMB2P1	2	1	40	60	100/2
	AI P-2	Techniques in Entrepreneur Microbiology	21UAMB2P1	2	1	40	60	100/2
IV	VE	Value Education-I	21USVE2A	2	2	25	75	100
		Value Education-II	21USVE2B					
TOTAL				30	23			700

III SEMESTER								
P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
I	TA 3	□□□□□□□□□□□□□□	21ULTA31	6	4	25	75	100
	AR 3	Applied Grammar and Translation – III	21ULAR31					
II	EN 3	One-Act Plays and Writing Skill	21ULEN31	6	4	25	75	100
III	DSC 5	Environmental Microbiology	21UCMB31	4	4	25	75	100
	SEC1	Introduction to computers	xxxxxx	2	2	25	75	100
	SEC2	MOOC (NPTEL course)	xxxxxx	2	2	25	75	100
	A-II-1	Bioinstrumentation	21UAMB31	4	3	25	75	100
	DSCP-3	Core Microbiology Practical-III	21UCMB3P1	2	1	40	60	100/2
	AII-P1	Techniques in Bioinstrumentation	21UAMB3P1	2	1	40	60	100/2
IV	NME-I	Vermiculture and Mushroom technology	21UNMB31	2	2	25	75	100
TOTAL				30	23			700

IV SEMESTER

P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
I	TA 4	□□□□□□□□□□	21ULTA41	6	4	25	75	100
	AR 4	Classical Prose	21ULAR41					
II	EN 4	A Practical Course in Spoken English	21ULEN41	6	4	25	75	100
III	DSC 6	Microbial Biotechnology	21UCMB41	4	4	25	75	100
	SEC3	Soft skills	XXXXXX	2	2	25	75	100
	SEC4	Food processing and quality control	21UEMB41	2	2	25	75	100
	AII-2	Pharmaceutical Microbiology and Quality Assurance	21UAMB41	4	3	25	75	100
	DSCP-4	Core Microbiology Practical-IV	21UCMB4P1	2	1	40	60	100/2
	AII-P2	Techniques in Pharmaceutical Microbiology	21UAMB4P1	2	1	40	60	100/2
IV	NME-2	Aquaculture and Apiculture	21UNMB41	2	2	25	75	100
V	EX	Extension Activities (Choose from the list)	---	--	1	--	100	100
		SOP	21UEXSOP		1*			
TOTAL				30	24+ 1*			800

V SEMESTER

P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
III	DSC 7	Immunology	21UCMB51	6	4	25	75	100
	DSC 8	Microbial genetics	21UCMB52	5	4	25	75	100
	DSC 9	Food and Dairy Microbiology	21UCMB53	5	4	25	75	100
	DSE1	Microbial nanotechnology	21UEMB51	4	4	25	75	100
	DSE2	Genetic engineering	21UEMB52	4	4	25	75	100
	DSCP-5	Core Microbiology Practical-V	21UCMB5P1	4	2	40	60	100
	DSCP-6	Core Microbiology Practical-VI	21UCMB5P2	4	2	40	60	100
TOTAL				30	22			700

VI SEMESTER

P	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
III	DSC 10	Medical Microbiology	21UCMB61	4	4	25	75	100
	DSC 11	Industrial Microbiology	21UCMB62	4	4	25	75	100
	DSC 12	Agricultural Microbiology	21UCMB63	6	6	-	-	100
	DSE3	Bioinformatics	21UEMB61	4	2	25	75	100
	DSE4	Project	21UEMB62	4	4	25	75	100
	DSCP-7	Core Microbiology Practical-VII	21UCMB6P1	4	2	40	60	100
	DSCP-8	Core Microbiology Practical-VIII	21UCMB6P2	4	2	40	60	100
		SEC5	Basic Dietetics	XXXXXX	2	2	25	75
TOTAL				30	26			800
I-V Sem		Massive Open Online Course ^{\$}		-	2 [#]			

B.Sc. Microbiology (2021-2021) Course Structure (CBCS)

(Applicable for students admitted in June 2019 and onwards)

PART I AND PART II SUBJECTS

TITLE OF THE PAPERS, CREDITS and MARKS

GROUP II COURSES (TWO YEAR LANGUAGE COURSES) (, B.A. Arabic, B.A. Tamil, B.A. English, B.A. History, B.Sc. Mathematics, B.Sc. Physics, B.Sc. Chemistry, B.Sc. Zoology, B.Sc. Microbiology and B.Sc. Nutrition and Dietetics)							
SEM	Title of the paper	S.CODE	H/W	C	I	E	T
PART I – TAMIL							
I	,f;fhyj; jkpo;	21ULTA11	6	4	25	75	100
II	rkaj; jkpo;	21ULTA21	6	4	25	75	100
III	gad;ghl;Lj; jkpo;	21ULTA31	6	4	25	75	100
IV	rq;fj; jkpo;	21ULTA41	6	4	25	75	100
TOTAL			24	16			400
PART I – ARABIC							
I	Applied Grammar and Translation – I	21ULAR11	6	4	25	75	100
II	Applied Grammar and Translation – II	21ULAR21	6	4	25	75	100
III	Applied Grammar and Translation – III	21ULAR31	6	4	25	75	100
IV	<i>Classical Prose</i>	21ULAR41	6	4	25	75	100
TOTAL			24	16			400
PART II – ENGLISH							
I	Communicative English -I	21ULEN11	6	3	25	75	100
II	Communicative English-II	21ULEN21	6	3	25	75	100
III	One – Act Plays and Writing Skill	21ULEN31	6	3	25	75	100
IV	A Practical Course in Spoken English	21ULEN41	6	3	25	75	100
TOTAL			24	12			400

PART III

Part III DSC, DSE and Project									
SEM	P	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS			
						I	E	T	
I	DSC1	Microbial World and Bacteriology	21UCMB11	4	4	25	75	100	
	DSC2	Virology, Mycology, Phycology	21UCMB12	4	4	25	75	100	
	CP 1	Core Microbiology Practical-I	21UCMB1P1	2	1	20	30	50	
II	DSC3	Microbial Physiology and Metabolism	21UCMB21	4	4	25	75	100	
	DSC4	Biochemistry	21UCMB22	4	4	25	75	100	
	CP 2	Core Microbiology Practical-II	21UCMB2P1	2	1	20	30	50	
III	DSC5	Environmental Microbiology	21UCMB31	4	4	25	75	100	
	CP 3	Core Microbiology Practical-III	21UCMB3P1	2	1	20	30	50	
IV	DSC6	Microbial Biotechnology	21UCMB41	4	4	25	75	100	
	CP 4	Core Microbiology Practical-IV	21UCMB4P1	2	1	20	30	50	
V	DSC7	Immunology	21UCMB51	6	4	25	75	100	
	DSC8	Microbial Genetics	21UCMB52	5	4	25	75	100	
	DSC9	Food and Dairy Microbiology	21UCMB53	5	4	25	75	100	
	CP 5	Core Microbiology Practical-V	21UCMB5P1	4	2	40	60	100	
	CP 6	Core Microbiology Practical-VI	21UCMB5P2	4	2	40	60	100	
	DSE 1 and 2	Microbial Nanotechnology Genetic engineering	21UEMB51 21UEMB51	4	4	25	75	100	
VI	DSC10	Medical microbiology	21UCMB61	4	4	25	75	100	
	DSC11	Industrial Microbiology	21UCMB62	4	4	25	75	100	
	DSC12	Agriculture Microbiology	21UCMB63	6	6	25	75	100	
	CP 7	Core Microbiology Practical-VII	21UCMB6P1	4	2	40	60	100	
	CP 8	Core Microbiology Practical-VIII	21UCMB6P2	4	2	40	60	100	
	DSE3	Bioinformatics	21UEMB61	4	2	40	60	100	
	DSE4	Project	21UEMB62	4	4	25	75	100	
TOTAL				94	78			2200	

PART III – ALLIED

SEM	SUB	TITLE OF THE PAPER	S.CODE	H/W	C	MARKS		
						I	E	T
I	AI-1	Aquatic Microbiology	21UAMB11	4	3	25	75	100
	AI-P1	Techniques in Aquatic Microbiology	21UAMB1P1	2	1	20	30	50
II	AI-2	Entrepreneur in Microbiology	21UAMB21	4	3	25	75	100
	AI-P2	Techniques in Entrepreneur Microbiology	21UAMB2P1	2	1	20	30	50
III	AII-1	Bioinstrumentation	21UAMB31	4	3	25	75	100
	AII-P1	Techniques in Bioinstrumentation	21UAMB3P1	2	1	20	30	50
IV	AII-2	Pharmaceutical Microbiology and Quality Assurance	21UAMB41	4	3	25	75	100
	AII-P2	Techniques in Pharmaceutical Microbiology	21UAMB4P1	2	1	20	30	50
TOTAL				24	16			600

PART IV – NON-MAJOR COURSE (FOR OTHER MAJOR STUDENTS)

SEM	Sub	Title of the paper	S.CODE	H/W	C	MARKS		
						I	E	T
III	NME-I	Vermiculture and Mushroom technology	21UNMB31	2	2	25	75	100
IV	NME-II	Aquaculture and Apiculture	21UNMB41	2	2	25	75	100
TOTAL				4	4			200

Part IV – SEC/SBC

III	SEC1	Introduction to Computers	21USMB51	2	2	25	75	100
III	SEC2	MOOC (NPTEL)	21USMB51	2	2	25	75	100
IV	SEC3	Soft skills	21USMB51	2	2	25	75	100
IV	SEC4	Food Processing and Quality Control	21USMB51	2	2	25	75	100
VI	SEC5	Basic Dietetics	21USMB51	2	2	25	75	100
TOTAL				6	6			300

Part IV – EVS and Value Education

I	EVS	Environmental Studies	21UENS11	2	2	25	75	100
II	VE	Value Education I	21USVE2A	2	2	25	75	100
		Value Education II	21USVE2B					
TOTAL				4	4			200

PART – V – Extension Activities

SEM	Extension Activities (Choose any one)	S.CODE	H/W	C	MARKS		
					I	E	T
I to IV	NCC	21UEXNCC		1			100
	NSS	21UEXNSS					
	Physical Education	21UEXPHE					
	Red Ribbon Club	21UEXRRC					
	Youth Red Cross	21UEXYRC					
	Youth Welfare	21UEXYWL					
	Yoga	21UEXYOG					
III to IV	Sadakath Outreach Programme (SOP)	21UEXSOP		1*			
Total			-	1+1*			100

Programme Learning Outcomes (PLO)

(Aligned with Graduate Attributes)

for

Bachelor of Science (B.Sc.)

in

**Mathematics, Physics, Chemistry, Zoology, Computer Science,
Information Technology, Microbiology, Nutrition and Dietetics,**

and

Bachelor of Computer Applications (B.C.A)

The students graduating with the Degree B.Sc / B.C.A will be able to:

PLO 1: Disciplinary Knowledge

- Acquire scientific knowledge and the understanding of major concepts and theoretical principles.

PLO 2: Creative Thinking and Practical Skills / Problem Solving Skills

- Enrich skills of observation / research related skills to draw logical inferences from scientific experiments/ programming and skills of creative thinking to develop novel ideas.
- Hone problem solving skills in theoretical, experimental and computational areas and to apply them in research fields and in real life situations.

PLO 3: Sense of inquiry and Skilled Communicator

- Develop the capability for raising appropriate questions relating to the current/emerging issues encountered in the scientific field and to plan, execute and express the results of experiments / investigations through technical writings as well as through oral presentations.

PLO 4: Ethical Awareness / Team Work / Environmental Conservation and Sustainability

- Equip them for conducting work as an individual / as a member, or as a leader in diverse teams upholding values such as honesty and precision and thus preventing unethical behaviours such as fabrication, falsification, misrepresentation of data, plagiarism etc. to ensure academic integrity.
- Realise that environment and humans are dependent on one another and to know about the responsible management of our ecosystem for survival, and for the well-being of the future generation as well.

PLO 5: Usage of ICT/ Lifelong Learning / Self-Directed Learning

- Inculcate the habit of learning continuously through the effective adoption of ICT to update knowledge in the emerging areas in Sciences for inventions/discoveries and also to engage in remote / independent learning.

Semester – I

Course Title	MICROBIAL WORLD AND BACTERIOLOGY
Total Hrs.	60
Hrs./Week	4
Sub.Code	21UCMB11
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course deals with the History and Scope of Microbiology, Microscope, Sterilization, Growth Media, Culture and Staining Techniques, Structure of the Cell Organelles, Bacterial Systematics and Assorted Characteristics of Prokaryotic Organisms.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Understand the development of microbiology.
CO-2	Illustrate the parts, working principles and applications of microscopes.
CO-3	Choose the methods of sterilization and culture techniques.
CO-4	Explain the structure, taxonomic order and classification of bacteria.
CO-5	Classify Archaeobacteria and Eubacteria based on general, cultural and biochemical characteristic features.

UNIT I: HISTORY AND MICROSCOPY (12 hours)

History and Scope of Microbiology – Spontaneous generation, Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Zobell, Alexander Fleming, Winogradsky – Recent contributions – Haeckel's three kingdom concept, Whittaker's five kingdom concept. Microscopy Principles and applications of simple, bright field, dark field, phase contrast, fluorescent and electron microscopy.

UNIT II: STERILIZATION AND CULTURE TECHNIQUES (12 hours)

Sterilization Instruments, Principles and methods – Physical moist heat, dry heat, filtration, Tyndallization, radiations and Chemical alcohols, aldehydes, phenols, halogens, metallic salts, gases and hypochlorite's. Culture techniques Serial dilution, Isolation and Purification - Spread, Pour, Streak technique. Preservation of microorganisms Slant, Lyophilization, Cryopreservation. Types of growth media Composition and purpose - General, Selective and differential media - Nutrient, MacConkey agar, Enrichment – blood agar. Transport media - Stuart's media.

UNIT III: CELL ORGANELLES AND STAINING METHODS (12 hours)

Structure and function of Prokaryotic cell and its components - Slime and capsule, Cell wall of Gram-positive and negative bacteria, the cytoplasmic and plasma membrane (fluid mosaic), mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; capsules, spores-endospores, exospores, biofilm. Staining principles – Simple, Negative, Gram and Spore staining.

UNIT IV: TAXONOMY AND BACTERIAL SYSTEMATICS (12 hours)

Major Characteristics of bacteria Morphological, Cultural, chemical, Metabolic, Antigenic, Genetic, Pathogenicity - Ecological characteristics. Microbial Classification Nomenclature, Classification and Identification - Taxonomic order. Bacterial classification – Goals, General methods, - Intuitive, Numerical taxonomy and Genetic relatedness, Bergy's Classification, Phenotypic and genotypic.

UNIT V: ARCHAEBACTERIA AND EUBACTERIA (12 hours)

Archaeobacteria General characteristics, phylogenetic overview, genera belonging to Crenarchaeota (*Sulfolobus*) and Euryarchaeota Methanogens (*Methanobacterium*), Thermophiles (*Thermococcus*) and Halophiles (*Halobacterium*).

Eubacteria Cultural and Biochemical characters of aerobic Gram positive (cocci – *Streptococcus sp*, rod – *Bacillus sp*), Gram negative (cocci – *Neisseria sp*, rod – *Pseudomonas sp*). Anaerobic gram positive (Cocci – *Peptostreptococcus sp*, rod – *Clostridium sp*), Gram negative (Cocci – *Veillonella sp*, Rod – *Bacteroides sp*). Facultative – *Escherichia coli*, *Spirochetes*, *Mycoplasma*, *Rickettsia*. Difference between Archea and Eubacteria.

Textbooks:

1. Dubey, R.C. and Maheswari, S. *A Text Book of Microbiology*. S. Chand and Co, New Delhi. 2003.
2. Kanika, S. *Textbook of Microbiology – Tools and Techniques*. (1st edn), Ane Books Pvt. Ltd, New Delhi. 2011.
3. Pelczar, M.J. *et al., Microbiology*. McGraw- Hill Inc New York. 1993.
4. Power, C.B. Dagina, W. *General Microbiology Volume I*. (2ndedn), Himalaya Publishing House, Delhi.2010.

Reference Books:

1. Atlas, R. *Principles of Microbiology* (2ndedn), Wm.C. Brown publishers. 1997.
2. Prescott, L. M. *et al., Microbiology. 9th edition*. McGraw- Hill Inc, New York. 2013.
3. Salle, A.J. *Fundamental Principles of Bacteriology*. (7thedn), Tata McGraw-Hill Publications Ltd. 1984.
4. Stanier, Y. *et al., General Microbiology*. MacMillan Press LTD, Houndmills, Basingstoke, Hampshire, London. 1999.

Course Outcomes (CO)

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Outline the historical events of microbiology.	1,2,3,5	Understanding
CO-2	Demonstrate the parts of microscope, types and its working principle of microscope.	1,2,5	Applying
CO-3	Choose the basic techniques including sterilization, staining and culturing microorganisms.	1,2,3,5	Applying
CO-4	Explain the structure, taxonomic order and classification of bacteria.	1,2,5	Analyzing
CO-5	Interpret the bacteria based on cultural and biochemical characteristic features.	1, 2,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
I	21UCMB11	Microbial World And Bacteriology					60	4				
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	✓	✓	✓	✓	✓	✓	✓			✓		
CO-2	✓	✓	✓	✓	✓	✓	✓			✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		✓		
CO-4	✓	✓	✓	✓	✓	✓	✓			✓		
CO-5	✓	✓	✓	✓	✓	✓	✓			✓		
	Number of matches (✓) = 41 Relationship = High Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)											

Prepared by
Name : Dr.K.Chitra

Signature :

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – I

Course Title	Virology, Mycology, Phycology, Parasitology
Total Hrs.	60
Hrs./Week	4
Sub.Code	21UCMB12
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course focuses on the basic characteristics, Structure, Classification, Nomenclature, Properties and Life cycle of Viruses, Fungi, Algae and Parasites.

Course Objectives:

The learners will be able to:

CO	Course Objectives
CO-1	Understand the basic characters, structures, classification, properties and economic importance of viruses.
CO-2	Instruct the replication of bacterial viruses.
CO-3	Demonstrate the basic characters, structures and classification of algae.
CO-4	Categorise the basic characters, structures and the classification of fungi.
CO-5	Perform the diagnosis and treatment of parasitic diseases.

UNIT I: BASICS OF VIROLOGY (12 hours)

Virology Discovery of viruses, nature and definition of viruses, general properties, concept of virion, prions. Structure of viruses. Viral taxonomy – Casjens and Kings Classification and nomenclature of different groups of viruses. Isolation, purification and cultivation of Viruses.

UNIT II: PLANT, ANIMAL, INSECT AND BACTERIAL VIRUS (12 hours)

Salient features, Classification, nomenclature and properties of plant virus (Cauliflower mosaic virus, Potato spindle tuber virus), Animal virus (Adeno virus, SARS virus, Rhabdo virus) Insect virus (NPV, CPV). Bacteriophages - lytic and lysogenic phages (T4 and lambda phages).

UNIT III: PHYCOLOGY (12 hours)

Algae – General characteristics, structure, FRITCH classification, Blue Green Algae (*Nostoc*), Red algae (*Gracilaria*), Euglenophyta (*Euglena*), Chrysophyta (*Diatom*), Phaeophyta (*Sargassum wightii*), Rhodophyta (*Chondrus crispus*), Unicellular (*Chlorella*) Economic Importance.

UNIT IV: MYCOLOGY (12 hours)

Fungi – General Characters, Morphology, Alexopoulos classification and their general features - reproduction – filamentous fungi (*Actinomycetes*), molds(*Aspergillus*), macroscopic fungi (mushroom-*Agaricusbisporus*) – unicellular fungi (Yeast-*Saccharomyces cerevisiae*) Economic Importance.

UNIT V: PARASITOLOGY (12 hours)

Distinguishing characters, structure and classification, life cycle, lab diagnosis, treatment for the following: *Entamoeba* sp, *Leishmania* sp, *Giardia* sp and *Trichomonas* sp. *Helminthescestodes (Taenia solium)* *Nematodes (Ascaris lumbricoides)*.

Textbooks:

1. Bilgrami, K.S.,and Sinha R.K.*Essentials of Microbiology*, CBS Publishers. 2010.
2. Pelczar Jr, M.J.,et al. *Microbiology-* McGraw- Hill Inc, New York. 1993.
3. Power CB,DaginaWala. *General Microbiology* Volume II, Himalaya Publishing House, Delhi. 2010.
4. Power CB,DaginaWala.*General Microbiology* Volume I, Himalaya Publishing House, Delhi. 2010.

REFERANCE BOOKS ;

1. Atlas R. M. *Principles of Microbiology*, Mosby 2nd Edition. 1996.
2. Oarsman S.N.J., et al. *Virology Illustrated colour text*, 1st Edn. Elsevier Health Sciences. 2012.
3. Prescott L.M, et al. *Microbiology*, (11th edition) McGraw- Hill Inc, New York. 2008.
4. Stanier Y., et al. *General Microbiology*. Palgrave Macmillan; 5th edition. 1987.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Illustrate the structure and classification of virus.	1,2,3,4, 5	Understanding
CO-2	Order viruses depending on the ability to infect different living forms.	1,2,3,4, 5	Applying
CO-3	Classify algae based on the characters, structures and features.	1,2,3,4, 5	Analyzing
CO-4	Detect the economic importance of fungi.	1,2,3,4, 5	Analyzing
CO-5	Predict the parasitic diseases and adopt preventive measures.	1,2,3,4, 5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
I	21UCMB12	Virology, Mycology, Phycology, Parasitology	60	4						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 50 Relationship = High										

Prepared by

Name :Dr.R.Janet Rani

Signature :

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – I

Course Title	AQUATIC MICROBIOLOGY
Total Hrs.	60
Hrs./Week	4
Sub.Code	21UAMB11
Course Type	Allied
Credits	1
Marks	100

General Objective:

The course deals with the basics of aquatic ecosystem, importance of microbial analysis of water and methods of studying aquatic microorganisms.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the types of aquatic ecosystems and the associated microorganisms.
CO-2	Demonstrate the importance of microbiological analysis of water and the methods used in characterizing the organisms.
CO-3	Examine the microbes associated with water borne diseases and that affect the aquatic environment.
CO-4	Assess the microorganisms involved in bioluminescence and also the treatment of pollutants.
CO-5	Prepare the importance of microorganisms in aquatic environment and its economic importance.

UNIT I: AQUATIC ECOSYSTEMS (12 hours)

Freshwater Ecosystem - Microorganisms of the freshwater habitat – Lentic and Lotic Structure, Habitat and Biota. Marine Ecosystem-Physical and chemical characteristics of marine ecosystem-Structure of the sea - Upwelling-Down welling - Biota of the sea, General characteristics-Functions of marine flora, Estuarine Ecosystem - Biota of Estuarine, Mangrove Ecosystem - Biota of mangroves. **Hydrothermal vents.**

Unit II: MICROBES AND HYDROSPHERE (12 hours)

Microbiology of Water- Bacteriological analysis of water- Methods of studying marine microorganisms- Collection, enumeration, isolation and identification based on morphological, physiological and biochemical characteristics- Preservation of marine microbes (Halophilic, Psychrophilic, Barophilic) Microbial nutrition- Influence of environmental factors on microbial growth and activity.

UNIT III: EUTROPHICATION AND WATER BORNE DISEASES (12 hours)

Eutrophication- Biofilm formation- biofouling. Water borne diseases- viral (jaundice), bacterial (cholera) and protozoan, (amoebic dysentery). Purification of water- Recycling of water.

UNIT IV: MARINE BIOLUMINESCENCE (12 hours)

Microorganisms responsible for bioluminescence in marine environment. Uses of bioluminescence. Mechanism of quorum sensing in *Vibrio fischeri*. Microbial indicators of marine pollution and control, Biodegradation- bioremediation of marine pollutants.

UNIT V: APPLICATION OF AQUATIC MICROBES (12 hours)

Probiotic bacteria and their importance in aquaculture- Aquatic Microbes of Biotechnological importance- Primary and secondary metabolites- Bioactive compounds from marine microbes.

TEXTBOOKS:

1. Karl, D., and Buckley M. *Marine Microbial Diversity* 2005.
2. Munn, C.B. *Marine Microbiology Ecology and applications* 2003.
3. Ramesh, K.V. *Environmental Microbiology*. MJP Publishers, Chennai 2004.

REFERENCE BOOKS:

1. Colwell R, and Belkin. *Ocean & health: Pathogens of the Marine Environment*. Springer 2010.
2. Miller, C., Wheeler, P.A. *Biological Oceanography* Wiley-Blackwell, 2012.
3. Mitchel, R., and Ji D.G. *Environmental Microbiology*. Wiley-John Black well Publishers, New York. 2010.
4. Mitchell, R. *Microbial Ecology of the Oceans*. Wiley 2008.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize fresh water and marine water ecosystem.	1,4,5	Understanding
CO-2	Demonstrate the biota of Mangrove Ecosystem.	1,5	Applying
CO-3	Analyze the various bacteriological tests to check water quality.	1, 2,3,4,5	Analyzing
CO-4	Plan the methods for isolation, identification and preservation of marine microorganisms.	1,5	Evaluating
CO-5	Propose modern techniques used to check the quality of water.	1, 2,3,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
II	21UAMB11	AQUATIC MICROBIOLOGY	60	1						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓			✓	✓
CO-2	✓	✓	✓	✓	✓	✓				✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓		✓				✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =41 Relationship = High										

Prepared by
 Name: Mr. S. Hameedullah Sherief
 Signature

Checked by
 Dr. R. Janet Rani
 Head of the Department

Semester – I

Course Title	TECHNIQUES IN MICROBIOLOGY & MICROBIAL DIVERSITY
Total Hrs.	30
Hrs./Week	2
Sub.Code	21UCMB1P1
Course Type	Discipline Specific Core Practical
Credits	3
Marks	50

General Objective:

The course offers hands on experience in learning the principle, working mechanism, handling of equipments in laboratory, microbial cultivation and about different staining techniques.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Describe the laboratory safety guidelines.
CO-2	Demonstrate the guidelines of handling instruments used in microbiology laboratory.
CO-3	Differentiate the media used for microbial cultivation.
CO-4	Formulate different plating techniques used in microbial isolation.
CO-5	Assess different straining techniques used to characterize the microorganisms.

Course outline:

1. Microbiology Laboratory Safety guidelines.
2. Instruments used in Microbiology (Compound Microscope, Autoclave, Laminar air flow, Incubator, Hot-air oven).
3. Preparation of Liquid and Solid media.
4. Serial Dilution Technique.
5. Plating techniques – Pour plate, Spread plate, Streak plate.
6. Haymount preparation to show different types of microbes.
7. Hanging drop technique.
8. Straining Techniques
 - a) Simple staining.
 - b) Gram's staining.
 - c) Spore Staining.
9. Microscopic observation of fungi – Yeast and Mold.
10. Iodine wet mount preparation – protozoa.
11. Cultivation of Algae (Demonstration).
12. Isolation of phage (Demonstration).

REFERENCE BOOKS:

1. Cappuccino, J.G., and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited. 2014.
2. Kannan N. *Laboratory Manual in General Microbiology*. PANIMA. 2002.
3. Dubey, R.C, Maheshwari DK, *Practical Microbiology*, SChand Publications. 2012.
4. Rajan S, R., andSelvi Christy. *Experimental procedures in Life Sciences*, (3rd reprint) Anjanaa Book House, Chennai. 2010.
5. Aneja, K.R.*Experiments in Microbiology*, Plant Pathology and Biotechnology (4th edition), New age international. 2003.
6. Vos, P., et al. eds, 2011. *Bergey's manual of systematic bacteriology*: Volume 3: The Firmicutes (Vol. 3). Springer Science & Business MediaDon J. Brenner, Noel R. Krieg, James T. Staley (eds). *Bergey's Manual of Systematic Bacteriology Second Edition*. Springer. 2005.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the basic principles of microbiological techniques.	1, 2,3,4,5	Understanding
CO-2	Demonstrate the safety guidelines of Microbiological laboratory.	1.2,4,5	Applying
CO-3	Differentiate various sterilization techniques.	1, 2,4,5	Analyzing
CO-4	Design different isolation methods	1, 2,3,4,5	Evaluating
CO-5	Assess different types of bacteria using staining techniques.	1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
I	21UCMB1P1	TECHNIQUES IN MICROBIOLOGY & MICROBIAL DIVERSITY					30	3		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓			✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-3	✓	✓			✓	✓	✓		✓	✓
CO-4	✓	✓			✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 42 Relationship = High										

Prepared by
Name:Dr.M.Senthil @ Sankar
Signature:

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – I

Course Title	TECHNIQUES IN AQUATIC MICROBIOLOGY
Total Hrs	30
Hrs/Week	2
Sub.Code	21UAMB1P1
Course Type	Allied Practical
Credits	2
Marks	50

General Objective:

The course provides the practical knowledge on isolation and identification of organisms, indicator and water borne pathogenic organisms from aquatic habitats and water quality analysis.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Practise the isolation of fresh and marine habitat microbes using standard methods.
CO-2	Experiment with the isolation and characterization of the faecal coliform using standard technique.
CO-3	Detect the water borne pathogens.
CO-4	Plan the isolation of fungal population from water.
CO-5	Measure the total Alkalinity of water.

Course Outline

1. Water analysis for total bacterial population by standard plate mount method from fresh and marine water.
2. Isolation and identification of faecal coliforms using MPN Technique.
3. Isolation and identification of Halophilic bacteria.
4. Isolation and identification of water borne pathogen from water sample.
5. Isolation of Yeast /mould from water sample.
6. Determination of total alkalinity of water.
7. Determination of Chlorine in water.
8. ISI (Indian Standard Institute) specification for drinking water.

REFERENCE BOOKS:

1. Aneja, K.R. *Experiments in Microbiology*, Plant Pathology and Biotechnology (4th edition), New age international. 2003.
2. Cappuccino, J.G., and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited. 2014.
3. Dubey, R.C., Maheshwari DK, *Practical Microbiology*, SChand Publications. 2012.

4. Kannan, N. *Laboratory Manual in General Microbiology*. PANIMA. 2002.
5. Parsons, T.R., et al, *Manual of chemical and biological methods for seawater analysis*. Pergamon press. 1984.
6. Rajan, S, R. and Christy S. *Experimental procedures in Life Sciences*, (3rd reprint) Anjanaa Book House, Chennai. 2010.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Practise the bacteria in fresh and marine habitats by isolation process.	PSO-1, 2,3,4,5	Applying
CO-2	Analyze the fungi from fresh and marine habitats by using selective media.	PSO-1, 2,3,4,5	Analyzing
CO-3	Examine the halophilic bacteria using selective media.	PSO-1, 2,3,4,5	Analyzing
CO-4	Plan the water quality analysis using MPN.	PSO-1, 2,3,4,5	Evaluating
CO-5	Assess the waterborne pathogen from water samples.	PSO-1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
I	21UAMB1P1	TECHNIQUES IN AQUATIC MICROBIOLOGY					30	2				
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PS O1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓		✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 45 Relationship = High												

Prepared by
Name: Dr. M. Senthil @ Sankar

Signature:

Checked by
Dr. R. Janet Rani
Head of the Department

Semester – II

Course Title	MICROBIAL PHYSIOLOGY AND METABOLISM
Total Hrs.	60
Hrs./Week	4
Sub.Code	21UCMB21
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course focuses on the nutritional requirement, classification, nutrient transport mechanisms of microorganisms, microbial metabolic pathway of carbohydrate, lipid and amino acids, microbial fermentation and photosynthesis.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the nutritional requirement and nutritional types of Microorganisms.
CO-2	Demonstrate the nutrient transport mechanisms and growth stages of bacteria.
CO-3	Illustrate the anabolism and catabolism reaction pathways of carbohydrate.
CO-4	Detail explanation on microbial metabolic pathway of lipid and amino acids.
CO-5	Summarize the photosynthetic reactions of bacteria.

UNIT I: MICROBIAL NUTRITION (12 hours)

The common nutrient requirements- Growth Factors-Nutritional types of Microorganisms Definitions and examples - Autotrophs, Chemotrophs, Heterotrophs, Chemolithotrophs, Photoautotrophs, Photoorganotrophs, Chemo - lithotrophs - ammonia, nitrate sulphur, hydrogen, iron oxidizing bacteria, Chemo - organotrophs; Classification on the basis of oxygen requirement and tolerance

UNIT II: NUTRITIONAL TRANSPORT AND GROWTH (12 hours)

Membrane structure and transport – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion, Active and passive transport, group translocation and iron transport. Enzymes involved in transport. Reproduction in Bacteria- Asexual methods of reproduction. Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Curve, Generation time, Methods of growth determination, Environmental factors influencing growth - temperature, pH, osmotic pressure and Radiations.

UNIT III:METABOLISM AND FERMENTATION (12 hours)

Anabolism and catabolism. Carbohydrate Metabolism Anabolism - Glycogenesis and Gluconeogenesis. Catabolism Carbohydrates - Glycolysis, TCA cycle, Pentose phosphate pathway, Entner - Doudoroff pathway, Fermentations alcohol fermentation, lactate and butyrate fermentation, Electron transport system and oxidative –substrate level Phosphorylation.

UNIT IV: LIPID, AMINO ACID AND NUCLEIC ACID METABOLISM (12 hours)

Lipid Metabolism Beta – oxidations of saturated fatty acids. Biosynthesis of cholesterol, regulation. Amino Acid/ Nucleic Acid Metabolism Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids (Tryptophan, Leucin), Biosynthesis of Purine and Pyrimidines nucleotides by salvage pathways.

UNIT V: PHOTOSYNTHETIC BACTERIA(12 hours)

Oxygenic phototrophic bacteria, Anoxygenic phototrophic bacteria, Photosynthetic pigments action and absorption spectrum, types, structure and location, physiology of bacterial photosynthesis light and dark reactions, cyclic and non-cyclic photophosphorylation.

Textbooks:

1. Dubey, R.C., and Maheswari, S. *A Text Book of Microbiology*. S.Chand and Co, New Delhi. 2003.
2. Meenakumari, S. *Microbial Physiology* (1stedn). MJP Publishers Chennai.2006.
3. Pelczar, M.J.,*et al.*, *Microbiology*. McGraw- Hill Inc New York. 1993.
4. Power, C. B., andDagina, W. *General Microbiology Volume II*. Himalaya Publishing House, Delhi. 2010.
5. Power, C.B., andDagina, W. *General Microbiology Volume I* (2ndedn) Himalaya Publishing House, Delhi.2010.

Reference Books:

1. Atlas, R. *Principles of Microbiology* (2ndedn). Wm.C.Brown publishers. 1997.
2. Prescott, L.M.,*et al.*, *Microbiology* (9thedn). McGraw- Hill Inc, New York. 2013.
3. Rajapandian, K. *Microbial physiology*. PBS Book Enterprises India, Chennai. 2010.
4. Stanier, Y., et al., *General Microbiology* (5thedn). MacMillan Press LTD, Houndmills, Basingstoke, Hampshire, London. 1999.

Course Outcomes

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive Level
CO-1	Explain the type's microorganism based on the nutritional requirements.	1,2,3,5	Understanding
CO-2	Illustrate the mode of nutrition uptake and metabolism of microorganisms.	1,2,3,5	Applying
CO-3	Compare various growth phases and effect of various factors on the growth of microorganisms.	1,2,3,5	Analyzing
CO-4	Summarize the basic concepts of anabolic and catabolic reactions of carbohydrate, lipid and amino acids.	1,2,3,5	Analyzing
CO-5	Compare various types of photosynthetic process involved in microorganism.	1,2,3,5	Evaluating

Semester	Course Code	Title of the Course					Hours	Credit				
II	21UCMB21	Microbial Physiology And Metabolism					60	4				
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓	✓		✓	✓	✓	✓		✓		
CO-2	✓	✓	✓		✓	✓	✓	✓		✓		
CO-3	✓	✓	✓		✓	✓	✓	✓		✓		
CO-4	✓	✓	✓		✓	✓	✓	✓		✓		
CO-5	✓	✓	✓		✓	✓	✓	✓		✓		
Number of matches (✓) = 45 Relationship = High												

Prepared by

Name : Dr.K.Chitra

Checked by

Dr.R.Janet Rani

Head of the Department

Signature :

Semester – II

Course Title	BIOCHEMISTRY
Total Hrs.	60
Hrs./Week	04
Sub.Code	21UCMB22
Course Type	Discipline Specific Core (DSC)
Credits	04
Marks	100

General Objective:

The course focuses on the mechanism of bioenergetics, molecular machinery of living cells, structure and mechanism of biomolecules.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Describe molecular machinery of living cells and explain the bioenergetics and metabolism.
CO-2	Examine the structure, characteristics and physico chemical properties of carbohydrates.
CO-3	Demonstrate the structure, characteristics and physico chemical properties of Lipids.
CO-4	Detail the structure, function and acid base properties of proteins and amino acids
CO-5	Create fundamental knowledge on enzymes and their importance in biological reactions.

Unit I: BIOENERGETICS (12 hours)

First and Second Laws of Thermodynamics, Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change. Energy rich compounds Phosphoenolpyruvate, 1, 3- Bisphosphoglycerate, Thioesters, ATP.

Unit II: CARBOHYDRATES (12 hours)

Structure, properties and classification- Monosaccharide's aldoses and ketoses, trioses, tetroses, pentoses, and hexoses, Stereoisomerism of monosaccharide's, epimers. Mutarotation and anomers of glucose. Disaccharides - concept of reducing and non-reducing sugars, and Haworth projections of maltose, lactose, and sucrose, Polysaccharides storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose.

Unit III: LIPIDS (12 hours)

Structure, properties and classification - Definition and major classes of storage and structural lipids, Fatty acids structure, Storage lipids, Essential fatty acids, Triacylglycerols structure, functions and properties, saponification, structure of lipids, phosphoglycerides building blocks, general structure, functions and properties

Unit IV: PROTEINS (12 hours)

Structure, properties and classification - Functions of proteins, Primary structures of proteins Amino acids, the building blocks of proteins. Concept of zwitterions. Amino acid –types, Classification, properties and functions.

Unit V: Enzyme (12 hours)

Structure, properties and classification - Structure Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD, metal cofactors. Classification of enzymes, Mechanism of action of enzymes active site, Lock and key hypothesis, and Induced Fit hypothesis, Effect of pH and temperature on enzyme activity, Vitamins- structure, properties and classification

TEXT BOOKS:

1. Satyanarayan., and Chakrapani. *Biochemistry*, Elsevier, 4th Edition, 2013.
2. Jain, J.L., et al. *Fundamentals of Biochemistry*, S. Chand and Company LTD, New Delhi, 2016.
3. Rambabu, K.R., et al. *Text book of Biochemistry (2nd edition)*, AITBS Publishers, India, 2013.

REFERENCE BOOKS:

1. Campbell, M.K, et al. *Biochemistry*, 9th Edn. Brooks /Cole Cenage Learning.2018.
2. Wilson, K., Walker, J. *Principles and Techniques of Biochemistry and Molecular Biology (7th edition)*, Cambridge University, 2010.
3. Nelson, D.L., and Cox M.M. *Lehninger Principles of Biochemistry, 7th Edn. Intl. Edition*, WH Freeman and Company, 2017.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the bioenergetics and its metabolism.	1,3,4,5	Understanding
CO-2	Analyze the physico chemical properties of carbohydrates from monosaccharide to polysaccharides.	1,3,4,5	Analyzing
CO-3	Determine lipids and its properties at the chemical, molecular and biological levels.	1,3,4,5	Evaluating
CO-4	Explain structure, functions, acid base properties of proteins and amino acids.	1,3,4,5	Evaluating
CO-5	Elaborate the importance of enzymes in biological reactions.	1,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
II	21UCMB22	Biochemistry					60	04		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
Number of matches (✓) =45 Relationship = High										

Prepared by
 Name: Mr. S. HameedullahSherief
 Signature:

Checked by
 Dr.R.Janet Rani
 Head of the Department

Semester – II

Course Title	ENTREPRENEUR IN MICROBIOLOGY
Total Hrs.	60
Hrs./Week	4
Sub.Code	21UCMB21
Course Type	Allied
Credits	3
Marks	100

General Objective:

The course highlights the entrepreneurial opportunities and guidelines, production of biofertilizers, vermicompost, fermented products, mushrooms and pigments.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Discuss the responsibilities of an entrepreneur.
CO-2	Use the Government contributions to an entrepreneur.
CO-3	Analyze and develop knowledge on Biofertilizers production.
CO-4	Design methods for Mushroom cultivation.
CO-5	Select the major fermented products and microbial pigments of industrial value.

UNIT I: INTRODUCTION TO ENTREPRENEUR (12 hours)

Entrepreneur development, scope and its importance activity, basic qualities of Entrepreneur, Institutes involved – DBT, ATAL Incubation Centre, NITI Ayogh ICAR, BIRAC - SIBRI, NABARD, Government contributions to entrepreneur, Risk assessment. Standards - ISO, FDA, FCI.

UNIT II: BIOFERTILIZERS (12 hours)

Isolation, mass cultivation, inoculum production - *Rhizobium*, *Azospirillum*, BGA, Ecto and Endo Mycorrhiza, VAM – Potash mobilize – *Frateuria aurantia*; Liquid Biofertilizers Methods of Field application, cost effectiveness, Constraints in commercialization.

UNIT III: MUSHROOM CULTIVATION (12 hours)

Edible and medicinal Mushroom- cultivation, Oyster and- *Ganoderma lucidum* Substrate selection, Spawn Preparation, perpetration of mushroom bed, maintaining optimal temperature, casing harvest, storage and spent substrate. Mushroom Value added products. Soilless agriculture/Farming advances - Vertical farming, hydroponics, aeroponics. Methods involved considerations, advantages, vermicompost and vermiwash.

UNIT IV: INDUSTRIAL PRODUCTION (12 hours)

Fermentation processes for the industrial production of Wine, Beer, Bacitracin. Microbial Insecticides - BT. Production of SCP – Spirulina. Prebiotics and probiotics. Algal biotechnology- microalgae-food, feed and fuel production - pharmaceutically potential of microalgae.

UNIT V: MICROBIAL PIGMENTS (12 hours)

Bacterial pigments – prodigiosin – violacein; fungal- monascin; algal carotenoids – astaxanthin – occurrence, isolation, chemistry and biological properties - its applications and importance. Extraction methods and Purification of pigments, future strategies and innovative areas of research.

TEXTBOOKS:

1. Aneja, K.R. *Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology*, 6th Edition, New age International Publication. 2003.
2. George, A.R. *Microbial pigments as potential natural colorants for contributing to textile industries: natural microbial colorants*. Notion Press; 1st edition 2020.
3. Kannaiyan, S. *Biotechnology of biofertilizers*, Narosa publishing house, New Delhi. 2002.
4. Khanka, S.S. *Entrepreneurial Development*. S Chand Publishing, New Delhi. 2006.
5. Rangaswami, G., Bagyaraj D. J. *Agricultural microbiology*, 2nd edition. Prentice hall of India. 2009.

REFERENCE BOOKS:

1. Bhatnagar, B., and Budhiraja, A. *Entrepreneurship Development and Small Business Management*. Vayu Education of India, New Delhi. 2011.
2. Brar, S.K., et al. *Biotransformation of Waste Biomass into High Value*. Springer. 2014.
3. Gupta, C.B., and Srinivasan, N.P. *Entrepreneurial Development in India*. Sultan Chand & Sons, New Delhi. 2014.
4. Palzelt H., (Editor), Thomas Brenner. *Handbook of Bioentrepreneurship*. Springer. 2008.
5. Soccol, C.R., et al. *Fermentation Processes Engineering in the Food Industry*. CRC Press. 2016.
6. Tilak, K.V.B.R. *Bacterial Biofertilizers*. IARI Publications, New Delhi. 1990.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the responsibility of an Entrepreneur.	1,2,3,4,5	Understanding
CO-2	Demonstrate the methods for isolation, identification and cultivation of biofertilizers.	1,2,4,5	Applying
CO-3	Analyze the methods for mushroom cultivation.	1,2,4,5	Analyzing
CO-4	Assess the production of value added products.	1,2,4,5	Creating
CO-5	Assess the process in production of various fermented products.	1,2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
II	21UCMB21	ENTREPRENEUR IN MICROBIOLOGY					60	3				
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PS O 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓		✓	✓	✓		✓	✓		
CO-3	✓	✓	✓		✓	✓	✓		✓	✓		
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO-5	✓	✓	✓		✓	✓	✓		✓	✓		
Number of matches (✓) = 46 Relationship = High												

Prepared by

Name :Dr.M.Senthil @ Sankar

Checked by

Dr.R.Janet Rani

Head of the Department

Signature :

Semester – II

Course Title	TECHNIQUES IN MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY
Total Hrs	30
Hrs/Week	2
Sub.Code	21UCMB2P1
Course Type	Discipline Specific Core Practical
Credits	1
Marks	50

General Objective:

The course offers practical knowledge on bacterial growth, biochemical tests used for bacterial identification and the methods used in determining enzymes, sugar and proteins.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Determine the bacterial growth.
CO-2	Perform the biochemical characterization of microbes.
CO-3	Analyse carbohydrate fermentation activity.
CO-4	Analyse the production of extracellular enzymes.
CO-5	Estimate production of Sugar, Protein and Vitamin C.

Course Outline:

1. Determination of Bacterial growth curve by turbidometry.
2. Biochemical test for identification of bacteria
 - a. Indole test
 - b. Methyl red
 - c. Voges-Proskauer test
 - d. Citrate utilization
 - e. TSI agar test
 - f. Urease
 - g. Catalase
 - h. Oxidase
3. Carbohydrate fermentation tests
 - a. Glucose
 - b. Lactose
4. Production of extra cellular enzymes
 - a. Starch hydrolysis
 - b. Casein hydrolysis
 - c. Lipid hydrolysis
5. Preparation of phosphate and citrate buffer solutions.
6. Estimation of Sugar by Anthrone method.
7. Estimation of proteins by Lowry's method.
8. Estimation of Ascorbic acid.

REFERENCE BOOKS:

1. Aneja, K.R. *Experiments in Microbiology, Plant Pathology and Biotechnology* (4th edition), New age international. 2003.
2. Cappuccino, J.G., and Sherman, N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited. 2014.
3. Dubey, R.C., Maheshwari, D.K. *Practical Microbiology*, SChand Publications. 2012.
4. Jayaraman, J. *Laboratory Manual in Biochemistry*. New Age International Private Limited. 2011.
5. Kannan, N. *Laboratory Manual in General Microbiology*. PANIMA. 2002.
6. Palanivelu, P. *Analytical Biochemistry and Separation Techniques – A Laboratory Manual*. Twenty first Century Publications. 2020.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Interpret the bacterial growth pattern.	1,2,4,5	Understanding
CO-2	Examine the isolated bacteria by various biochemical tests.	1,2,3, 4,5	Applying
CO-3	Examine the coliform and bacterial indicators to check the water quality.	1,2,4,5	Analyzing
CO-4	Organize the bacteria based on its ability to produce extracellular enzymes.	1,2,4,5	Evaluating
CO-5	Compare the cultural characteristics of bacteria.	1,2,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
II	21UCMB2P1	TECHNIQUES IN MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY					30	1		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of matches (✓) = 45 Relationship = High										

Prepared by
Name: Dr. M. Senthil @ Sankar
Head of the Department Signature:

Checked by
Dr. R. Janet Rani

Semester - II

Course Title	TECHNIQUES IN ENTERPRENEUR IN MICROBIOLOGY
Total Hrs	30
Hrs/Week	2
Sub.Code	21UAMB2P1
Course Type	Discipline Specific Allied Practical
Credits	1
Marks	100

General Objective:

The practical course focuses on understanding and standardization methods of cultivating *Spirulina*, *Azolla*, *Rhizobium*, Mushroom and *Rhizobium*.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Identify the methods for cultivation of <i>Spirulina</i> and <i>Azolla</i> .
CO-2	Practise Mushroom cultivation.
CO-3	Experiment the media and cultural conditions for mass production of <i>Rhizobium</i> .
CO-4	Formulate Vermicompost production system.
CO-5	Compare suitable method for Pigment extraction.

Course Outline:

1. Cultivation of *Spirulina*.
2. Cultivation of *Azolla*.
3. Oyster Mushroom cultivation – bag method.
4. Cultivation of VAM fungi.
5. Mass production of *Rhizobium*.
6. Demonstration of Food colorant producing fungi – *Monascuspurpureus*
7. Extraction of pigment from bacteria.
8. Vermicompost production.

REFERENCE BOOKS:

1. Ahmad, W., et al. *Application of bacterial pigments as colorant. the malaysian perspective*. SpringerBriefs in Molecular Science. 2012.
2. Biswas, S., et al. *Mushrooms: A Manual for Cultivation*, PHI. 2012.
3. Kannaiyan, S.. *Biotechnology of biofertilizers*, Narosa publishing house, New Delhi. 2002.
4. Kim, T., et al. *Cultivating Spirulina maxima: Innovative approaches*. Cyanobacteria, 61 (2018).

5. Lad, H. *A-Z Oyster Mushroom cultivation Training Book: Oyster Mushroom Cultivation*. Notion Press; 1st edition. 2020.
6. NPCS Board of Consultants & Engineers. *The Complete Technology Book on Vermiculture and Vermicompost*. Asia Pacific Business Press Inc. 2004.
7. Selvendran, D. *Large Scale Algal Biomass (Spirulina) Production in India*. In: D. Das (Ed.) *Algal Biorefinery: An Integrated Approach*, Springer. 2015.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify different isolation methods for <i>Spirulina</i> and <i>Azolla</i> .	2, 4, 5	Understanding
CO-2	Demonstrate with mushroom cultivation method.	1, 2, 4, 5	Applying
CO-3	Experiment with Vermicompost production.	1, 2, 3,4, 5	Analyzing
CO-4	Prepare mass production method of <i>Rhizobium</i> .	1, 2, 4, 5	Evaluating
CO-5	Choose suitable pigment extraction method from bacteria.	1, 2, 3,4, 5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
II	21UAMB2P1	TECHNIQUES IN ENTERPRENEUR IN MICROBIOLOGY					30	1		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓		✓	✓		✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-3	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓		✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 43 Relationship = High										

Prepared by

Checked by

Name :Dr.M.Senthil @ Sankar

Dr.R.Janet Rani

Head of the Department

Signature :

Semester – III

Course Title	ENVIRONMENTAL MICROBIOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB31
Course Type	Course Specific Core
Credits	4
Marks	100

General Objective:

The course explains the vital role and application of various microbial ecosystem, microbial processes on treatment of waste materials, biodegradation and bioremediation.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Describe the microbial community present under diverse conditions.
CO-2	Interpret the general microbes present in air and associated diseases.
CO-3	Categorize the different types of pollutant treatment using microbes.
CO-4	Formulate the industrial effluent treatment through biological treatment.
CO-5	Evaluate the role of microbes in Bioremediation.

UNIT I: MICROBIAL ECOLOGY (12 hours)

Microbial ecology- Concept, development of microbial community in biosphere, biofilm and its ecological implication. Extreme habitats microbes (extremophiles) thriving at high and low temperatures, pH, high hydrostatic and osmotic pressures, salinity, polar and low nutrient levels. Concept of metagenomics.

UNIT II: AEROMICROBIOLOGY (12 hours)

Aeromicrobiology – microbes in aerosol. Microbial Allergens (Spores) – assessment of quality of air – air borne diseases caused by bacteria, fungi and viruses – symptoms and preventive measures.

UNIT III: SOLID AND LIQUID WASTE MANAGEMENT (12 hours)

Sources and types of solid waste, methods of solid waste disposal incineration, sanitary landfill, composting. Solid and liquid based treatment, biological (aerobic, anaerobic, primary, secondary and tertiary) treatment.

UNIT IV: WATER POLLUTION (12 hours)

Water purification- aeration, sedimentation, coagulation, flocculation, sand filtration. treatment of municipal water. Treatment of waste water by aerobic and anaerobic process- Septic tank, Imhoff tanks, Activated Sludge, Trickling filters.

UNIT V: MICROBIAL DEGRADATION AND BIOREMEDIATION (12 hours)

Bioremediation of contaminated soils and marine oil pollutants. Degradation of pesticides (DDT and Propanil). Role of microbes in e-waste management and hospital waste management, Biotransformation of API (Active Pharmaceutical Ingredients), pros and cons of biotransformation. Xenobiotics, biomagnification and bioaugmentation.

TEXTBOOKS:

1. Dubey, R.C., and Maheswari, S. *A Text Book of Microbiology*, S.Chand and Co, New Delhi. 2003.
2. Kudesia, V.P., Jetley UK. *Environmental and Biochemistry*, Pragati Prakashan 2001.
3. Ramesh, K.V. *Environmental Microbiology*. MJ Publishers. Chennai. 2004.

REFERENCE BOOKS:

1. Atlas, R.N., and Bartha, R. *Microbial Ecology: Fundamentals and Applications*, 3rd Edition. Redwood City, CA Benjamin/Cummings. 1992.
2. Pelczar, Jr, et al. *Microbiology*- McGraw- Hill Inc, New York. 1993.
3. Pepper, I.L., Gerba, C.P. *Environmental Microbiology: A Laboratory manual*, 2nd Edn. Academic Press. 2004.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the physiological adaptation of microbes.	3,4,5	Understanding
CO-2	Illustrate the role of microorganisms in biogeochemical cycles.	1,2,3,4,5	Applying
CO-3	Analyze the biodegradation of various pollutants.	1,2,3,4,5	Analyzing
CO-4	Organize the bacterial indicators of water quality and safety.	1,2,4,5	Evaluating
CO-5	Assess the biological treatment of effluents of sugar, pulp and paper industry.	1,2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
III	21UCMB31	ENVIRONMENTAL MICROBIOLOGY	60	4						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓			✓	✓	✓
CO-2	✓	✓			✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 45 Relationship = High										

Prepared by

Name :Dr.M. Senthil @ Sankar

Checked by

Dr.R.Janet Rani

Head of the Department

Signature :

Semester – III

Course Title	INTRODUCTION TO COMPUTERS
Total Hrs.	30
Hrs./Week	2
Sub.Code	
Course Type	Skilled Enhancement course
Credits	2
Marks	100

General Objective:

The course teaches the basics and its function of computer, MS-office, internet, communication through internet and significance of computer in presentation of data.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Discuss the basics of computer.
CO-2	Practice MS-office.
CO-3	Use internet.
CO-4	Analyze emails.
CO-5	Prepare power point presentation.

UNIT I: BASICS OF COMPUTER(6 hours)

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software. Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

UNIT II: UNDERSTANDING WORD AND SPREADSHEET (6 hours)

Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; formatting of text; Table handling; Spell check, printing of word document.

Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet.

UNIT III: INTRODUCTION TO INTERNET, WWW AND WEB BROWSERS(6 hours)

Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet. World Wide Web; Web Browsing softwares, Search Engines; Understanding URL; IP Address.

UNIT IV: COMMUNICATIONS AND COLLABORATION(6 hours)

Basics of electronic mail; Getting an email account; Sending and receiving emails; Accessing sent emails; Using Emails; Document collaboration; Instant Messaging.

UNIT V: MAKING SMALL PRESENTATION(6 hours)

Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts.

Textbooks:

1. ITL. Education Solutions Ltd. *Introduction to Computer Science* (2ndedn). Pearson Education India. 2011.
2. Priti, S. and Pradeep, K.S. *Computer Fundamentals: Concepts, Systems & Applications* (8thedn). BPB Publications. 2004
3. Rajaraman, V and Adabala, N. *Fundamentals of Computers* (6thedn). Prentice Hall India Learning Private Limited. 2014.

Reference Books:

1. Fox, R. *Information Technology: An introduction for today's digital world*. CRC Press. 2013.
2. Lambert, JF and Curtis, D. *Microsoft Office Step By Step*, Phi Learning. 2016.
3. Peter, N. *Complete Concepts Text (Peter Norton's Introduction to Computers)*. McGraw-Hill Inc, US. 1994.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the basics of computer.	1, 5	Understanding
CO-2	Apply MS- office and its applications.	1, 5	Applying
CO-3	Analyze web browsers.	1, 5	Analyzing
CO-4	Recommend e-mail communication.	1, 5	Evaluating
CO-5	Create data presentation using MS-power point.	1, 5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
III		Introduction To Computers					30	2				
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓	✓		✓	✓				✓		
CO-2	✓	✓	✓		✓	✓				✓		
CO-3	✓	✓	✓		✓	✓				✓		
CO-4	✓	✓	✓		✓	✓				✓		
CO-5	✓	✓	✓		✓	✓				✓		
Number of matches (✓) = 30 Relationship = Medium												

Prepared by
Name :Dr.K.Chitra
Signature :

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – III

Course Title	BIOINSTRUMENTATION
Total Hrs.	60
Hrs./Week	04
Sub.Code	21UAMB31
Course Type	ALLIED THEORY – I
Credits	03
Marks	100

General Objective:

The course focuses on principle and mechanism of Bioanalytical instruments and its applications.

Course Objectives: The learners will be able to

CO	Course Objectives
CO-1	Explain the working mechanism of Fundamental laboratory instruments.
CO-2	Practice various centrifuges and electrophoresis techniques.
CO-3	Analyze the principles and working of spectroscopy methods.
CO-4	Detail the types of Chromatographic and centrifugation techniques with applications.
CO-5	Adapt the working process of Biosensors and Radioisotopes and its applications in biology.

UNIT I: BASIC INSTRUMENTATION IN MICROBIOLOGY (12 hours)

Basic Laboratory Instruments Principle and working of pH meter, Laminar-air flow, Rotary evaporator, Soxhlet apparatus, distillation unit.

UNIT II: CHROMATOGRAPHIC AND ELECTROPHORETIC TECHNIQUES (12 hours)

Theory, principles and applications of paper, thin layer (TLC, HP-TLC), gel filtration, ion exchange, affinity, hydrophobic, gas liquid (GC), high pressure/ performance liquid chromatography (HPLC)

UNIT III: CENTRIFUGATION TECHNIQUES (12 hours)

Centrifuge Basic principles of sedimentation – relative centrifugal force – Types of centrifuges (clinical, high speed, refrigerated and ultra). Centrifugation- Principles and various types – Applications. Electrophoresis techniques proteins and nucleic acids – Types of electrophoresis – Paper, Gel, Immunoelectrophoresis.

UNIT IV: COLORIMETRY AND SPECTROSCOPY (12 hours)

Principles of Colorimetry verification of Beer's law, Spectroscopic techniques, theory and applications of UV, Visible, IR, NMR and Use of NMR in elucidation biosynthesis pathways - Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.

UNIT V: RADIOISOTOPIC TECHNIQUES (12 hours)

Use of radioisotopes in life sciences, radioactive labelling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger-Muller and Scintillation counters, autoradiography and its applications – Dosimetry.

TEXT BOOKS:

1. Bajpai, P.K. *Biological Instrumentation and Methodology*. S.Chand and Co. Ltd, New Delhi, 2010.
2. Palanivelu, P. *Analytical Biochemistry and Separation Techniques*. Third edition, MKU Co-op. Press Ltd, Madurai, 2004.
3. Veerakumari, L. *Bioinstrumentation*, MJP Publishers, Chennai. 2015.

REFERENCE BOOKS:

1. Wise L.W. *Bioinstrumentation and Biosensors*, Marcel Dekker. Inc. Newyork, 1991.
2. Webster, J.G. *Bioinstrumentation*, Wiley Publication, United States, 2007.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Define theoretical knowledge of basic Laboratory equipment's.	1,2,3, 4,5	Remembering
CO-2	Demonstrate the principle and mechanism of spectroscopy.	2,3,4,5	Understanding
CO-3	Explain the principle and applications of centrifuge and electrophoresis.	2,3,4,5	Understanding
CO-4	Utilize colorimeter and spectroscopy to Separate and understand the compounds.	2,3,4,5	Applying
CO-5	Explain role of Biosensors, Radioisotopes and imaging techniques in research.	2,3,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
III	21UAMB21	Bioinstrumentation	60	03						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓		✓	✓	✓	✓
Number of matches (✓) = 46 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Checked by
Dr.R.Janet Rani
Head of the Department

Signature:

Semester – III

Course Title	TECHNIQUES IN ENVIRONMENTAL MICROBIOLOGY
Total Hrs.	30
Hrs./Week	02
Sub.Code	21UCMB3P1
Course Type	Discipline Specific Core Practical III
Credits	01
Marks	50

General Objective:

The course provides practical knowledge to isolate, handle and analyze the microorganisms from various samples.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the practical concepts of isolation, identification, Measurement of bacteria and fungi from air and waste water.
CO-2	Practice the role of bacterial indicators to check water quality.
CO-3	Test the total Coliforms using MPN method.
CO-4	Perform the isolation process of cellulose degrading bacteria.
CO-5	Plan to isolate <i>Pseudomonas sp</i> for pesticide tolerance.

Course Outline

1. Isolation of *E. coli* and fungi from waste water
2. Measurement of microbial activity in soil by soil respiration method.
3. Microbial assessment of air quality - open plate, impingement method (bacteria and fungi).
4. Evaluation of total Coliforms-MPN method.
5. Bacterial indicators for water quality.
6. Isolation of Cellulose degrading bacteria.
7. Screening of *Pseudomonas sp* for pesticide tolerance.
8. Sewage treatment – demonstration.

REFERENCE BOOKS:

1. Cappuccino, J.G., and Sherman, N. *A laboratory Manual Microbiology – Benjamin CUMMINS*, New York, 1996.
2. Dubey, D.C., and Maheshwari, D.K. *Practical Microbiology*, S. Chand and Company Pvt Ltd, Delhi, 2012.
3. Kannan, N. *Laboratory Manual in General Microbiology – Palani Paramount Publ*, Palani, 1996.

Course Outcomes

CO. No	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the isolation process of <i>E.coli</i> and fungi from waste water.	1,2,3,4,5	Understanding
CO-2	Demonstrate the microbial activity by soil respiration method.	2,3,4,5	Applying
CO-3	Examine the air quality using open plate and impingement method (bacteria and fungi).	2,3,4,5	Analyzing
CO-4	Determine the total Coliforms using MPN method.	2,3,4,5	Analyzing
CO-5	Perform the isolation process of cellulose degrading bacteria and <i>Pseudomonas</i> sp for cellulose degradation and pesticide tolerance.	2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
III	21UCMB3P1	Techniques in Environmental Microbiology					30	01		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓		✓	✓	✓	✓
Number of matches (✓) = 46 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Signature:

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – III

Course Title	Techniques in Bioinstrumentation
Total Hrs.	30
Hrs./Week	02
Sub.Code	21UAMB3P1
Course Type	Allied II
Credits	01
Marks	50

General Objective:

The course provides hands on training of general laboratory equipments, computational and data-handling experiences in lab exercise.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the skills required to separate amino acids, proteins and bio-active compounds.
CO-2	Demonstrate the mechanism of chromatography technique.
CO-3	Make use of soxhlet apparatus in extraction of bio active compounds.
CO-4	Determine the pH value using pH meter.
CO-5	Elaborate mechanism of SDS-PAGE for protein isolation.

Course Outline

- 1) Preparation of Buffer
- 2) Determination of pH using pH meter.
- 3) Verification of Beer-Lambert's Law using Spectrophotometer
- 4) Separation of amino acids using Paper chromatography
- 5) Separation of bio-active compounds using aqueous and organic solvents
- 6) Extraction of plant compounds using soxhlet apparatus
- 7) High performance liquid chromatography (Demonstration)
- 8) Separation of Protein using SDS-PAGE (Demonstration)

REFERENCE BOOKS:

1. Cappuccino, J.G., and Sherman, N. *Microbiology – A Laboratory Manual*. Benjamin Cummins. New York, 1996.
2. Dubey, D.C., and Maheshwari, D.K. *Practical Microbiology*, S. Chand and Company pvt ltd, Delhi, 2012.
3. Guansekar, P. *Laboratory Manual in Microbiology*, New Age International Ltd, Publishers, New Delhi, 1996.
4. Jayaraman, J. *Laboratory Manual in Biochemistry*, Wiley Eastern Ltd, New Delhi, 1985.
5. Kannan. N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani, 1996.
6. Sundararaj T. *Microbiology – Laboratory Manual. (1st Edition)*. Pub In. Sundararaj. T, Chennai, 2005.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the process of buffer preparation and determine the pH using pH meter.	2,3,4,5	Understanding
CO-2	Analyze the Beer Lambert law using Spectrophotometer.	2,3,4,5	Analyzing
CO-3	Estimate Amino acids using Paper Chromatography.	1, 2,3,4,5	Evaluating
CO-4	Assess bioactive compounds from using soxhlet apparatus.	2,3,4,5	Evaluating
CO-5	Discuss the mechanism of HPLC and SDS PAGE to separate bioactive compounds and proteins.	2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
III	21UAMB3P1	Techniques in Bioinstrumentation					30	01		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 47 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Signature:

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – III

Course Title	VERMICULTURE AND MUSHROOM TECHNOLOGY
Total Hrs.	30
Hrs./Week	2
Sub.Code	21UNMB31
Course Type	Non- major elective
Credits	2
Marks	100

General Objective:

The course focuses on explaining the role of earthworms in soil, its cultivation and harvest methods. Furthermore, the course includes the importance, types and cultivation of mushrooms.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the importance of earthworms in soil.
CO-2	Demonstrate the vermiculture techniques.
CO-3	Differentiate the methods of vermicompost.
CO-4	Prepare the importance of industrial mushrooms.
CO-5	Select the mushroom cultivation methods.

UNIT I: VERMITECHNOLOGY (6 hours)

Definition, Introduction, Scope and Importance of vermitechology. Habitat of Earthworm - Soil, Chemical and biological changes brought by earthworm in soil.

UNIT II: VERMICULTURE TECHNIQUES (7 hours)

Steps involved in vermiculture-site selection for vermiculture, species selection, vermibed, inoculation of earthworms, feeding, suitable condition, Harvesting, vermiculture process-Factors influencing the culture of earthworms.

UNIT III: METHODS OF VERMICOMPOSTING (5 hours)

Batch system, Continuous flow system, Pit method, Heap method, Bin or tray method. Vermiwash- Preparation, composition of vermiwash, Applications of vermiwash. Role of vermicompost in crop production

UNIT IV: INTRODUCTION TO MUSHROOM (6 hours)

Morphology – habitat- Importance of mushrooms – as food (Oyster mushroom) and medicines (Ganoderma).

UNIT V: MUSHROOM CULTIVATION (6 hours)

Mushroom cultivation – Spawn preparation and mushroom bed preparation- Applications – bioconversion of organic wastes into protein rich mushrooms.

TEXTBOOKS:

1. Bahl, N. *Handbook on mushrooms*. Oxford and IBH Co, Pvt. Ltd, New Delhi. 2000.
2. Gupta, P.K. *Vermicomposting for sustainable agriculture*. Agrobios. 2008.
3. Lekshmy, M.S. R., and Santhi, N. *Vermitechnology*, Saras Publication.
4. Ranganathan, L.S. *Vermibiotechnology from soil health to human health*. Agrobios. 2006.

REFERENCE BOOKS:

1. Biswas, S., et al. *Mushrooms: A Manual for Cultivation*, PHI. 2012.
2. Changs, T., and Hayanes, W.A. (Ed.) *Biology and Cultivation of Edible Mushrooms*. Academic Press. N.Y. 1978.
3. Pathak, V.N. *Mushroom Production and Processing Technology*. IST Edition. Agrobios. 2011.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the importance of earthworms.	PSO- 2, 4,5	Understanding
CO-2	Demonstrate the steps involved in vermiculture.	PSO-1, 2, 4, 5	Applying
CO-3	Experiment the methods of vermicomposting.	PSO-1, 2, 4, 5	Analyzing
CO-4	Prepare the importance of mushrooms.	PSO-1, 2, 4, 5	Evaluating
CO-5	Compare the medicinal and food-grade mushrooms.	PSO-1, 2, 4, 5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
III	21UNMB31	VERMI CULTURE AND MUSHROOM TECHNOLOGY	30	2						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓		✓		✓		✓	✓
CO-2	✓	✓	✓		✓	✓	✓		✓	✓
CO-3	✓	✓	✓		✓	✓	✓		✓	✓
CO-4	✓	✓	✓		✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of matches (✓) = 40 Relationship = High										

Prepared by
Name :Dr.M. Senthil @ Sankar

Checked by
Dr.R.Janet Rani
Head of the Department

Signature :

Semester – IV

Course Title	MICROBIAL BIOTECHNOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB41
Course Type	Course Specific Core
Credits	4
Marks	100

General Objective:

The course is formulated with an objective to provide basic concepts, and molecular techniques underlying ethical issues, biotechnology research and innovation.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the importance of biotechnology.
CO-2	Demonstrate DNA and its types.
CO-3	Analyze RNA and its types.
CO-4	Design different molecular techniques.
CO-5	Select Plant and animal tissue culture techniques.

UNIT I: INTRODUCTION TO BIOTECHNOLOGY (12 hours)

Biotechnology – history, scope and importance of Biotechnology. Branches of Biotechnology- Plant, Animal, Marine, Agriculture, Healthcare, Industrial, Pharmaceutical, Environmental. Nucleic acid–Nucleosides, Nucleotides - Structure of Nucleotides – DNA- Composition and structure - DNA double helix – other types of DNA - structure - Size of the DNA molecule. RNA and types.

UNIT II: RIBONULEIC ACID (12 hours)

RNA- Structure of RNA – Types of RNA (Structure and functions) - Messenger RNA - Transfer RNA - Ribosomal RNA -other types of RNA. Proteins- Amino acids- types and classification of Aminoacids. Purification and Separation of Nucleic Acids and Proteins– Gel Electrophoresis – AGE, SDS PAGE. Genetic Code.

UNIT III: TISSUE CULTURE (12 hours)

Plant tissue culture- applications. Organogenesis and somatic embryogenesis. Protoplast culture and fusion. Agrobacterium mediated transformation in plants. Animal tissue culture – Different cell lines, Monolayer culture.

UNIT IV: PCR AND RECOMBINANT TOOLS (12 hours)

PCR-definition, steps involved. Types of PCR- RT PCR, real-time PCR, Reverse- Transcriptase (RT-PCR), Multiplex PCR, Nested PCR. Recombinant DNA- importance of gene cloning- properties of Cloning Vectors. Types - Plasmids- pBR322, pUC18.

Bioconversions: Biomining and bioleaching of ores (Use of thermophilic microorganisms). Bio-gas, Bio-leaching, Bio-diesel, biopolymer.

UNIT V: APPLICATION AND ETHICAL ISSUES (12 hours)

Applications of Biotechnology in Agriculture- GM Papaya, GM Tomato- Fungal and Insect Resistant Plants. BT Cotton - Pros and Cons. Ethics in Biotechnology and intellectual property (IPR).

TEXTBOOKS:

1. Bhojwani, S.S., and Razdan, M.K. *Plant Tissue Culture: Theory and Practice*, Volume 5 1st Edition. 1996.
2. Dubey, R.C. *A Text of Biotechnology*. Multicolor Illustrative edition, S. Chand and Company Ltd, New Delhi. 2005.
3. Gupta, P.K. *Elements of Biotechnology*. Rastogi Publications. 2005.
4. Nambisan, P. *An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology*. Academic Press. 2017.
5. Narayanaswami, K. *Safety and regulatory arrangements in Biotechnology* in Sohal and Srivastava (eds) *Environment and Biotechnology*. 1994.
6. Pasupuleti, M. *Molecular Biotechnology*. MJP Publishers, Chennai. 2006.
7. Rema, L.P. *Applied Biotechnology*. MJP Publishers, Chennai. 2006.
8. Satyanarayanan, U. *Biotechnology*. First edition, Books and Allied (P) Ltd. 2005.
9. Trevan, M.D., et al. *Biotechnology – The basic principles* – Tata McGraw Hill edition. 1990.

REFERENCE BOOKS:

1. Glazer, N.A., and Nikaido, H. *Microbial Biotechnology: Fundamentals of Applied Microbiology* 2nd edition, Cambridge University Press. 2007.
2. Glick, B.R., and Cheryl, L. Patten. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, 5th Edition. ASM press. 2017.
3. Glick, B.K., and Pasternik, J.J. *Molecular Biotechnology. Principles and applications of recombinant DNA*. [Second Edition]. ASM Press. 1998.
4. Ramawat, K., and Goyal, S. *Molecular Biology and Biotechnology*. 1st edition, S.Chand and company Ltd, New Delhi. 2010.
5. Ratledge, C., and Kristiansen, B. *Basic Biotechnology*, 2nd Edition, Cambridge University Press. 2001.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the historical events and the scope of biotechnology.	1, 2, 4, 5	Understanding
CO-2	Illustrate the composition, structure of DNA and RNA.	1, 2, 3, 4, 5	Applying
CO-3	Analyze the theoretical aspects of separation of nucleic acid and protein.	1, 2, 3, 4, 5	Analyzing
CO-4	Formulate the plant and animal tissue culture by using various techniques.	1, 3, 4	Evaluating
CO-5	Select the diagnostic techniques in medical and pharmaceutical fields.	1, 2, 3, 4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
IV	21UCMB41	MICROBIAL BIOTECHNOLOGY					60	4				
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓		✓	✓			
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Number of matches (✓) = 46 Relationship = High												

Prepared by

Name : Dr.M. Senthil @ Sankar

Signature :

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – IV

Course Title	SOFT SKILLS
Total Hrs	30
Hrs/Week	2
Sub.Code	21USSS41
Course Type	Skill Based
Credits	2
Marks	100

General Objective:

The course is focused to develop and nurture the soft skills through individual and group activities, personality and the employability skills.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Describe the significance of Soft Skills.
CO-2	Apply and improve Interpersonal relations
CO-3	Analyze and improve Public speaking.
CO-4	Prepare the parameters in Group discussion.
CO-5	Assess the Interview skills.

UNIT I: INTRODUCTION TO SOFT SKILLS (6 hours)

An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. Self-Discovery: Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Positivity and Motivation: Developing Positive Thinking and Attitude; Enhancing Motivation Levels.

UNIT II: INTERPERSONAL COMMUNICATION (6 hours)

Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.

UNIT III: PUBLIC SPEAKING AND GROUP DISCUSSION (6 hours)

Skills, Methods, Strategies and Essential tips for effective public speaking. Group Discussion: Importance, Planning, Skills assessed; effectively disagreeing, Initiating, Summarizing and Attaining the Objective. Non-Verbal Communication: Importance and Elements; Body Language.

UNIT IV: INTERVIEW SKILLS (6 hours)

Interviewer and Interviewee – Before, During and After the Interview. Presentation Skills: Types, Content, Audience Analysis, Overcoming Nervousness. Etiquette and Manners, Time Management – Concept, Essentials.

UNIT V: DECISION MAKING AND PROBLEMSOLVING SKILLS (6 hours)

Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution. Stress Management: Stress - Definition, Types,

Symptoms and Causes; Management of Stress. Leadership and Assertiveness Skills: A Good Leader; Types of Leaders; Leadership Behaviour; Assertiveness Skills.

TEXTBOOKS:

1. Dhanavel, S.P. *English and Soft Skills*. Orient Blackswan. 2010.
2. Ghosh, B.N. *Managing Soft Skills for Personality Development*. McGraw Hill. 2017.
3. Lata, P., and Kumar, S. *Communicate Or Collapse: A handbook of effective public speaking, group discussions and interviews*. Prentice Hall India Learning Private Limited. 2007.

REFERENCE BOOKS:

1. Brent, M., and Dent, F. *The leader's guide to managing people: how to use soft skills to get hard results*. Pearson Education. 2020.
2. Rayapeddi, V. *Soft Skills: To Ace All Interviews*. Notion Press; 1st edition. 2019.
3. Sharma, P. *Soft skills personality development for life success*. BPB Publications. 2018.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Identify the important aspects of soft skills.	5	Understanding
CO-2	Practise the interpersonal relationship skills.	5	Applying
CO-3	Experiment with the Strategies for effective public speaking.	5	Analyzing
CO-4	Formulate the process for group discussion.	5	Evaluating
CO-5	Evaluate the importance of interview process.	5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
IV	21USSS41	SOFT SKILLS	30	2						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓					✓
CO-2	✓	✓	✓	✓	✓					✓
CO-3	✓	✓	✓	✓	✓					✓
CO-4	✓	✓	✓	✓	✓					✓
CO-5	✓	✓	✓	✓	✓					✓
Number of matches (✓) = 30 Relationship = Medium										

Prepared by
Name :Dr.M. Senthil @ Sankar

Checked by
Dr.R.Janet Rani
Head of the Department

Signature :

Semester IV

Course Title	FOOD PROCESSING AND QUALITY CONTROL
Total Hrs.	30
Hrs./Week	2
Sub.Code	21USMB42
Course Type	Skill Elective
Credits	2
Marks	100

General Objective:

The course focuses on the post-harvest process and its importance, food packaging material and techniques, and importance of quality control in food processing industry.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Understand the basics of Food processing.
CO-2	Apply the sensory assessment to check the food quality.
CO-3	Categorize food packaging materials.
CO-4	Interpret the modern concept of food package technology.
CO-5	Assess the importance of quality control in food processing industry.

UNIT I: BASICS OF FOOD PROCESSING (5 hours)

Introduction- Post Harvest Technology - Introduction, Definition, Primary and secondary processing- Importance. Definition and importance of sensory evaluation, Quality attributes –appearance, flavor, texture and additional quality factors.

UNIT II: SENSORY ASSESSMENT OF FOOD QUALITY (6hours)

Taste (Gustation) - Introduction and importance. Taste sense to mouth, tongue. Chemical dimensions of basic tastes- sweet, bitter, sour, salt and umami, Taste enhancers, perception of taste, Taste measurement- E-tongue. Odour And Flavor (Olfaction) Introduction and importance of odour and flavor, Smelling techniques- Vonskramlk Test, E- Nose. Colour - Introduction and importance. Texture -Introduction, and importance, Texture classification.

UNIT III: FOOD PACKING (7 hours)

Definition, functions and requirements for effective packaging. Classification of food packaging Primary, secondary and tertiary packaging. Flexible, rigid and Semi- rigid packaging. Materials for Food Packaging- types, uses, merits and draw backs- Paper, Glass, Tin, Aluminium, Plastic, Boxes, Jars, Cans, Bottles. Interaction between food packaging material and foods- Tin can corrosion and Global migration of plastics.

UNIT IV: MODERN CONCEPTS OF PACKAGING TECHNOLOGY (6 hours)

Aseptic packaging, Form Fill Seal packaging, Edible Films, Vacuum, Controlled atmospheric Packaging, Retort Pouches, Active and intelligent packaging systems. Easy - Open End, Boil in- bags, Closures.

UNIT V: QUALITY ASSURANCE AND QUALITY CONTROL (6 hours)

Definition of Quality Assurance, Difference between QA and QC. Total Quality Control- Definition, History, approaches, advantages and limitation. Definition of Statistical Quality Control- Definition, History, Characteristics, Advantages and limitation of SQC.

Textbooks:

1. Davis, E.G. *Evaluation of tin and plastic containers for food*. CBS publishers. New Delhi.2004.
2. Potter, N.N. and Hotchkiss, J. H. *Food Science*. CBS Publishers, New Delhi. 2000.
3. Srilakshmi, B. *Food Science*, New Age International (P) Limited, New Delhi. 2005.

Reference Books:

1. Jellinek, G. *Sensory Evaluation of Food- Theory and Practice*. Elis Horwood Ltd England. 1985.
2. Kher, C.P. *Quality control for the food industry*. ICT Publishers, Geneva. 2000.
3. Manay, S. and Shadaksharaswamy, M. *Food Facts and Principles*. New Age International (P) Limited, New Delhi. 2008.
4. Sacharow, S., and Griffin, R.C. *Food Packaging*. AVI publishing Company, West Port, Connecticut.2000.

Course Outcome (CO)

CO	Upon completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	Explain the significance of the food processing technology.	1,2,4, 5	Understanding
CO-2	Examine the quality of food by sensory assessment.	1,2,4, 5	Applying
CO-3	Make use of different materials for food packaging.	1,2,4, 5	Applying
CO-4	Summarize the modern techniques for food package.	1,2,4, 5	Analyzing
CO-5	Assess the significance of the quality control in food industry.	1,2,4, 5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21USMB42	FOOD PROCESSING AND QUALITY CONTROL					60	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of matches (✓) = 45 Relationship = High										

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – IV

Course Title	Pharmaceutical Microbiology & Quality Assurance
Total Hrs.	60
Hrs./Week	04
Sub.Code	21UAMB41
Course Type	Allied Theory
Credits	03
Marks	100

General Objective:

The course focus on microbial control, antimicrobial agents, Microbiological assays, drug resistance, cGMP, QC, quality certifications and regulatory affairs in manufacturing industry.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Define therapeutic usage of antibiotics in Medicines.
CO-2	Demonstrate sterilization and methods of microbial assay.
CO-3	Inspect spoilage and disinfectants.
CO-4	Assess the Quality Standards of Pharmaceutical products.
CO-5	Improve the Quality Assurance of APIs.

UNIT I: INTRODUCTION TO ANTIBIOTICS (12 hours)

Antibiotic agents History, Properties, therapeutic, prophylactic usage and adverse reactions; Mechanism of action of antibiotics. Inhibition of cell wall synthesis, nucleic acid and protein synthesis – β – lactam, amino glycosides, tetracyclines, macrolides. Antifungal antibiotics Griseofulvin. Antiviral drugs Amantidines and interferons. Microbial resistance to antibiotics Penetration of antimicrobial agents - Cellular permeability barrier, cellular transport system and drug diffusion.

UNIT II: STERILIZATION AND MICROBIAL ASSAY (12 hours)

Sterilizations Steam, dry heat, Radiation, Gaseous and Filtration for bacteriostatic and bactericidal actions. Microbiological assay Principle and methods of different microbiological assay. Safety profile of drugs pyrogenicity, Toxicity – Hepato – Hepato, - nephro, - cardio and neurotoxicity. Toxicological evaluation of drug LC50, Acute, Subacute and chronic toxicity. Sterility test of products solid, liquid, ophthalmic and other sterile products according to Pharmacopeia standards like IP, BP, USP.

UNIT III: SPOILAGE, PRESERVATION AND DISINFECTANTS (12 hours)

Spoilage Types, sources, assessment of microbial contamination and spoilage. Preservation objectives, ideal preservative properties. Antimicrobial agents, evaluation of microbial stability of formulations. Disinfectant Classification and mode of action of disinfectants, antiseptics and their evaluation.

UNIT IV: QA STANDARDS (12 hours)

Quality assurance Microbiological quality standards. Government regulatory practices and policies. FDA, EPA, HACCP, ISI.

UNIT V: QUALITY ASSURANCE (12 hours)

Objectives, Importance and Functions of quality Assurance Role of quality audit. Total Quality Management. Quality control, methods – raw materials, manufacturing process and finished products. Biosafety Concept and issues.

TEXT BOOKS:

1. Hugo, W. B., and Russell A.D. *Pharmaceutical Microbiology*. Sixth Edition, The Black well Science Ltd, UK, 1998.
2. Mehra P.S. *A Text book Pharmaceutical Microbiology*, I.K. International Publishing House, New Delhi, 2011.
3. Quality Assurance Guide by organization of *Pharmaceutical Products of India*.
4. Reed, G. Prescott and Dunn's *Industrial Microbiology*. Macmillian Publishers, UK, 1982.
5. Sandle, T, *Pharmaceutical Microbiology. Essentials for Quality assurance and Quality control*. Wood head Publishing, Sawston, Cambridge, 2015.

REFERENCE BOOKS:

1. Maitra,K., and Ghosh, S.K. *A guide to Total Quality Management*,
2. *Good Laboratory Practice Regulations*, 2nd Edition, Sandy Weinberg Vol. 69.
3. Deckker, M. *Good laboratory Practices–Series9*. ICH guidelines, ISO 9000 and 14000 guidelines.
4. Sharma, P. *How to Practice GMP's –Series 6*. ISO 9000 and *Total Quality Management* – Sadhank G Ghosh.
5. *Quality Assurance of Pharmaceuticals- A compendium of Guide lines and related materials Vol I* WHO Publications.
6. The International Pharmacopoeia – Vol I, II, III, IV- *General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms*.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Describe the mechanism of action of Non-therapeutic antimicrobial and therapeutic antimicrobial agents.	1,2,3,4, 5	Understanding
CO-2	Practice various process of sterility testing, disinfects and microbial assays.	1,2,3,4, 5	Applying
CO-3	Detail the mechanism of Microbial spoilage, antimicrobial preservation and application of disinfectants.	1,2,3,4, 5	Analyzing
CO-4	Estimate the Quality Standards of Pharmaceutical products.	1,3,4, 5	Evaluating
CO-5	Assess the pharmaceutical standards & quality Assurance practices.	1,3,4, 5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21UAMB41	Pharmaceutical Microbiology & Quality Assurance					60	03		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
Number of matches (✓) = 48 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Checked by
Dr.R.Janet Rani
Head of the Department

Signature:

Semester – IV

Course Title	TECHNIQUES IN BIOTECHNOLOGY
Total Hrs.	30
Hrs./Week	02
Sub.Code	21UCMB4P1
Course Type	Core Practical
Credits	01
Marks	50

General Objective:

The course focuses to understand complexity of genetic process, technique of vectors biology of bacteria and microbes.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Discuss the practical concept to isolation and confirmation of genomic DNA and Plasmid DNA from <i>E.coli</i> .
CO-2	Examine the genomic DNA and RNA.
CO-3	Describe protein separation techniques like SDS-PAGE.
CO-4	Illustrates the importance of immobilization of enzymes and raw materials in manufacturing process.
CO-5	Apply the nature of plant and animal growth processes in the tissue culture environment.

Course Outline:

1. Isolation of genomic DNA from *E. coli*.
2. Isolation of Plasmid DNA.
3. Protein separation by SDS – PAGE.
4. Estimation of genomic DNA.
5. Estimation of RNA.
6. Immobilization of an enzyme or Cell.
7. Plant Tissue culture – Micro propagation (Demonstration).
8. Animal cell Culture – Monolayer Culture (Demonstration)

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain process of genomic and plasmid DNA from <i>E.coli</i> .	1,2,3,4,5	Understanding
CO-2	Identify proteins and separate using SDS-PAGE.	1,2,3,4,5	Applying
CO-3	Estimate the quantification of Genomic DNA & RNA using spectrophotometer.	1,2,3,4,5	Evaluating
CO-4	Perceive knowledge to immobilize enzyme or cells for long time storage.	1,3,4,5	Evaluating
CO-5	Perform plant and animal tissue culture in plant propagation and cell line cultures.	1,2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21UCMB4P1	TECHNIQUES IN BIOTECHNOLOGY					30	01		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 49 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Checked by
Dr.R.Janet Rani
Head of the Department

Signature:

Semester – IV

Course Title	TECHNIQUES IN PHARMACEUTICAL MICROBIOLOGY
Total Hrs.	30
Hrs./Week	02
Sub.Code	21UAMB4P1
Course Type	Allied II/2P
Credits	01
Marks	50

General Objective:

The course focuses on microorganisms in our life, production of pharmaceutically active compounds and its applications.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Interpret the nature of pharmaceutical products by observation.
CO-2	Demonstrate the solubility of drug at room temperature.
CO-3	Calculate the microbial load in pharmaceutical products.
CO-4	Estimate the nature of antibiotics by assaying cup plate method and MIC.
CO-5	Assesses Pyrogen present in pharmaceutical products.

Course outline

1. Observation of pharmaceutical product details.
2. Determination of solubility of drug at room temperature.
3. Enumeration of microbial load in pharmaceutical products.
4. Microbiological assay of antibiotics by cup plate method and other methods.
5. Determination of MIC.
6. Pyrogen test (demonstration).

REFERENCE BOOKS:

- 1) Beckett, A.H., and Stenlake's J.B. *Practical Pharmaceutical Chemistry Vol I and II*, Stahlone Press of University of London, 1962.
- 2) Vogel, A.I. *Text Book of Quantitative Inorganic analysis*, 1978.
- 3) Dubey, D.C. Maheshwari DK, *Practical Microbiology*, S. Chand and Company pvt ltd, Delhi, 2012.
- 4) Hugo, W.B., and Russel, A.D. *Pharmaceutical Microbiology*, Blackwell Scientific publications, Oxford London, 2007.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain nature of pharmaceutical products and its efficacy.	1,2,3,4,5	Understanding
CO-2	Develop the exact solubility nature of drugs at specific pH and room temperature.	1,2,3,4,5	Applying
CO-3	Analyze the drug manufacturing process.	2,3,4,5	Analyzing
CO-4	Compare the potency of antibiotics by various microbial assays.	2,3,4,5	Evaluating
CO-5	Discuss MIC of drugs and estimate Pyrogen in pharmaceutical products.	2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21UAMB4P1	TECHNIQUES IN PHARMACEUTICAL MICROBIOLOGY					30	01		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓		✓	✓	✓	✓
Number of matches (✓) = 47 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief

Signature:

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – IV

Course Title	AQUACULTURE AND APICULTURE
Total Hrs.	30
Hrs./Week	02
Sub.Code	21UNMB41
Course Type	Non Major Elective (NME)
Credits	02
Marks	100

General Objective:

This course focuses on general characters, practices and management of aquaculture and apiculture.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Discuss the culture practices of both fin fish and shell fishes, feeding and breeding techniques.
CO-2	Demonstrate the development of aquatic organisms and its habitat conditions.
CO-3	Detail the importance of fish feeding and its production methods.
CO-4	Examine the fish pathogenic diseases and its management.
CO-5	Discuss about honey bees, its life style, social behavior, equipments, colonization, honey extraction and its marketing.

UNIT I: BASICS OF AQUACULTURE (4 hours)

Definition, Scope of aquaculture - Aquaculture in India- Fresh water, Coastal and marine aquaculture- Culturable organisms and their qualities.

UNIT II: FISH CULTURE (5 hours)

Types of cultures - Extensive, Semi-intensive and Intensive culture, Monoculture, Polyculture. Integrated fish farming- Paddy cum fish culture, Sewage fed fish culture.

UNIT III: FISH FEED AND DISEASES (6 hours)

Fish feed- Definition, Classification of feed- Live feed, artificial feed. Composition of fish feed. Fish feed formulation- Principles, Preparation of artificial feed. Feeding Schedule, Feeding methods. Fish Diseases- Bacterial diseases (Erythroderma, Gill rot, Enteritis), Fungal Diseases (Gill rot, Saprolegniasis), Protozoan diseases (White spot disease, Whirling disease).

UNIT IV: APICULTURE (7 hours)

Introduction, Scope, History of Apiculture. Advantages of Bee Keeping. Choice of bee in Apiculture- Desirable traits for bee keeping, Good Choice, Best Choice and Poor choice. Bee keeping methods- Wall hive, Pot hive, Bamboo hive, Modern Bee-keeping. Appliances of Apiaries, Honey Extraction

UNIT V: PRESERVATION AND STORAGE OF HONEY (8 hours)

Honey- Properties, Chemical composition, Nutritional value of Honey, Medicinal value. Honey Processing, Bottling and Packing, Storage of Honey.

TEXT BOOKS:

1. Aennan, J.F, and Smiteman,R.O.*Principles and practices of Pond Aquaculture*,Oregon State University, U.S.A, 1983.
2. Arumugam, N. *Aquaculture*,Saras Publication, 2016.
3. Cherian, R., and Ramanathan, K.R. *Bee keeping in India*, 1992.
4. Jayashree, K.V., et al.*Apiculture*, Sara’s publishers, 2014.
5. Jhingran, V.G.*Fish and Fisheries in India*, Hindustan Publishing Corporation, New Delhi, 1982.
6. Mishra, R.C. *Honey bees and their Management in India*, ICAR, 1985.

REFERENCE BOOKS:

1. Akpaniteaku, R. *Basic Handbook of Fisheries and Aquaculture*,Akinik Publications, 2018.
2. Egna,H.S., and Boyd, C.E. *Dynamics of Pond Aquaculture*, CRC Press, 1997.
3. Stickney, R.R. *Encyclopedia of Aquaculture*, John Wiley & Sons Publishing Corporation, 2000.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain about fish farm construction and its management.	1,3,4,5	Understanding
CO-2	Apply aquaculture techniques in fish culture practices.	1,3,4,5	Applying
CO-3	Explain fish feeding, breeding and rearing techniques.	1,3,4,5	Evaluating
CO-4	Explain fish pathogenic diseases with suitable treatment methods.	1,3,4,5	Evaluating
CO-5	Develop knowledge about apiculture, disease management and economic importance.	1,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21UNMB41	Aquaculture and Apiculture					30	02		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓		✓	✓	✓
CO-2	✓	✓	✓	✓		✓		✓	✓	✓
CO-3	✓	✓	✓	✓		✓		✓	✓	✓
CO-4	✓	✓	✓	✓		✓		✓	✓	✓
CO-5	✓	✓	✓	✓		✓		✓	✓	✓
Number of matches (✓) = 40 Relationship = High										

Prepared by
Name: Mr.S.HameedullahSherief
Signature:

Checked by
Dr.R.Janet Rani
Head of the Department

V SEMESTER

Course Title	IMMUNOLOGY
Total Hrs.	75
Hrs./Week	5
Sub.Code	21UCMB51
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course covers on the basic concept of immunity, structure, types, functions of immunoglobulin and antigens, types of vaccines, and immunodeficiency diseases.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the organ and cells of the immune system.
CO-2	Illustrate the structure and functions of immunoglobulin and antigen.
CO-3	Summarize antigen neutralization process.
CO-4	Classify the hypersensitivity reactions.
CO-5	Justify the importance of different types of vaccines .

UNIT I: INTRODUCTION TO IMMUNOLOGY (15 hours)

Introduction - History and the scope of immunology. Types of immunity – Innate and Acquired. Cell and humoral mediated immunity. Immuno organs and Cells Immune system – Structure and Function of Primary lymphoid organ- **Bone marrow**, Thymus- Bursa of Fabricus- Structure and Function of Secondary lymphoid organs- Lymph nodes, Spleen, Mucosa associated lymphoid organs. Cells of the immune system – Lymphocytes- T and B cells, Null cells, Phagocytic cell.

UNIT II: ANTIGENS AND IMMUNOGLOBULINS (15 hours)

Antigens- Types, properties, haptens – adjuvants – Immunoglobulins. Structure, Types, Properties and Functions. Monoclonal Antibody- Production (Hybridoma technology). Immunological Techniques - Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Immunofluorescence, Radio immunoassay.

UNIT III: HISTOCOMPATIBILITY AND COMPLEMENT SYSTEM (15 hours)

Major Histocompatibility Complex Organization of MHC locus Structure and Functions of MHC I and II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways) Complement System Components of the Complement system; Activation pathways (Classical, **Alternative and Lectin pathways)**

UNIT IV: HYPERSENSITIVITY AND TRANSPLANTATION (15 hours)

Hypersensitivity reactions – antibody mediated, Type I anaphylaxis, Type II – Antibody dependent cell cytotoxicity, Type III – immune complex

reactions – cell mediated immune responses – Type IV – Hypersensitivity reactions. Transplantation types, immunological mechanisms of graft rejection- immunological strategies to prevent graft rejection-

UNIT V:IMMUNODEFICIENCY DISEASES AND VACCINES(15 hours)

Vaccines – types - Live, killed, recombinant DNA, edible vaccines, plantibodies. Toxoid. Immunodeficiency disorder- primary (x-linked disorder) and secondary (diabetes)- symptoms, diagnosis and treatment.

Textbooks:

1. Begum, F. *Monoclonal antibodies: The hopeful drugs*. MJP Publisher, Chennai. 2008.
2. Kannan, I. *Immunology*. MJP Publisher, Chennai. 2007.
3. Madhaveelatha, P. *A textbook of immunology*. S. Chand & Company. 2012.
4. Vamanrao, C. *Immunology* (2ndedn). Narosa Publishing House, New Delhi. 2007.

Reference Books:

1. Abbas, A.K., *et al.*, *Basic Immunology* (4thedn). Saunders. 2012.
2. Ananthanarayan., and Panicker A. *Textbook of Microbiology* (8thedn) Orient Longman 2009
3. Kuby. *Immunology* (2ndedn). W.H.Frumen and Company, New York. 1993.
4. Roit, I.M. *Essential Immunology* – Blackwell Scientific Publications, Oxford. 1994.

Course Outcomes

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive Level
CO-1	Outline the structure and functions of primary and secondary lymphoid cells.	PSO- 1, 4,5	Understanding
CO-2	Illustrate the structure, types and functions of immunoglobulin, antigen.	PSO- 1, 4,5	Applying
CO-3	Examine the neutralize process of the antigen	PSO-1,2,3, 4,5	Analyzing
CO-4	Assessthe different types of hypersensitivity reaction against the allergen.	PSO-1,2,3, 4,5	Evaluating
CO-5	Recommend the appropriate vaccines to the specific infections.	PSO-1,2,3, 4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V	21UCMB51	Immunology	75	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓			✓	✓
CO-2	✓	✓	✓	✓	✓	✓			✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 46 Relationship = High										

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – V

Course Title	MICROBIAL GENETICS
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB52
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course is constructed to be familiar with basic knowledge on structure of nucleic acids, concepts in transcription, translation and mutation process.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Summarize the principles and organization of the genetic material- DNA, RNA.
CO-2	Illustrate the structure of DNA, RNA and plasmids.
CO-3	Arrange the steps involved in replication process.
CO-4	Prepare the importance and types of plasmids.
CO-5	Assess DNA Mutation and repair mechanisms.

UNIT I: GENETIC MATERIAL INTRODUCTION (12 hours)

DNA and RNA as genetic materials, experiments of Griffith, Avery, Macleod and McCarty, Hershey and Chase, Lederberg and Tatum, Chargaff's principles. Genomic Organization in Prokaryotes and Eukaryotes. Chromosome and Chromatin Structure. DNA and RNA as genetic material DNA structure, Watson – Crick Model. Types of DNA, and RNA.

UNIT II: REPLICATION AND TRANSCRIPTION (12 hours)

Replication of DNA Bidirectional and unidirectional replication, semi-conservative, semi-discontinuous replication. DNA polymerases, DNA ligase, primase - Mechanism of DNA replication. DNA proof-reading and its importance. Transcription in prokaryotes - RNA polymerase, promoter, Steps in transcription- promoter, enhancer and silencer. Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation);

UNIT III: TRANSLATION AND OPERON (12 hours)

Translation- tRNA, steps in translation, post translational modification. General characters of a genetic code. Operon concept – lac, trp, Ara operons.

UNIT IV: PLASMIDS AND TRANSPOSONS (12 hours)

Plasmids and transposable elements Types of plasmids F plasmid and R plasmid, Col plasmid, metal resistance plasmids, Ti plasmid, linear plasmids. Copy number and incompatibility. **Transposons.**

Unit V: Mutation (12 hours)

Spontaneous mutation – induced mutation; types of mutations –base substitutions, frameshifts, deletions, insertions, duplications, inversions. Silent, conditional and lethal mutations. Physical and chemical mutagenic agents. DNA damage and repair mechanisms. Isolation and Characterization of mutants. Auxotrophs, aminoacidutilizingauxotrophs, Mutation enrichment technique. AMES test.

TEXTBOOKS:

1. Channarayappa A. *Molecular Biology*, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.
2. McLennan, A., et al. *Bios Instant Notes Molecular Biology*, 4th Edn. Taylor & Francis. 2012.
3. Sambaurthy, A.V.S.S. *Molecular biology*. Narosa publishing house, New Delhi.2008.
4. Verma, P.S., and Agarwal, V.K. *Cell biology, Genetics, Molecular biology, Evolution and Ecology*. S. Chand. Reprint Edn. 2006.
5. Willey, J., et al. Prescott/Harley/Klein's *Microbiology*, McGraw Hill. 2008.

REFERENCE BOOKS:

1. Cox, M.M., et al. *Molecular biology: Principles and Practice*, WH Freeman and Company. 2012.
2. Frifelder, D. *Molecular Biology*, Narosa publishing house. 2nd edition. 2008.
3. Karp, G. *Cell and Molecular Biology: Concepts and Experiments*, 6th edition, John Wiley and Sons. Inc. 2010.
4. Lodish, H., et al. *Molecular Cell Biology*, 8th Edn. 2016.
5. Maloy, S.R., et al. *Microbial Genetics*. Narosa Publishing House. 1994.
6. Watson, J.D., et al. *Molecular Biology of Gene*, 7th Edn. Pearson Benjamin - Cummings. 2014

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize the structure and functions of the genetic material.	PSO-2,4,5	Understanding
CO-2	Illustrate the genome organization, transcription and translation process in prokaryotes.	PSO-1,2,3,4,5	Applying
CO-3	Analyze the regulation of gene expression.	PSO-1,2,3,4,5	Analyzing
CO-4	Construct the mode of replication process in different types of viruses.	PSO-1,2,3,4,5	Evaluating
CO-5	Evaluate the mutation process and mutagenic agents.	PSO-1,2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V	21UCMB52	MICROBIAL GENETICS	60	4						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓				✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 42 Relationship = High										

Prepared by

Checked by

Name :Dr. M. Senthil @ Sankar

Dr.R.Janet Rani

Head of the Department

Signature :

Semester – V

Course Title	Food & Dairy Microbiology
Total Hrs	60
Hrs/Week	04
Sub.Code	21UCMB53
Course Type	Core
Credits	04
Marks	100

General Objective:

The course is designed to explain the basic of the microbes causing spoilage in different kinds of foods, food borne infections, and fermented foods.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the general principles of food microbiology.
CO-2	Demonstrate spoilage of various types of food by microorganisms.
CO-3	Categorize food preservation methods and microbiological examination of foods.
CO-4	Inspect the quality of dairy and other foods products.
CO-5	Create knowledge about the role of microorganisms in fermentation.

UNIT I: INTRODUCTION OF FOOD MICROBIOLOGY (12 hours)

Introduction - Importance of food Microbiology – Types of microorganisms in food – Factors influencing microbial growth in foods Extrinsic and intrinsic factors (Nutrient content, pH, Redox potential, Relative humidity- water activity (water activity, Temperature, Gaseous atmosphere,) .

UNIT II: FOOD SPOILAGE AND PRESERVATION (12 hours)

Microbial contamination of foods- Spoilage of food by microbes in cereals and cereal products- fruits, vegetables and its dried products- Eggs and poultry- meat-fish- canned foods. Principles of food preservation Methods of food preservation- Aseptic handling, Pasteurization, refrigeration, and freezing, dehydration, Radiation- UV, smoking. Chemicals- organic acids, nitrates, nitrites, sulphur dioxide and sulphites. Natural Preservatives.

UNIT III: FOOD POISONING AND QUALITY ASSESSMENT (12 hours)

Food borne infections (a) Bacterial *Staphylococcal*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella* (b) Fungal Mycotoxins (aflatoxin), (c) Viral Hepatitis, (d) Algal toxins. Food Sanitation Good manufacturing practices – Hazard analysis, **Critical control points**, **Personal hygiene**.

UNIT IV: DAIRY MICROBIOLOGY AND DISEASES (12 hours)

Milk- Composition, nutritive types, benefits. Types of milk, Scope of dairy industry, Commercial grades of milk. Normal Flora, Sources of microorganisms in milk - Classification of microbes (Morphology, Biochemical Characteristics, Pathogenicity), Contamination, spoilage and preservation of milk, Diseases -etiology- Symptoms, mode of transmission, prophylaxis and control Foot and Mouth Disease, Brucellosis, Q fever, Mastitis, bovine tuberculosis, distemper and Ranikhet.

UNIT V: FERMENTED PRODUCTS AND DISEASES (12 hours)

Fermented milk - Flavoured milk - Butter milk, Cheese, Milk cream, whey, Yoghurt - Lactic starter culture. Food fermentation Bread, Tempeh, Saurkraut, pickles, olives, dairy products (Kefir, Koumiss, acidophilus milk).

TEXT BOOKS:

1. Banwart, GJ. *Basic Food Microbiology*, Chapman and Hall New York. 1989.
2. Frazier, WC, Westhoff, DC. *Food Microbiology*, TATA McGraw Hill Publishing company ltd, New Delhi. 1988.

REFERENCE BOOKS:

1. Adams, M.R., and Moss, M.O. *Food Microbiology*, the Royal Society of Chemistry, Cambridge. 1995.
2. Board, R.C. *A Modern Introduction to Food Microbiology*, Blackwell Scientific Publications, Oxford. 1983.
3. Robinson, R.K. *Dairy Microbiology*, Elsevier Applied Science, London. 1990.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Summarize the significance and activities of microorganisms in food.	PSO-1,2,3,4,5	Understanding
CO-2	Demonstrate the characteristics food spoilage and preventive measures.	PSO-1,2,3,5	Applying
CO-3	Analyze the contamination of foods based on physical, chemical characteristic change in food.	PSO-1,2,3,5	Analyzing
CO-4	Select suitable evaluating microbiological methods in food and dairy products.	PSO-1,2,3,5	Analyzing
CO-5	Assess the role of microorganisms in fermentation.	PSO-1,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
V	21UCMB53	Food and Dairy Microbiology					60	04		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
Number of matches (✓) = 46 Relationship = High										

Prepared by

Name : DR. R. Janet Rani

Checked by

Dr.R.Janet Rani

Head of the Department

Signature :

Semester V

Course Title	MICROBIAL NANOTECHNOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UEMB51A
Course Type	Elective
Credits	4
Marks	100

General Objective:

The Course teaches the History and development of Nanotechnology, self-assembly of biological materials in nanoscale, biological synthesis of nanoparticles, characterization and medical application of Nanoparticles.

Course Objectives:The learners will be able to:

CO	Course Objectives
CO-1	Summarize the basic concepts of Nanotechnology.
CO-2	Illustrate self-assembly process of biomolecules and microorganisms in nanoscale.
CO-3	Categorize the Nanofabrication methods.
CO-4	Analyse the characteristic features of nanoparticles.
CO-5	Interpret biomedical applications of nanoparticles.

UNIT I: BASICS OF NANOTECHNOLOGY (12 hours)

Introduction- Nanotechnology, Nanoparticles, Important Contributions of Nanotechnology. Overview of Nano Fabrication Methods- Top-down and bottom-up approaches, Lithography, Deposition

UNIT II: NANOSCALE SELF-ASSEMBLY (12 hours)

Introduction to self-assembled biological nanomaterials in nature. Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA). Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus).

UNIT III: BASICS OF FABRICATION METHODS (12 hours)

Top-Down fabrication methods –Types of Top-Down fabrication methods (mechanosynthesis, thermal, high energy, chemical fabrication and lithography-concepts with examples only). Bottom-Up fabrication methods-Types of Bottom-Up fabrication methods (gaseous-phase, liquid phase, solid-phase).

UNIT IV: BIOLOGICAL SYNTHESIS OF NANOPARTICLES (12 hours)

Introduction to biomolecules as reducing and capping agents, Bacteria, fungi as sources of reducing and capping agents and for biogenic synthesis of nanomaterials. Advantages and applications of biologically

synthesized nanomaterials. DNA based Nano-structures, Protein based Nano structures

UNIT V: TOOLS AND APPLICATION OF NANOTECHNOLOGY (12 hours)

Principle and Application -UV spectrophotometer, Scanning Electron Microscope, Atomic Force Microscopy, Transmission Electron Microscope, Fourier-Transformation-fundamentals and working principle. Application of Nanoparticles- Drug delivery, Cancer Cell Imaging, Detection of food borne pathogen and water borne pathogen using fluorescent nanoparticles (Silica).

Textbooks:

1. Balaji, S. *Nanobiotechnology*. MJP Publishers, Chennai. 2019.
2. Nicolini, C. *Nanobiotechnology and Nanobiosciences*. Pan Stanford Publishing Pte. Ltd. 2009.
3. Niemeyer, C.M., and Mirkin, C.A. *Nanobiotechnology, Concepts, Applications and perspectives*. WILEY-VCH, VerlagGmbHandCo. 2004.
4. Pradeep, T. *A Textbook of Nanoscience and Nanotechnology*. McGraw Hill Education. 2017.

REFERENCE BOOKS:

1. Goodsell, D.S. *Bionanotechnology, Lessons from Nature*, Wiley-Liss, Inc, 2004.
2. Diwan, P., and Bharadwaj, A. *Nanomedicines*. Pentagon Press, 2006.
3. Torchilin, V.P. *Nanoparticles as Drug Carriers*. Imperial College Press, North Eastern University, USA. 2006.

Course Outcome(CO)

CO No	Open the completion of this course, student will be able to	PSO addressed	Cognitive Level
CO-1	Explain the fundamentals of nanotechnology.	1,3,5	Understanding
CO-2	Demonstrate the self- assembly process of biomolecules and virus in nanoscale.	1,3,5	Applying
CO-3	Examine the techniques for the fabrication of nanoparticles.	PSO-1,2, 3,5	Analyzing
CO-4	Choose techniques to characterize the nanoparticles.	PSO-1,2, 3,5	Evaluating
CO-5	Prepare nanoparticles for cancer cell imaging and drug delivery.	PSO-1,2, 3,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V	21UEMB51A	Microbial Nanotechnology	60	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓		✓	✓		✓		✓
CO-2	✓	✓	✓		✓	✓		✓		✓
CO-3	✓	✓	✓		✓	✓	✓	✓		✓
CO-4	✓	✓	✓		✓	✓	✓	✓		✓
CO-5	✓	✓	✓		✓	✓	✓	✓		✓
Number of matches (✓) = 38 Relationship = High										

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – V

Course Title	VETERINARY MICROBIOLOGY
Total Hrs.	60
Hrs/Week	4
Sub. Code	21UEMB51B
Course Type	Discipline Specific Elective
Credits	4
Marks	100

General Objective:

In this course the student will develop the knowledge and skills necessary to perform the duties required of a veterinary technician in the area of microbiology.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Understand History and development of Veterinary Microbiology
CO-2	Outline the core concepts of veterinary microbiology
CO-3	Utilize the various methods available in microbial techniques
CO-4	List out sources of infection and pathogenic transmission
CO-5	Create knowledge on various animal diseases and treatments

Unit – 1:

History of microbiology and introduction to the microbial world. Microorganisms and fermentation, Germ theory of diseases, Development of various Microbiological techniques and golden era of microbiology. Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner.

Unit – 2:

Physiochemical and biological characteristics of microorganisms (including viruses), Introduction to oncogenic viruses. Types of oncogenic DNA and RNA viruses: Bacterial structure, Nutritional requirements of bacteria, Types of media, Physical conditions required for bacterial growth, Bacterial growth curve, methods of measurement of bacterial growth

Unit – 3:

Microbial techniques: Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria,. Buffers in culture medium, Cultivation of fungi, actinomycetes, yeasts, Cultivation of anaerobes. Optical and Electron microscope (Structure and function),

Unit – 4:

Sources and routes of infection, Transmission of pathogens, portals of entry of pathogen, Microorganisms and animal host interactions, Toxins (endo and exo)

Unit – 5:

Study of following animal diseases with respect to etiology, symptoms, mode of transmission, prophylaxis and control: Q fever FMD, swine flu, bird flu, Rabies, bovine tuberculosis, , Infections caused by Campylobacter, Salmonella Marek's, ranikhet, brucellosis, distemper. Common cattle disease Bovine Respiratory

Disease Complex (BRDC), Clostridial Disease, or "Blackleg", BRSV (Bovine Respiratory Syncytial Virus) BVD (Bovine Viral Diarrhea) (Infectious Bovine Rhinotracheitis), (Parainfluenza Type 3), Pasteurella haemolytica and Pasteurella multocida.

Text Books:

1. Textbook of Veterinary Microbiology (2015) By Sharma S.N. Vikas Publishing

Reference Books:

1. General Veterinary Microbiology - An introduction (2017) By R.P. Diwakar R.K. Diwakar Astral Publishing
2. Veterinary Microbiology and Microbial Disease (2011), 2nd Edition By P. J. Quinn, B.
3. K. Markey, F. C. Leonard, P. Hartigan, S. Fanning, E. S. Fitzpatrick Wiley
4. N. Maclachlan Edward J Dubovi Fenner's Veterinary Virology 5th Edition Academic Press (2016)
5. G. R. Carter, Darla J. Wise. Essentials of Veterinary Bacteriology and Mycology, Wiley-Blackwell (2003) P. J. Quinn, B. K. Markey, F. C. Leonard, P. Hartigan, S. Fanning, E. S.
6. Fitzpatrick. Veterinary Microbiology and Microbial Disease. Wiley-Blackwell (2011)

Course Outcomes (CO)

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Outline the basic concepts, History and development of veterinary microbiology	PSO-1,4	Remembering
CO-2	Interpret the basic phenotypic characteristics in veterinary microbiology.	PSO-1	Understanding
CO-3	Examine the basic concepts of causation of diseases by different types of microorganisms.	PSO-1,2,3	Applying
CO-4	Explain the common diseases of microbial etiology for animals especially the domesticated animals and the vaccines available for animal immunization.	PSO-1,2,3	Analyzing
CO-5	Assess the laboratory identification of disease causing microbes and antibiotic sensitivity testing.	PSO-1,2,3	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Cred it		
Xx	21UXXXX	VETERINARY MICROBIOLOGY					60	4		
Course Outcome s (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓			✓	
CO-2	✓	✓	✓	✓	✓	✓				
CO-3	✓				✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 34 Relationship = High Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)										

Prepared by
Name: Mr.S.Hameedullah Sherief

Checked by
Dr. R. Janet Rani
Head of the
Department

Signature:

Semester – V

Course Title	BIOSTATISTICS
Total Hrs	60
Hrs/Week	4
Sub.Code	21UEMB51C
Course Type	Elective
Credits	4
Marks	100

General Objectives:

This course focuses on the collection of data, measures of central tendency, correlation and statistical inferences.

Course Objectives: The learner will be able to

CO	Course Objectives
CO-1	Summarize statistical methods
CO-2	Choose appropriate method for data collection
CO-3	Calculate the central tendency
CO-4	Predict relationship between variables
CO-5	Find error in collected data

UNIT: I Basics of Biostatistics (15 hours)

Biostatistics - Definition - Statistical methods - Basic principles. Variables - Measurements, Functions, Limitations and Uses of statistics.

UNIT:II Data Collection (15 hours)

Collection of data primary and secondary - Types and Methods of data collection procedures - merits and demerits. Classification - Tabulation and Presentation of data - sampling methods.

UNIT:III Measures of central tendency (15 hours)

Mean, Median, Mode, Geometric mean - merits & demerits. Measures of dispersion - Range, Standard deviation, Mean deviation, Quartile deviation - merits and demerits; Co-efficient of variations.

UNIT:IV Correlation(15 hours)

Types and Methods of Correlation, Regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.

UNIT:V Statistical inference (15 hours)

Hypothesis - Simple hypothesis - Student 't' test- Introduction, student's t -Distribution, Applications of t-Distribution - Chi square test- Introduction, Definition , Procedure for χ^2 Test, and application . Concept of analysis of variance (one-way classification).

Textbooks:

- 1.Gurumani,N. An Introduction to Biostatistics, MJP Publishers, 2015.
2. Ramakrishnan, P. Biostatistics .Saras Publication, 2015.

3. Kulkarni, A.P. Basics of Biostatistics. CBS Publishers & Distributors, 2018

REFERENCE BOOKS

1. Danniell, W.W. Biostatistics. John Wiley Sons. New York, 1987.
2. Selvin, S. Statistical Analysis of epidemiological data. New York University Press, 1991.
3. Campbell, R.C. Statistics for Biologists. Cambridge University Press, 1998.
4. Colton, T. Statistics for medicine. Little Brow, Boston, 1974.

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Understand the concept of statistical methods	PSO-1, 2, 5	Understanding
CO-2	Use graph and table to present their data.	PSO-2, 3, 5	Applying
CO-3	Calculate mean, standard deviation of the collected data.	PSO-2, 3, 5	Analyzing
CO-4	Predict the relationship between variables.	PSO-2, 3, 5	Evaluating
CO-5	Test probability of the collected data	PSO-2, 3, 5	Applying

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
V		Cell Biology					60	4				
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO4	PLO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓	✓	✓	✓	✓	✓			✓		
CO-2	✓	✓	✓	✓	✓		✓	✓		✓		
CO-3	✓	✓	✓	✓	✓		✓	✓		✓		
CO-4	✓	✓	✓	✓	✓		✓	✓		✓		
CO-5	✓	✓	✓	✓	✓		✓	✓		✓		
Number of matches (✓) = 40...High....												

Prepared by
Name :Dr.K. Chitra

Signature :

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – VI

Course Title	PLANT PATHOLOGY AND DISEASE MANAGEMENT
Total Hrs.	60
Hrs/Week	4
Sub. Code	21UEMB52A
Course Type	Discipline Specific Elective
Credits	4
Marks	100

General Objective:

In this course the student will develop the knowledge and skills necessary to perform the duties required of a subject of Plant Pathology and its disease management concepts and principles.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Describe the concepts of what constitutes disease in plants.
CO-2	Identify major principles of plant pathology.
CO-3	Employ methods to diagnose and manage a wide range of plant diseases.
CO-4	List out sources of infection and pathogenic transmission of plant fungal diseases
CO-5	Explain the impact of plant disease on human affairs.

Unit – 1: PRINCIPLES OF PLANT PATHOLOGY

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases, role of environment and host nutrition on disease development.

Unit – 2: PLANT BACTERIOLOGY

Morphology, biochemical characteristics, reproduction and life cycle of Phytopathogenic & fastidious prokaryotes, Host parasite interaction, recognition concept and infection (role of enzymes, toxins and growth regulators) symptomatology, disease development of aster yellows, bacterial wilt, canker and crown gall.

Unit – 3: PLANT VIROLOGY

Plant viral pathogens: Morphology, biochemical characteristics, reproduction and life cycle of Host parasite interaction, recognition concept and infection (role of enzymes, toxins and growth regulators) symptomatology, transmission and disease development of curly top, mosaic, psorosis and spotted wilt.

Unit – 4: PLANT FUNGAL DISEASES

Plant fungal pathogens: Morphology, biochemical characteristics, reproduction and life cycle of Host parasite interaction, recognition concept and infection (role of enzymes, toxins and growth regulators) symptomatology, transmission and disease development of black spot, rust, botrytis blight and powdery mildew.

Unit – 5: PLANT DISEASE MANAGEMENT

Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanical methods of plant disease control. Integrated Disease Management (IDM) in important crops - rice, wheat, cotton, sugarcane, rapeseed, mustard, *kharif* pulses, vegetable crops and fruit crops; Disease resistance and molecular approach for disease management.

Text Books:

1. Bos L. 1964. *Symptoms of Virus Diseases in Plants*. Oxford & IBH., New Delhi.
2. Singh RS. 1982. *Plant Pathogens ñ The Fungi*. Oxford & IBH, New Delhi.
3. Goto M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.
Jayaraman J & Verma JP. 2002. *Fundamentals of Plant Bacteriology*. Kalyani Publ., Ludhiana.
4. Verma JP, Varma A & Kumar D. (Eds). 1995. *Detection of Plant Pathogens and their Management*. Angkor Publ., New Delhi.

Reference Books:

1. Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ & Watson L. 1995. *Virus of Plants: Descriptions and Lists from VIDE Database*. CABI, Wallington.
2. Gibbs A & Harrison B. 1976. *Plant Virology - The Principles*. Edward Arnold, London.
3. Mount MS & Lacy GH. 1982. *Phytopathogenic Prokaryotes*. Vols. I, II. Academic Press, New York.
4. Upadhyay RK & Mukherjee KG. 1997. *Toxins in Plant Disease Development and Evolving Biotechnology*. Oxford & IBH, New Delhi.
5. Pathak VN. 1984. *Laboratory Manual of Plant Pathology*. Oxford & IBH, New Delhi.
6. Fry WE. 1982. *Principles of Plant Disease Management*. Academic Press, New York.

Course Outcomes (CO)

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Annotate the basic concepts, types, History and development of plant pathology	PSO-1,2	Understanding
CO-2	Explain how plant diseases are classified by symptoms displayed on plants	PSO-1,2,3	Analyzing
CO-3	Validate disease and determine the best cultural, mechanical, and biological control methods used to manage the plant disease.	PSO-2,3,4	Evaluating
CO-4	Review the economic and pathological importance of bacteria and fungi	PSO-1,2,3	Evaluating
CO-5	Adapt various integrated pest management strategies for plant disease management.	PSO-2,3,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course								Hours	Credit
xx	21UXXXX	PLANT PATHOLOGY AND DISEASE MANAGEMENT								60	4
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)					
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	✓	✓	✓	✓	✓	✓	✓			✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO-3	✓	✓	✓	✓	✓		✓	✓	✓	✓	
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓		✓	✓	✓	✓	
	Number of matches (✓) = 44 Relationship = High Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)										

Prepared by
Name: Mr.S.Hameedullah Sherief

Signature:

Checked by
Dr. R. Janet Rani
Head of the Department

Semester – V

Course Title	GENETIC ENGINEERING
Total Hrs	60
Hrs/Week	4
Sub.Code	21UEMB52B
Course Type	Elective
Credits	4
Marks	100

General Objective:

The course discusses the steps involved in the cloning process, the blotting techniques for transferring of DNA, RNA and Protein into a carrier and the applications of genetic engineering.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the basic concepts of genetic engineering.
CO-2	Illustrate Cloning Vectors.
CO-3	Analyze blotting Techniques and polymerase chain reaction.
CO-4	Summarize transgenic plants and animals.
CO-5	Propose to apply genetic engineering in environment.

UNIT I: BASICS OF GENETIC ENGINEERING (12 hours)

Cloning- Introduction, steps in cloning- enzymology of cloning - construction of rDNA –Gene transfer methods - screening of chimeric DNA.

UNIT II: CLONING VECTORS (12 hours)

Cloning vectors for rDNA(plasmids, phages, cosmids, viruses, transposons)- Binary and shuttle vectors.

UNIT III: EXPRESSION VECTORS (12 hours)

Expression vectors for high level cloned genes (*E.coli*, yeast, insect cell, mammalian cell)-Expression cassettes- DNA libraries- Genomic, cDNA.

UNIT IV: BLOTTING TECHNIQUES (12 hours)

Southern blot, Western blot, Northern blot - PCR and its modification- RFLP, RAPD – DNA finger printing.

UNIT V: APPLICATIONS OF GENETIC ENGINEERING (12 hours)

Transgenic plants - Development of crops for disease resistance (Bt cotton), herbicide tolerance- Transgenic animals (sheep), Transgenic fish (Tilapia), Medicine (insulin), Environment - role of superbug in biodegradation and industries (ethanol).

Textbooks:

1. Dubay, R.C. *A Text Book of Biotechnology*(1st edn).S.Chand and Company Ltd,NewDelhi. 2001.
2. Kumar, H.D. *Modern concepts of Biotechnology*. Vikas Publishing House Pvt. Ltd. Noida. 2009.
3. Lohar, S.P. *Text Book of Biotechnology*. MJP Publishers, Chennai. 2012.

4. Rastogi, S.C. *Biotechnology Principles and applications*. Narosa Publishing House Pvt. Ltd. NewDelhi. 2007.
5. Sathyanarayana, U. *Biotechnology*. Books and Allied (P) Ltd. Kolkata. 2008.

Reference Books:

1. Gardener, E.J. *Principles of Genetics*.(8th Ed.). John Wiley and sons, Newyork. 1991.
2. Glick, B.R., and Pasternak, J. J. *Molecular Biotechnology – Principles and Applications of Recombinant DNA*. ASM Press, Washington D.C. 1998.
3. Jogdhand, S.N. *Gene Biotechnology*. Himalaya Publishing House Pvt.Ltd. Mumbai. 2007.
4. Lewin, B. *Genes*. Oxford University Press, Oxford. 2000.

Course Outcomes

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Explain the methodologies of genetic engineering.	PSO-1,4,5	Understanding
CO-2	Illustrate vectors used for the cloning technique.	PSO-1,4,5	Applying
CO-3	Detect microorganisms using blotting and DNA finger printing techniques.	PSO-2, 3,4,5	Analyzing
CO-4	Choose recombinant techniques to produce disease resistant plants and animals.	PSO-2, 4,5	Evaluating
CO-5	Predict the role of genetic engineering in Environment	PSO-2, 4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V	21UEMB52B+-	GENETIC ENGINEERING	60	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO3	PLO4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓			✓	✓
CO-2	✓	✓	✓	✓	✓	✓			✓	✓
CO-3	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓		✓		✓	✓
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
Number of matches (✓) = 41 Relationship = High										

Prepared by
Dr.K.Chitra
Name and Signature

Checked by
Dr.R.Janet Rani
Head of the Department

Semester – V

Course Title	Cell Biology
Total Hrs	60
Hrs/Week	4
Sub.Code	21UEMB52C
Course Type	Elective
Credits	4
Marks	100

General Objectives:

This course focuses on the concept of cell theory, structure and function of cell organelles, cell cycle, cancer, cell signaling and development of cell.

Course Objectives: The learner will be able to

CO	Course Objectives
CO-1	Summarize cell theory
CO-2	Explain Different forms of Chromosomes
CO-3	Teach the causes, treatment of cancer
CO-4	Classify cell signalling
CO-5	Evaluate growth level of cell

UNIT I: Cell – Unit of Life (12 hours)

Cell biology - Definition, History, Cell theory, Protoplasm theory, Organismal theory, Unit of measurement of cell biology, Scope of cell biology. Structure of Cell Wall: Prokaryotic and Eukaryotic cell wall, Cell organelles: Structure and function- Endoplasmic Reticulum, Golgi complex, Lysosomes, Vacuoles, Peroxisomes, Ribosomes, Mitochondria, Chloroplast, Nucleus Extracellular matrix.

UNIT II: Chromosome (10 hours)

Chromosome- Structure, chemical composition and functions of Chromosome. Special type of Chromosome, Super Numerary chromosome. Karyotype- Preparation of Karyotype, Spectral Karyotype technique.

UNIT III: Cell cycle and Cell division (14 hours)

Mitosis and Meiosis-Cell death: Eukaryotic cell cycle and its regulation, Development of cancer- Causes, Types, Diagnosis and Therapy. Programmed cell death

UNIT IV: Cell signaling (12 hours)

Cell signaling – Introduction, types of Cell signaling, Mechanism of cell signaling – Cell signaling through G- Protein linked surface receptors, Cell signaling through steroid hormone receptors, cell signaling through second messengers. Bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

UNIT V: Reproduction and Growth

Reproduction- Sexual and asexual reproduction. Growth- levels of growth – Limits and unlimited growth, Cell growth- kinetics of cell growth,

mechanisms involved in cell growth- RNA synthesis and cell growth, Protein synthesis and cell growth .

Textbooks:

1. Pawar, C.B. Cell Biology. Himalaya Publishers. 1983.
2. Verma, P.S. Agarwal, V. K. Cell biology, Genetics, Molecular biology, Evolution and Ecology. S. Chand Publications, 2016.
3. Arumugan,N Cell biology and Molecular biology. Saras Publication, 2015.

REFERENCE BOOKS:

1. Gerald Karp, Cell biology, McGraw Hill Book company, New York, 2013
2. Maloy, S.R. CronanJr, J.S. Freidfelder, D. Microbial Genetics. Jones and Bartlett Publishers, 1994.
3. Lewin, B. Genes XII, Jones & Bartlett Publishers, Inc2007.
4. Willey, J. Sherwood, L. &Woolverton, C. Prescott/Harley/Klein's Microbiology, McGraw Hill, 2007.

CO No	Upon completion of this course, students will be able to:	PSO addressed	Blooms taxonomy classification
CO-1	Understand the concepts of cell theory.	PSO-1, 2, 4	Understanding
CO-2	Illustrate structure of Chromosome	PSO-1,2 3,4	Applying
CO-3	List out the causes of cancer	PSO-1, 2, 3, 4, 5	Applying
CO-4	Analyze bacterial quorum sensing	PSO-1,2, 5	Analyzing
CO-5	Predict mechanism involved in cell growth	PSO-1, 2, 3, 5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V		Cell Biology	60	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO3	PLO4	PLO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓			✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
Number of matches (✓) = 44...High....										

Prepared by

Name :Dr.K. Chitra

Signature :

Checked by

Dr.R.Janet Rani

Head of the Department

Semester - V

Course Title	TECHNIQUES IN IMMUNOLOGY AND MICROBIAL GENETICS
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB5P1
Course Type	Core – Practical
Credits	2
Marks	100

General Objective:

The course teaches the analyse the blood type and blood cell count, disease diagnostic techniques using antigen and antibody reactions and genetic material transfer process.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Examine blood grouping.
CO-2	Predict count of blood components.
CO-3	Analyze of disease condition using antigen and antibody reactions.
CO-4	Detect mutation of microorganism.
CO-5	Choose transfer mechanism of genetic material.

Course Outline:

1. Blood grouping and Rh typing.
2. Total and differential blood count
 - a. Red Blood Cell Count.
 - b. White Blood Cell Count.
3. VDRL Test.
4. RA agglutination test.
5. WIDAL agglutination test.
6. Antigen – Antibody reaction – Ouchterlony technique- Double diffusion.
7. UV induced auxotrophic mutants production and isolation of mutants by replica plating technique.
8. Isolation of streptomycin resistant mutants by gradient plate technique.
9. Transformation (Demonstration).
10. Conjugation (Demonstration).
11. ELISA (Demonstration).

Reference Books:

- 1) Cappuccino, J.G., and Sherman, N. *Microbiology – A laboratory manual*. Benjamin CUMMINS. New York. 1996.

- 2) Dubey, D.C., and Maheshwari, D.K. *Practical Microbiology*. S. Chand and Company pvt ltd, Delhi. 2002.
- 3) Kannan, N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani. 1996.
- 4) Rajan, S., and Christy, S.R. *Experimental Procedure in Life sciences*. Anjanaa Book House. 2012.

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive Level
CO-1	Predict the blood group using agglutination method.	PSO-1, 2,3,4,5	Applying
CO-2	Examine the number of red blood cells and white blood cells.	PSO-1, 2,3,4,5	Applying
CO-3	Analyze the pathological condition of individuals using antigen and antibody reactions.	PSO-1, 2,3,4,5	Analyzing
CO-4	Choose physical and chemical agents to produce mutant strain	PSO-1, 2,3,4,5	Evaluating
CO-5	Perform the transfer of genetic material by transformation and conjugation process	PSO-1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
V	21UCMB5P1	Techniques In Immunology And Microbial Genetics					60	2				
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 50 Relationship = High												

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

Dr.R.Janet Rani

Head of the Department

Semester - V

Course Title	TECHNIQUES IN FOOD AND DAIRY MICROBIOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB5P2
Course Type	Core – Practical
Credits	2
Marks	100

General Objective:

The course focuses on the analyze of spoiled fermented food, vegetable and fruits under microscope using wet mount preparation, TVC of bacterial and fungal cells in vegetables, fruits and meat and the quality of milk using various techniques.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Examine the spoiled vegetables and fruit using Wet mount technique.
CO-2	Analysis of microbial load in vegetables and fruits.
CO-3	Analysis of microbial load in meat and fish.
CO-4	Assess of milk quality using various techniques.
CO-5	Predict the thermal death time.

Course outline:

1. Wet mount preparation of spoiled bread, tomato, grapes, potato.
2. Enumeration of bacteria from meat.
3. Enumeration of bacteria from fresh and spoiled vegetables .
4. Enumeration of bacteria from fresh and spoiled fish.
5. Determination of quality of milk-
 - a. Methylene Blue Reduction Test (MBRT).
 - b. Resazurin test of milk.
6. Determination of Pasteurized milk quality- Phosphatase Test.
7. Direct microbial count of Milk
8. Thermal Death Time(TDT)

REFERENCES

- 1) Cappuccino, J.G., and Sherman, N. *Microbiology – A laboratory manual* . Benjamin CUMMINS. New York. 1996.
- 2) Dubey, D.C., and Maheshwari, D.K. *Practical Microbiology* . S. Chand and Company pvt ltd, Delhi. 2002.
- 3) Kannan, N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani. 1996.
- 4) Rajan, S., and Christy, S.R. *Experimental Procedure in Life sciences*. Anjanaa Book House. 2012.

Course Outcome (CO)

CO. No.	Upon completion of this course, students will be able to:	PSO addressed	Cognitive Level
CO-1	Examine wet mount preparation of spoiled bread, vegetables and fruits under microscope.	1, 2,3,4,5	Applying
CO-2	Analyze the number of bacterial cell in vegetable and fruits	1, 2,3,4,5	Analyzing
CO-3	Estimate the number of bacterial cell in meat and fish	1, 2,3,4,5	Evaluating
CO-4	Choose technique to check the quality of milk.	1, 2,3,4,5	Evaluating
CO-5	Assess thermal death time	1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
V	21UCMB5P2	Techniques In Food And Dairy Microbiology					60	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO3	PLO4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) =50 Relationship = High										

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

Dr.R.Janet Rani

Head of the Department

VI - SEMESTER

Course Title	MEDICAL MICROBIOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB61
Course Type	Core
Credits	4
Marks	100

General Objective:

The course teaches normal microflora, infection, types and its transmission, epidemiology, pathogenesis, diagnosis, prevention and treatment of bacterial and viral infections, fungal and parasite diseases.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the normal flora and its importance.
CO-2	Demonstrate on epidemiology, pathogenesis, diagnosis and treatment of bacterial diseases.
CO-3	Apply the diagnostic methods and the treatment for viral diseases.
CO-4	Classify the superficial, subcutaneous systemic mycoses, and opportunistic mycoses.
CO-5	Interpret the parasitic infections including amoebiasis, giardia and malaria.

UNIT I: BASICS OF MEDICAL MICROBIOLOGY (12 hours)

Introduction- Importance of Medical Microbiology, Normal flora of the human body Importance of normal flora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction Definitions- Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Collection, transport and culturing of clinical samples, Pandemic Epidemic and Endemic diseases, Koch Postulates.

UNIT II: MEDICAL BACTERIOLOGY (12 hours)

Introduction - Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following bacteria-pyogenic infection (*Streptococcus pyogenes*), *E. coli*(traveler'sdiarrhea), *Shigella* (Shigellosis), *Salmonella* (Typhoid), *Vibrio cholerae* (Cholera), *Mycobacterium tuberculosis*(Tuberculosis), *Clostridium tetani* (Tetanus), *Neisseria gonorrhoeae*(gonorrhoea), *Treponema palladium* (*Syphilis*).

UNIT III: MEDICAL VIROLOGY (12 hours)

Introduction- Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and treatment of the following virus - Hepatitis virus – A and B,

Influenza Virus, HIV, COVID- 19, Rabies virus-Polio virus- Dengue- Swine flu.

UNIT IV: MEDICAL MYCOLOGY (12 hours)

Introduction- Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following fungal infections—Cutaneous mycoses (Tineapedis), Superficial (Tineanigra), subcutaneous and systemic mycoses (Candidiasis), Opportunistic mycoses, Dermatophytosis.

UNIT V: Parasitology (12 hours)

Introduction- Epidemiology, Pathogenesis, Laboratory diagnosis, Prevention and treatment of the following parasitic infections-Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium(Malaria).

Textbooks:

- 1) Anathanarayanan, R., andPanicker, J. *Text book of microbiology.* Orient Longmans, India. 2000.
- 2) Pasha C., and Muthenna, P. *A text book of medical microbiology,* KedarNath Ram Nath, Meerut. 2019.
- 3) Mukherjee, K.L. *Medical Laboratory Technology Vol I-III.* Mc Graw Hill Publishing Co, Ltd, New Delhi. 2010.
- 4) Rajan, S. *Medical microbiology.* MJP publisher, Chennai. 2007.

Reference Books:

- 1) Sherris, K.J.R. *Medical Microbiology 7th edition.* McGraw- Hill Inc, New York.2018.
- 2) Pelczar, J. *et al.,Microbiology-* McGraw- Hill Inc, New York. 1993.
- 3) Prescott, L.M. *et al.,Microbiology 7th edition.* McGraw- Hill Inc, New York. 2008.

Course Outcome (CO)

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive level
CO-1	Outline the importance of medical microbiology.	1, 4,5	Understanding
CO-2	Demonstrate the epidemiology, pathogenesis, diagnosis and treatment of bacterial diseases.	1, 4,5	Applying
CO-3	Apply the diagnostic methods and the treatment for viral diseases.	1, 2,3,4,5	Applying
CO-4	Analyze the superficial, subcutaneous systemic mycoses, and opportunistic mycoses.	1, 2,3,4,5	Analyzing
CO-5	Intrepret the parasitic infections including amoebiasis, giardia and malaria.	1, 2,3,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
VI	21UCMB61	Medical Microbiology					75	4		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓			✓	✓
CO-2	✓	✓	✓	✓	✓	✓			✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 46 Relationship = High										

Prepared by

Name :Dr.R.Janet Rani

Signature :

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – VI

Course Title	Industrial Microbiology
Total Hrs.	60
Hrs./Week	04
Sub.Code	21UCMB62
Course Type	Discipline Specific Core (DSC)
Credits	04
Marks	100

General Objective:

This course focuses on topics like basic and advanced concepts and emerging areas in industrial microbiology.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain strain development strategies.
CO-2	Demonstrate mechanism of microbial fermentation.
CO-3	Construct, design and operate fermentor.
CO-4	Formulate industrial upstream & downstream process.
CO-5	Facilitate pharmaceutical products and immobilization techniques.

UNIT I: BASICS OF INDUSTRIAL MICROBIOLOGY (12 hours)

Brief history and developments in industrial microbiology, Sources of industrially important microbes and methods for their isolation, and maintenance of industrial strains, Screening (primary and secondary) strain improvement, Media formulation- media formulation - crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates.

UNIT II: FERMENTOR (12 hours)

Fermentor - design and components. Types of Fermentor laboratory, pilot-scale and production fermenters, constantly stirred tank and air-lift fermenters, Types of fermentation process Solid state and liquid state (Stationary and submerged) single, batch, continuous, multiple, surface, submerged.

UNIT III: UPSTREAM AND DOWNSTREAM PROCESSING (12 hours)

Upstream processing – Substrates for fermentation industry, inoculum development; formulation of fermentation medium, sterilization of air, medium and fermentor, media inoculation. Down-stream processing - Cell disruption, filtration, centrifugation, solvent extraction, precipitation, Lyophilization. Microbial cells as food.

UNIT IV: INDUSTRIAL FERMENTATION TECHNOLOGY (12 hours)

Production of Antibiotics- Penicillin, streptomycin. Biofuel-Ethanol; Organic acids - acetic acid, citric acid; Enzymes - amylase, protease and lipase. Vitamins – Vitamin B12 and D.

UNIT V: IMMOBILIZATION (12 hours)

Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase). **Role of Microbes in Medicine and textile industry.**

TEXT BOOKS:

1. Malik, V.S., and Sridhar, P. *Industrial Biotechnology*. Oxford and IBH. 1992.
2. Prave, P., et al. *Fundamentals of Biotechnology*, ASM Press. 1987.
3. Reed. G. Prescott and Dunn's *Industrial Microbiology*. Macmillian Publishers. 1982.
4. Solomon, D.A.L. *Manual of Industrial Microbiology and Biotechnology*, ASM Press. 1986.

REFERENCE BOOKS:

1. Puvanakrishnan R, et al. *Microbial Technology*, MJP Publishers, Chennai, 2012.
2. Srivastava, M.L. *Fermentation technology*, Narosa Publishing House, New Delhi, 2008.
3. Stanbury, P.F, et al. *Principles of Fermentation Technology*, Aditya Books (P) Ltd, New Delhi, 2016.
4. Venkataraman, L.V. *A Monograph on Spirulina platensis*. CFTRI, Mysore. 1983.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain strain development strategies and industrial media formulation.	1, 2,3,4,5	Understanding
CO-2	Practice concepts of Industrial Microbiology and types of fermentation process.	1, 2,3,4,5	Applying
CO-3	Summarize design, construction and types of fermenters	1, 2,3,4,5	Analyzing
CO-4	Formulate industrial upstream, downstream processes, microbial metabolites, antibiotics and vitamins.	1, 2,3,4,5	Evaluating
CO-5	Demonstrate immobilization in long term storage of industrial raw material and products.	1, 2,3,4,5	Applying

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
IV	21UCMB62	Industrial Microbiology					60	04		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 50 Relationship = High										

Prepared by
Name: Mr.S. HameedullahSherief

Checked by
Dr.R.Janet Rani
Head of the Department

Signature:

Semester – VI

Course Title	Agricultural microbiology
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB63
Course Type	Discipline Specific Core
Credits	4
Marks	100

General Objective:

The course aims to explain the vital role and application of microorganisms in agricultural practises, plant pathogenesis, biopesticides and biofertilizer.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Summarize the significance of microorganisms in soil.
CO-2	Demonstrate the types of interactions in soil microbes.
CO-3	Compare the mechanism of different nutrient cycles.
CO-4	Examine the infections mechanism of plant pathogens.
CO-5	Evaluate the importance of Plant growth promoting <i>Rhizobacteria</i> .

UNIT I: NATURE OF SOIL(12 hours)

Significance of microorganisms in soil, soil as a culture medium, microbiological examination of soil. Microbes in soil surface and different zones of soil. Role of microorganisms in soil fertility; influence of soil and environmental factors on microflora, moisture, pH, temperature, organic matter, agronomic practices. Winogradsky column – principle and significance.

UNIT II : MICROBIAL INTERACTION(12 hours)

Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation- (rhizosphere, rumen, lichens, mycorrhiza, bioluminescence) Microbe-Plant Interactions (Phyllosphere; leguminous plant-*Rhizobium*). VAM.

UNIT III: BIOGEOCHEMICAL CYCLES (12 hours)

Biogeochemical cycles – carbon, nitrogen (nitrogen fixation, symbiotic, non-symbiotic, associative organisms, ammonification, nitrification, denitrification, factors affecting nitrogen transformation;), phosphorus (phosphorus solubilization by phosphobacteria and P mobilization by mycorrhizal fungi), sulphur. Nitrogen fixation – root nodule formation – nitrogenase, biochemistry of nitrogen fixation (nif –genes. Nod genes, nitrogenase complex, leghemoglobin).

UNIT IV: PLANT PATHOGENIC MICROORGANISMS (12 hours)

Diseases - Mode of entry of pathogens, disease symptoms, spread – fungal disease- leaf blight of potato, Powdery mildew, Red rot of sugarcane; bacterial disease- rice blast, crown galls, viral disease- Papaya ring spot, tomato yellow leaf curl; nematode disease - root-knot nematodes (*Meloidogyne* spp.).

UNIT V: BIOPESTICIDES AND BIOFERTILIZER (12 hours)

Plant growth promoting rhizobacteria (PGPR) – Biological control of phytopathogens. Biopesticides - Mechanism of control – *Trichoderma* sp. *Bacillus thuringiensis* and

Pseudomonas sp. Biofertilizer – *Azotobacter*, *Azolla*. Systemic Acquired Resistance (SAR), Induced Systemic Resistance (ISR). Opportunities in Agriculture Microbiology.

TEXTBOOKS:

1. Rangaswami, G., and Bagyaraj, D.J. *Agricultural microbiology*, 2nd edition. Prentice hall of India Learning. 2009.
2. SubbaRao, N.S. *Soil Microbiology*. Fourth edition, Oxford and IBH Publishing Co.Pvt. Ltd, New Delhi. 2004.
3. Sylvia, D.M., et al. *Principles and Applications of Soil Microbiology*, 2nd Edn. Pearson, Prentice Hall. 2005.

REFERENCE BOOKS:

1. Glick, B.R. *Beneficial Plant Bacterial Interactions*, Springer. 2015.
2. Madigan, M.T., et al. *Brock Biology of Microorganisms*, 15th Edn.(Global Edn.). Pearson Education. 2017.
3. Paul, E.A. (Ed.) *Soil Microbiology, Ecology and Biochemistry*, 4th Edn, Academic Press. 2015.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the role of microorganisms in soil.	1,3,5	Understanding
CO-2	Show the diseases associated with plants.	1, 2,3,4,5	Applying
CO-3	Analyze the microbial interactions with plants.	1, 2,3,4,5	Analyzing
CO-4	Examine the different types and steps involved in nitrogen fixation.	1, 3,4,5	Analyzing
CO-5	Select the suitable microorganisms to produce biofertilizers and biopesticides.	1, 3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
VI	21UCMB63	AGRICULTURALMICROBIOLOGY					60	4		
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
Number of matches (✓) = 45 Relationship = High										

Prepared by
Name :Dr.M. Senthil @ Sankar

Checked by
Dr.R.Janet Rani
Head of the Department

Signature :

Semester – VI

Course Title	BIOINFORMATICS
Total Hrs	60
Hrs/Week	4
Sub.Code	21UEMB61A
Course Type	Course Specific Elective
Credits	4
Marks	100

General Objective:

The course is designed to explain the applications of computers in biology and to familiarize with sequence analysis, databases and advancements in the field of bioinformatics.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the development of computers and Bioinformatics.
CO-2	Demonstrate the sequencing methods, format and alignment of sequences.
CO-3	Analyze the types of sequence databases available for target analysis.
CO-4	Select the Phylogenetic Methods and evaluation.
CO-5	Compare the Omics and advanced fields.

UNIT –I: INTRODUCTION TO BIOINFORMATICS (12 hours)

Computer, characteristics of computers, applications of computer. History, Scope and application of Bioinformatics. Opportunities and emerging areas. Central dogma of molecular biology. **Biocomputing. Human Genome Project.**

UNIT –II: SEQUENCE AND ALIGNMENT (12 hours)

Sequence Definition and types. Sequencing method – first, second and third generation. Definition, basics of sequence similarity, sequence alignment. Sequence File Formats- FASTA, Genbank and Uniprot. Sequence alignments- sequence similarity, sequence alignment -Local alignment and Global alignment, Pairwise alignment (BLAST) **and multiple sequence alignment (Clustal W). Finding and retrieving sequences.**

UNIT –III: DATABASE (12 hours)

Database- Types of Databases. Primary nucleotide databases – (NCBI, DDBJ, and EMBL). Protein sequence databases – Swissprot, Uniprot, TrEMBL, Structural databases – PDB, PubChem, ChemBank, CATH, SCOP. Specialized Genome databases (SGD, TIGR, and ACeDB) Bibliographic databases-Pubmed, PMC, PloS.

UNIT IV: PHYLOGENY (12 hours)

Molecular Phylogeny - Introduction, Phylogenetic Methods. Types of Trees. Evaluation method- bootstrap, MEGA, PHYLIP.

UNIT V: ADVANCE FIELDS OF BIOINFORMATICS (12 hours)

Omics- Genomics, Proteomics, Transcriptomics, Metabolomics, Pharmacogenomics and Cheminformatics. Microarray. Introduction to drug discovery – Docking and design.

TEXT BOOKS:

1. Balagurusamy, E. *Programming in ANSIC*. Tata McGraw Hill.1991.
2. Claverie, J.M., and Notredame C. *Bioinformatics for Dummies*, 2nd Edn. Wiley Publishers. 2007.
3. Gibas, C., et al. *Developing bioinformatics in computer skill: An Introduction to Software Tools for Biological Applications*, O'Reilly Media.2001.
4. Lesk, M.A. *Introduction to Bioinformatics*, 3rd International Student Edition, Oxford Publication. 2008.
5. Wood, A.H., et al. *Introduction to bioinformatics*, Pearson education Asia. 2001.

REFERENCE BOOKS:

1. Chavali, L.N. *Bioinformatics and Bioprogramming in C*, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2009.
2. Higgins, D., and Taylor, W. *Bioinformatics: Sequence, Structure and databanks*. Oxford University Press. 2002.
3. Masatoshi,N., and Kumar, S. *Molecular Evolution and Phylogenetics*. OUP USA. 2000.
4. Mount, D.W. *Bioinformatics: Sequence and Genome analysis*, 2nd Edn. Paperback, CBS Publishers. 2005.
5. Posada, D. *Bioinformatics for DNA Sequence Analysis*. Totowa, NJ : Humana Press, 2009.
6. Singh, R., and Sharma, R. *Bioinformatics: Basics, algorithms and applications*, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2010.

Course Outcomes

CO	Course Outcomes	PSOs Addressed	Cognitive Level
CO-1	Explain the history and development of Bioinformatics.	1, 2,4,5	Understanding
CO-2	Demonstrate nucleic acid sequence databases by NCBI, EMBL and DDBJ.	1, 2,3,4,5	Applying
CO-3	Examine Protein Sequence characters using SWISS –PROT.	1, 2,3,4,5	Analyzing
CO-4	Choose the sequence alignment using BLAST.	1, 2,3,4,5	Creating
CO-5	Assess the molecular visualization of protein by using RASMOL.	1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
VI	21UEMB61A	BIOINFORMATICS	60	4						
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓			✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 47 Relationship = High										

Prepared by

Name :Dr.M. Senthil @ Sankar

Signature :

Checked by

Dr.R.Janet Rani

Head of the Department

Semester – VI

Semester – VI

Course Title	HERBAL TECHNOLOGY
Total Hrs.	60
Hrs/Week	4
Sub.Code	21UXXXX
Course Type	Discipline Specific Elective
Credits	4
Marks	100

General Objective:

1. The course covers the topics such as Pharmacology, medicinal plants, its identification and chemical composition, parts of the medicinal plants used as medicine and herbs of industrial importance.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Understand the Indian systems of medicine.
CO-2	Outline the medicinal plants classification.
CO-3	Utilize the various medicinal plant parts.
CO-4	List out the beneficial herbs used to treat ailments.
CO-5	Create knowledge on production of cosmetics with industrial value.

UNIT I PHARMACOLOGY (12 hours)

Pharmacognosy- Pharmacology - Definition and history; Indian systems of medicine -Siddha, ayurvedha, and Unani systems.Aroma Therapy.Cosmetology.

UNIT II (12 hours)

Classification of medicinal plants. Crude drugs - chemical composition - pharmaceutical uses - Source of Herbs Selection, identification and authentication of herbal materials - processing and marketing.

UNIT III MEDICINAL PLANT PARTS AS HERBAL MEDICINES (12 hours)

Leaves - Adathoda, Eucalyptus; Flower - Clove; fruits seeds - Nutmegs, Gooseberry - unorganized drugs; Gum - Acacia - Resin - Turpentine, fixed oil - castor oil. Underground stem - ginger, Alpinia; Roots - Belladonna; Aerial parts - Bark - Cinchona.

UNIT IV HERBAL MEDICINES FOR HUMAN AILMENTS (12 hours)

Herbs for gastric problems- turmeric and fenugreek.Indigestion-importance of fasting, Ginger, garlic.Gynaec problems- moringa, Asparagus.Respiratory- adathoda, tulsi.Head ache and anxiety – aloe vera, sandal wood.oils- clove, eucalyptus.

UNIT V HERBS OF INDRUSTIAL VALUE (12 hours)

Role of biotechnology in medicinal plants - Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws. Indian

Pharmacopoeia, US Pharmacopoeia, British Pharmacopoeia, WHO's Pharmacopoeia.

TEXT BOOKS

1. Herbal Drug Technology, 2nd Edition. Agarwal, S.S and Paridhavi, M 2012. Universities Press (India) Private Ltd.
2. Herbal Plants and their Applications in Cosmeceuticals. Kuntal Das. 2014. CBS publishers and distributors Pvt. Ltd., Chennai.
3. Alagappan R. 2017. Medicine For Ayush Students 1st Edition ,Atithi books, New Delhi.

REFERENCE BOOKS

1. Pharamcognosy by 2nd Edition. Handa, S.S. and Kapoor. 2009. V.K. VallabhPrakashan Publishers, New Delhi.
2. Introduction to Medical Botany and Pharmacognosy. Kumar N.C. 2004. Emkay Publications.
3. M.S. Krishnamurthy and JV Hebbar. 2018. Easy Ayurveda Home Remedies: Based OnAuthentic, Traditional Ayurveda Practice, Repro Books.

Course Outcomes (CO)

CO No	Uponcompletionofthiscourse,studentswill be ableto:	PSO addressed	Blooms taxonomy classification
CO-1	Outline the Indian systems of medicine.	1	Understanding
CO-2	Demonstrate the medicinal plants classification and its importance.	1	Applying
CO-3	Choose the medicinal parts from the herbs.	2	Applying
CO-4	Explain the beneficial herbs used to treat ailments.	2	Analyzing
CO-5	Create knowledge on production of cosmetics with industrial value.	6	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
Xx	21UXXXX	HERBAL TECHNOLOGY	60	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
Number of matches (✓) = 47 Relationship = High Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)										

Prepared by
Name :Dr.M.SENTHIL @ SANKAR

Checked by
Dr.R.Janet Rani
Head of the Department

Signature :

Semester – VI

Course Title	PUBLIC HEALTH AND MICROBIOLOGY
Total Hrs.	60
Hrs/Week	4
Sub.Code	21UXXXX
Course Type	Discipline Specific Elective
Credits	4
Marks	100

General Objective:

1. The course covers the concepts on public health, importance of microbiology, types of diseases associated with air, water and food and significance of monitoring and diagnosis of hospital borne infection

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the importance of public health and microbiology.
CO-2	Illustrate the air composition and associated infections.
CO-3	Summarize the methods to evaluate water quality.
CO-4	Classify the steps to prevent food spoilage and infections.
CO-5	Justify the microbial techniques for monitoring and diagnosis.

UNIT I INTRODUCTION TO PUBLIC HEALTH MICROBIOLOGY (12 hours)

Definition, scope, concept and importance of public health microbiology. The history and Contributions of Microbiology – Anton Van Leewenhoek, Joseph Lister, Louis Pasteur, Robert Koch). Classification of microorganisms – bacteria, fungi, virus, protozoa. Roles of microbiologist in public health.

UNIT II AIR BORNE INFECTIONS (12 hours)

Air and its composition – indoor air – outdoor air – air borne diseases (bacterial, fungal and viral) – methods of enumeration of microorganisms in air – air sanitation.

UNIT III WATER BORNE INFECTIONS (12 hours)

Water borne diseases (viral, bacterial, protozoan) – methods of enumeration of microorganisms in water – indicator organism – water treatment, control of water borne diseases

UNIT IV FOOD BORNE DISEASES (12 hours)

Food borne diseases: definition and importance of food hygiene – types (spoilage of meat and its products, milk and dairy products) – role of

	Number of matches (✓) = 49 Relationship = High Low (If the No. of matches are less than 25) Medium (If the No. of matches are between 25 and 33) High (If the No. of matches are more than 33)
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Name : Dr. M.SENTHIL @ SANKAR

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Head of the Department

Signature :

Semester VI

Course Title	PROJECT
Total Hrs.	90
Hrs./Week	4
Sub.Code	21UEMB62
Course Type	Elective
Credits	4
Marks	100

General Objective:

The course promotes the problem solvingskills of the chosen field and encourages teamwork.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Prepare a research framework.
CO-2	Apply the techniques of microbiology.
CO-3	Analyse and interpret the collected data.
CO-4	Solve the research issues.
CO-5	Integrate a statistical tool to analyse the collected data.

RESEARCH PROJECT

RESEARCH PROJECT

To plan and design statistically, retrieve relevant literature, organize and process the data, photograph relevant observations, evaluate by statistical programme, present the project in any State/ Regional / National conference/ Seminar during the second year of the course and submit during the final semester examinations. The work has to be conducted in the Department / Collaborative organization / Institute under the guidance of the Project Supervisor. Inter- disciplinary collaborations from External Departments / Institutions can also be organized for essential areas of the

CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Number of matches (✓) = 50 Relationship = High									

Semester VI

Course Title	TECHNIQUES IN MEDICAL MICROBIOLOGY
Total Hrs	60 hours
Hrs/Week	4 hours
Sub.Code	21UCMB6P1
Course Type	Discipline Specific Core – Practical
Credits	2
Marks	100

General Objective:

The course teaches the isolation and identification of pathogen from clinical sample, the tolerance ability of lactose and antibiotic sensitivity of microorganisms.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Practiceto count bacterial cell in urine.
CO-2	Examine Urine, skin, throat and wound sample to diagnose infectious condition.
CO-4	Detectthe antibiotic sensitivity of microorganism.
CO-5	Analyze lactose tolerance test.
CO-6	Perform fungal and protozoa slide culture.

Course Outline

1. Enumeration of Bacteria in Urine sample.
2. Isolation and identification of UTI causing pathogen from urine.
3. Isolation and identification of pathogen from wound.
4. Isolation and identification of pathogen from throat swab.
5. Isolation and identification of pathogen from skin.
6. Antibiotic sensitivity test by Disc and diffusion method.
7. Lactose tolerance test
8. Fungal slide culture.
9. Observation of Protozoa –permanent slide method.

Reference Books:

- 1) Cappuccino, J.G., and Sherman, N. *Microbiology – A laboratory manual*. Benjamin CUMMINS. New York. 1996.
- 2) Dubey, D.C. and Maheshwari, D.K. *Practical Microbiology*. S. Chand and Company pvt ltd, Delhi. 2002.
- 3) Kannan, N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani. 1996.
- 4) Rajan, S., and Christy, S.R. *Experimental Procedure in Life sciences*. Anjanaa Book House. 2012.

Course Outcome (CO)

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive Level
CO-1	Examine the bacterial cell in clinical urine sample.	1, 2,3,4,5	Applying
CO-2	Analyze the clinical urine, skin, throat and wound samples to find out the bacteria responsible for the infection.	1, 2,3,4,5	Analyzing
CO-4	Examine the antibiotic sensitivity of pathogen using disc and well diffusion.	1, 2,3,4,5	Analyzing
CO-5	Recommend the specific antibiotic for the associated infection condition.	1, 2,3,4,5	Evaluating
Co-6	Predict the structure of protozoa and fungi using permanent slide observation.	1, 2,3,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit				
VI	21UCMB6P1	Techniques In Medical Microbiology					60	2				
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)						
	PLO 1	PLO2	PLO3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 50 Relationship = High												

Prepared by

Dr.K.Chitra

Name and Signature

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Head of the Department

Semester VI

Course Title	TECHNIQUES IN INDUSTRIAL AND AGRICULTURE MICROBIOLOGY
Total Hrs	60
Hrs/Week	4
Sub.Code	21UCMB6P2
Course Type	Core – Practical
Credits	2
Marks	100

General Objective:

The course focuses the identification of industrially important microorganism, immobilization of microbial cell in active form for long lasting, the isolation of pathogen from diseased plant.

Course Objectives:The learners will be able to:

CO	Course Objectives
CO-1	Predict industrially important microorganisms.
CO-2	Examine the production of alcohol by the fermentation process using sugar cane.
CO-3	Analyzecell immobilization process.
CO-4	Perform the isolation of nitrogen fixing bacteria.
CO-5	Plan to isolate fungal and bacterial plant pathogen.

Course Outline:

1. Isolation and identification of industrially important microorganisms- crowded plate technique.
2. Isolation of Yeast from grape juice.
3. Production of alcohol from sugarcane.
4. Screening of Biopolymer producing Bacteria.
5. Cell immobilization.
6. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes.
7. Isolation of *Rhizobium* species from root nodules of leguminous plants.
8. Isolation of *Azotobacter* sp from soil.
9. Isolation of fungal and bacterial pathogen from diseased plant parts.

REFERENCES

1. Kannan, N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani. 1996.
2. Dubey, D.C. and Maheshwari, D. K. *Practical Microbiology*. S. Chand and Company pvt ltd, Delhi. 2002.
3. Cappuccino, J.G., and Sherman, N. *Microbiology – A laboratory manual*. Benjamin CUMMINS. New York. 1996.

4. Rajan, S., and Christy, S.R. *Experimental Procedure in Life sciences*. Anjanaa Book House. 2012.

Course Outcome (CO)

CO NO	Upon the completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	Predict the industrially important microorganism using crowded plate technique.	1, 2,3,4,5	Applying
CO-2	Analyze the structure of Yeast isolated from grape juice.	1, 2,3,4,5	Analyzing
CO-3	Prepare wine using sugarcane juice.	1, 2,3,4,5	Evaluating
CO-4	Perform an experiment to isolate nitrogen fixing bacteria from root nodules of the leguminous plants.	1, 2,3,4,5	Creating
CO-5	Plan to identify the fungal and bacterial plant pathogen.	1, 2,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credit		
VI	21UCMB6P2	Techniques In Industrial And Agriculture Microbiology					60	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of matches (✓) = 50 Relationship = High										

Prepared by

Dr.K.Chitra

Name and Signature

Checked by

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Head of the Department

Semester VI

Course Title	BASIC DIETETICS
Total Hrs	30
Hrs/Week	2
Sub.Code	21USMB61
Course Type	Skill Based Elective
Credits	2
Marks	100

General Objective:

The course teaches the on role of dietitian, nutritional care for obesity and overweight, nutritional diet for gastro intestinal tract, liver and biliary system.

Course Objectives: The learners will be able to:

CO	Course Objectives
CO-1	Explain the diet therapy.
CO-2	Demonstrate on nutritional care for weight management.
CO-3	Apply the nutritional care for diseases of the gastro intestinal tract.
CO-4	Assess the nutritional care for diseases of liver and biliary system.
CO-5	Predict the nutritional care for deficiency disorders.

UNITI: DIET THERAPY (6 hours)

Definition, purposes of a therapeutic diet, principles and types of hospital diet clear fluid, full fluid, soft, light, bland and regular diet. Dietitian – Types, qualities, qualification and role of dietitian in managing hospital dietary.

UNITII: NUTRITIONAL CARE FOR WEIGHT MANAGEMENT (6 hours)

Obesity and overweight Identification, etiology, dietary management and behavioral modifications. Underweight Etiology, assessment and dietary management. Nutritional care for febrile condition – Acute, chronic and recurrent Malaria, Typhoid and TB – Etiology, symptoms and dietary management.

UNITIII: NUTRITIONAL CARE FOR DISEASES OF THE GASTRO INTESTINAL TRACT (6 hours)

Gastric and duodenal ulcer, diarrhoea, constipation, malabsorption syndrome, hemorrhoids, ulcerative colitis, flatulence and steatorrhea – Etiology, symptoms and dietary management.

UNITIV: NUTRITIONAL CARE FOR DISEASES OF LIVER AND BILIARY SYSTEM (6 hours)

Viral hepatitis, cirrhosis of liver, cholelithiasis and cholecystitis Etiology, symptoms and dietary management.

UNITV: NUTRITIONAL CARE FOR DEFICIENCY DISORDERS (6 hours)

PEM, Nutritional anemia, VitaminA deficiency, Iodine deficiency, osteoporosis and osteomalacia- Etiology, symptoms and dietary management.

Textbooks:

1. Mahan, L.K., and Arlin, M.T. *Food, Nutrition and Diet Therapy*. W.B. Saunders Company, London Publications, 8th edition, 1992.
2. Paul, S. *Textbook of Bio-Nutrition*, Curing diseases through diet. CBS publications, first edition, 2005.
3. Begum, R. *A textbook of Foods, Nutrition and Dietetics*. Sterling Publishers, New Delhi, 1989.

Reference Books:

1. Joshi, S.A. *Nutrition and Dietetics*. Tata McGraw Hill Publications, New Delhi, 2004.
2. Robinson, C.H. *et al., Normal and Therapeutic Nutrition*. MacMillan Publishing Co, 17th edition, 1986.
3. Srilakshmi, B. *Dietetics*. New Age International (P) limited Publications, 2004.

Course Outcomes:

CO No	Upon completion of this course, students will be able to:	PSO addressed	Cognitive level
CO-1	Apply the diet therapy for various health disorders.	4,5	Applying
CO-2	Analyze the nutritional care for weight management.	4,5	Analyzing
CO-3	Solve the gastrointestinal disorders by nutritional care for.	3,4,5	Analyzing
CO-4	Prepare nutritional care for liver disease.	3,4,5	Evaluating
CO-5	Identify the vitamin deficiency.	3,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credit						
V	21UCMB51	IMMUNOLOGY	75	4						
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓				✓	✓
CO-2	✓	✓	✓	✓	✓				✓	✓
CO-3	✓	✓	✓	✓	✓			✓	✓	✓
CO-4	✓	✓	✓	✓	✓			✓	✓	✓
CO-5	✓	✓	✓	✓	✓			✓	✓	✓
Number of matches (✓) = 38 Relationship = High										

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Name and Signature

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Head of the Department