RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE (AUTONOMOUS) SULUR, COIMBATORE-641402

DEPARTMENT OF MICROBIOLOGY

B.Sc MICROBIOLOGY

Syllabus effective for the students admitted during the Academic Year 2019 – 2020 Batch & onwards

(2019- 2022)

HOD PRINCIPAL COE

PROGRAMME OUTCOMES (POs):

PO1	Graduates can have strong fundamentals in their specific discipline along with DIGITAL STRATEGIC knowledge.
PO2	To increase student's ability to communicate effectively with the community /society in verbal /written courage for such as to give or receive clear instruction.
PO3	To enhance their ability to understand and identify the professional and ethical responsibilities.
PO4	To enrich their personality and character development

PROGRAMME SPECIFIC OUTCOMES: (PSOs)
Upon completion of Bachelor of Microbiology Degree,
STUDENTS are able to achieve the following outcomes

PSO1	Inculcate the learners to acquire, articulate, retain and apply the knowledge of microbiology in Medical, Diagnosis, Agricultural, Industrial, Pharmaceutical and other relevant fields.
PSO2	To prepare, promote and apply microbial knowledge to excel as succeeding microbiologist on isolation and identification of challenging microbes in the field of medical and agricultural field.
PSO3	Demonstrate the knowledge of interaction between humans and microorganisms by formally applying in quality analysis of production and products in the industrial level
PSO4	Understand and develop ability to use, the scientific methods including observation, hypotheses testing, data collection, and analysis to engage in higher studies and scholarly research activities.

GRADUATE ATTRIBUTES

- DISIPLINEKNOWLEDGE
- PROBLEMANALYSIS
- CRITICALTHINKING
- MODERN TOOLSUSAGE
- SOFTSKILLS
- SELFLEARNING
- LIFE LONGLEARNING
- INDIVIDUAL & TEAMWORK
- PROJECT MANAGEMENT &FINANCE

RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS AND SCIENCE

(Autonomous)

Affiliated to Bharathiar University, Coimbatore 641 402

SCHEME OF EXAMINATION -CBCS PATTERN

PROGRAMME: B.Sc., (Microbiology)

(Effective from the academic year 2019 - 2020)

Credits & Marks Distribution

Sl No.	Course Type	Number of Courses	Credits	Marks	Total Credits
1	Multi-Indian/ International Languages (MIL)	2	4	200	8
2	Ability Enhancement Compulsory Courses (AECC) – (I & II) : Group-I (English)	2	4	200	8
3	Ability Enhancement Compulsory Courses (AECC) –(II & IV) : Group-II	2	1+3	200	4
4	Discipline Specific Courses (DSC)	12	6	1200	72
5	Discipline Specific Elective Courses (DSE)	4+1	6	500	30
6	Extra Disciplinary Course (EDC) (DSE)	1	6	100	6
7	Skill Enhancement Courses (SEC)	2+1	4	200	8
8	ALCTA – e Learning in MOOC platform	1	4*	completion	4*
9	Non Credit Courses – Group I	2	-	Grade	-
10	Non Credit Courses – Group II	6	-	Pass	-
11	Non Credit Courses – Group III	4		Completed	
Total				**2600**	**136+4***

MULTI-INDIAN/INTERNATIONAL LANGUAGES (MIL)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
Two Courses – Any ONE Group								
Group I								
MIL	Tamil I	6	-	-	25	75	100	4
MIL	Tamil II	6	-	-	25	75	100	4
Group II								
MIL	Hindi I	6	-	-	25	75	100	4
MIL	Hindi II	6	-	-	25	75	100	4
Group III								
MIL	Malayalam I	6	-	-	25	75	100	4
MIL	Malayalam II	6	-	-	25	75	100	4
Group IV								
MIL	French I	6	-	-	25	75	100	4

MIL	French - II	6	-	-	25	75	100	4
Group V								
MIL	Arabic I	6	-	-	25	75	100	4
MIL	Arabic II	6	-	-	25	75	100	4
Total							200	8

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC) - GROUP I : (I & II SEMESTER)								
AECC – G1-I	English I	6	-	-	25	75	100	4
AECC – G1-II	English II	6	-	-	25	75	100	4
Total							**200**	**8**

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC) - GROUP II : (II & IV SEMESTER)								
AECC –G-2-I	Environmental Studies	1	-	-	100	-	100	1
AECC –G-2 -II	Aptitude	3	-	-	100	-	100	3
Total							**200**	**4**

DISCIPLINE SPECIFIC COURSES (DSC)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
DSC – I	Principles of Microbiology	4		4	25 40	75 60	100	6
DSC – II	Applied Biochemistry	5	1		25	75	100	6
DSC – III	Microbial Diversity	4	-	4	25 40	75 60	100	6
DSC – IV	Biostatistics	5	1		25	75	100	6
DSC – V	Microbial physiology and metabolism	4		4	25 40	75 60	100	6
DSC – VI	Bioinstrumentation methods and analysis	4		4	25 40	75 60	100	6
DSC – VII	Immunology	4		4	25 40	75 60	100	6
DSC – VIII	Bacteriology and Virology	4		4	25 40	75 60	100	6
DSC – IX	Mycology and Parasitology	5	1		25	75	100	6
DSC – X	Microbial Genetics	4		4	25 40	75 60	100	6
DSC – XI	Food Microbiology	4		4	25 40	75 60	100	6
DSC – XII	Industrial Microbiology	4		4	25 40	75 60	100	6
Total							**1200**	**72**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) I : (III SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the Group								
DSE - I	Environmental Microbiology	4	-	4	25 40	75 60	100	6
DSE - I	Cell Biology	4	-	4	25 40	75 60	100	6
Total							**100**	**6**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) II : (IV SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the Group								
DSE - II	Agricultural Microbiology	4	-	4	25 40	75 60	100	6
DSE - II	Biodegradation and Bioremediation	5	1	-	25	75	100	6
Total							**100**	**6**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) III : (V SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the Group								
DSE - III	Recombinant DNA Technology	4	-	4	25 40	75 60	100	6
DSE - III	Vaccine in Health Management	4	-	4	25 40	75 60	100	6
Total							**100**	**6**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) IV : (VI SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the Group								
DSE –IV	Diagnostic Microbiology	4	-	4	25 40	75 60	100	6
DSE – IV	Plant Pathology	5	1	4	25	75	100	6

Total	100	6

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) (V- SEMESTER)								
EXTRA DISCIPLINARY COURSE (EDC)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the Group								
B.A. English	Professional Communication	5	1	-	25	75	100	6
BBA	Entrepreneurship	5	1	-	25	75	100	6
BBA (CA)	Project Management	5	1	-	25	75	100	6
B.COM	Insurance and Risk Management	5	1	-	25	75	100	6
B.COM (CA)	Social Media Marketing	5	1	-	25	75	100	6
B.COM (IT)	E-Commerce	5	1	-	25	75	100	6
B.COM (PA)	Indian Tax System	5	1	-	25	75	100	6
B.COM (BA)	Digital marketing	5	1	-	25	75	100	6
BCA	Responsive Web Design	5	1	-	25	75	100	6
B.Sc., (CS)	Business Analytics	5	1	-	25	75	100	6
B.Sc., (IT)	Big Data Engineering	5	1	-	25	75	100	6
B.Sc., CSHM	Hospitality Management	5	1	-	25	75	100	6
B.Sc., ECS	Fundamentals of Digital Computers	5	1	-	25	75	100	6
B.Sc., MATHS	Computational Mathematics	5	1	-	25	75	100	6
B.Sc., BC	Health Management	5	1	-	25	75	100	6
B.Sc., BT	Forensic Science	5	1	-	25	75	100	6
B.Sc., MB	Microbes – Health & Disease	5	1	-	25	75	100	6
B.Sc., N&D	Health & Life Style Disorders	5	1	-	25	75	100	6
Total							**100**	**6**

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) V : (VI SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
One Course – From the group								
DSE –V	Elective – VI- Project Work Report & Viva voce	6	-	-	40	60	100	6
DSE – V	Elective – VI- Industrial Exposure Training Report & Viva Voce	6	-	-	40	60	100	6
Total							**100**	**6**

SKILL ENHANCEMENT COURSES : GROUP I (III & IV SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**

SEC – G1-I	Communicative Skills – I	2	-	-	50	-	50	2
SEC – G1-II	Communicative Skills – II	2	-	-	50	-	50	2
Total							**100**	**4**

SKILL ENHANCEMENT COURSES : GROUP II (V SEMESTER)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**ESE**	**Total**	**Credits**
Any ONE Group								
Group A								
SEC –G2 – AI	Placement - College to Corporate - I	2	-	-	50	-	50	2
SEC –G2 – AII	Placement - College to Corporate – II	2	-	-	50	-	50	2
Group B								
SEC – G2 – B	Entrepreneurship Development	4	-	-	100	-	100	4
Total							**100**	**4**

NON CREDIT COURSE– GROUP I (III & IV SEMESTER)			
NCC – G1-I (III Semester)	Career skills-I	RVS Training Academy	Grade
NCC – G1-2 (IV Semester)	Career skills-II	RVS Training Academy	Grade

NON CREDIT COURSES : GROUP II (COP)									
Semester	**Course opted**	**Course Name**	D	L	T	P	CIA	MODEL	Marks
I	NCC–G2-I	MUSHROOM CULTIVATION	3	1	1	-	25	75	100
II	NC–G2-II	PRACTICAL I - MUSHROOM CULTIVATION	3	1	-	1	25	75	100
III	NC –G2 -III	FERMENTATION TECHNOLOGY	3	1	1	-	25	75	100
IV	NCC–G2 -IV	PRACTICAL II- FERMENTATION TECHNOLOGY	3	1	-	1	25	75	100
V	NCC– G2 - V	BIO-FERTILIZERS	3	1	1	-	25	75	100
VI	NCC– G2 - VI	PROJECT REPORT AND VIVA VOCE	3	1	-	1	25	75	100

NON CREDIT COURSE– GROUP III (I - IV SEMESTER)			
Any ONE Course			
NCC – G3	National Service Scheme	NSS	Completion
	National Cadet Corps	NCC	Completion
	Sports	Physical Education	Completion
	Literacy & Cultural Club	Language Department	Completion
	Youth Red Cross / Red Ribbon Club	YRC	Completion
	Fine Arts Club	Language Department	Completion

EXTRA OPTIONAL CREDIT COURSE (ALCTA) I – VI SEMESTER			
Any ONECourse with 4 Extra Credits			
I – VI Semester	e-Learning in MOOC Platform	4 Credits	Completion

SCHEME OF EXAMINATIONS

B. Sc., MICROBIOLOGY 2019 - 2020 BATCH

Sem.	Course Opted	Course Name	D	L	T	P	CIA	ESE	Marks	Credits
I	MIL - I	Tamil-I/Hindi-I / Malayalam – I/ French-I/Arabic- I	3	6	-	-	25	75	100	4
	AECC – G1 -I	English-I	3	6	-	-	25	75	100	4
	DSC – I	Principles of Microbiology	3	4	-	4	25 40	75 60	100	6
	DSC – II	Applied Biochemistry	3	5	1	-	25	75	100	6
	NCC – G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
	LIB	Library	-	1	-	-	-	-	-	-
	Total				**28**				**400**	**20**
II	MIL-II	Tamil-II/Hindi-II/Malayalam – II/French-II/Arabic-II	3	6	-	-	25	75	100	4
	AECC – G1 -II	English-II	3	6	-	-	25	75	100	4
	DSC – III	Microbial Diversity	3	4	-	4	25 40	75 60	100	6
	DSC – IV	Biostatistics	3	5	**1**		25	75	100	6
	AECC-G2-I	Environmental Studies	3	1			100		100	1
	NCC – G3	NCC/NSS/ SPORTS/CULTURALS		1	-	-	-	-	-	-
	LIB	Library		1	-	-	-	-	-	-
	Total				**29**				**500**	**21**

Sem.	Course Opted	Course Name	D	L	T	P	CIA	ESE	Marks	Credits
III	DSC – V	Microbial Physiology and Metabolism	3 3	4	-	4	25 40	75 60	100	6
	DSC – VI	Bioinstrumentation methods and Analysis	3 3	4	-	4	25 40	75 60	100	6
	DSE - I	Elective - I	3 3	4	-	4	25 40	75 60	100	6
	SEC – G 1 – I	Communicative Skills - I	3	2	-	-	50	-	50	2
	NCC– G 1 – I	Career skills-I	3	2	-	-	Grade			
	NCC – G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
	Total				**29**				**350**	**20**
IV	DSC – VII	Immunology	3 3	4	-	4	25 40	75 60	100	6
	DSC – VIII	Bacteriology and Virology	3 3	4	-	4	25 40	75 60	100	6
	DSE - II	Elective-II	3 3	4	-	4	25 40	75 60	100	6
	SEC – G1 - II	Communicative Skills - II	3	2	-	-	50	-	50	2
	NCC – G 1 – II	Career skills - II	3	2	-	-	Grade			
	AECC-G2-II	Aptitude	3	3			100	-	100	3
	NCC – G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
	Total				**32**				**450**	**23**

Sem.	Course Opted	Course Name	D	L	T	P	CIA	ESE	Marks	Credits
V	DSC – IX	Mycology and Parasitology	3	5	1	-	25	75	100	6
	DSC – X	Microbial Genetics	3	4	-	4	25	75	100	6
			3				40	60		
	DSE – III	Elective - III	3	4	-	4	25	75	100	6
			3				40	60		
	DSE	Elective - (EDC)	3	5	1	-	25	75	100	6
	Any ONE Group									
	Group A									
	SEC – G 2 – A -I	Placement - College to Corporate-I	3	2	-	-	50	-	50	2
	SEC – G2 – A - II	Placement - College to Corporate - II		2	-	-	50	-	50	2
	Group B									
	SEC – G 2 - B	Entrepreneurship Development Water quality analysis potable assurance	3	4	-	-	100	-	100	4
	NCC – G3	NCC/NSS/SPORTS/CULTURALS	-	1	-	-	Good/ Satisfactory			
	Total				**32**				**500**	**28**
VI	DSC – XI	Food Microbiology	3	4	-	4	25	75	100	6
			3				40	60		
	DSC – XII	Industrial Microbiology	3	4	-	4	25	75	100	6
			3				40	60		
	DSE-IV	Elective-IV	3	4	-	4	25	75	100	6
			3				40	60		
	DSE – V	Elective – V	-	6	-	-	40	60	100	6
	ALCTA	(e-Learning in MOOC Platform)	Extra Credits							4*
	Total								**400**	**24**
TOTAL									**2600**	**136 +4* =140**

ABBREVIATIONS

MIL	- Multi Indian/ International Languages
AECC-G1	- Ability Enhancement Compulsory Courses – I & II: Group - I (English)
AECC-G2	- Ability Enhancement Compulsory Courses – II & II: Group - II
DSC	- Discipline Specific Courses
DSE	- Discipline Specific Elective Courses
EDC	- Extra Disciplinary Course
NCC	- Non Credit Course
SEC	- Skill Enhancement Courses (Group-I & II)
ALCTA	- Advanced Learners Course in Thrust Areas– e Learning in MOOC platform

DSE I -Discipline Specific Elective Courses I: (III Semester)

1. Environmental Microbiology
2. Cell Biology

DSE II- Discipline Specific Elective Courses II: (IV Semester)

1. Agricultural Microbiology
2. Biodegradation and Bioremediation

DSE III-Discipline Specific Elective Courses III: (V Semester)

1. Recombinant DNA Technology
2. Vaccines in Health Management

DSE IV- Discipline Specific Elective Courses IV: (VI Semester)

1. Diagnostic Microbiology
2. Plant Pathology

DSE - Discipline Specific Elective Courses : (V Semester)

1. Extra Disciplinary Course (EDC)

DSE V- Discipline Specific Elective Courses V: (VI Semester)

1. Project Work Report & Viva voce
2. Industrial Exposure Training Report and Viva Voce

NCC - I (Non – Credit course) Group – I (Professional English)

The assessment will be done by RVS Training Academy and grade will be given based on internal evaluation in the respective semester

NCC – II (Non – Credit Course) Group – II

The students shall complete the activities in the concerned semester and completion status will be mentioned in their fifth semester mark statement. However, completing the activities listed in Group – II is mandatory to complete their degrees.

COURSE CONTENT

Course Title : **PRINCIPLES OF MICROBIOLOGY (T)**	Course Code : 13A
Semester : **I**	Course Group : DSC – I
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **04**
Map Code : C (THEORY – CONCEPTS)	Total Contact Hours : **60**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

COURSE OUTCOME: PRINCIPLES OF MICROBIOLOGY

No.	Course Outcome (Cos)	POs & PSOs	Cl. Ses	CL
CO1	Recognize the positive and negative role of microbes in the environment and daily life	PO1 & PSO1	12	R
CO2	Pinpoint the control measures of microbes determining their resistance and sensitivity in the host and environment	PO1 & PSO1	10	U
CO3	Distinguish the microbial culturing methods to interpret in the epidemiological situations	PO1 & PSO1	10	U
CO4	Identify the techniques for observing the microbial world in the *in vitro* level	PO1 & PSO1	10	Ap
CO5	Impart and demonstrate the small world with chromophores to differentiate under morphological characteristics	PO1 & PSO1	10	Ap
CO6	Exercise the concepts in unique circumstances	PO1 & PSO1	08	Ap

UNIT I **(LECTURE HOURS: 14)**

HISTORY AND SCOPE OF MICROBIOLOGY:

History of Microbiology (Antony van Leeuwenhoek, Robert Koch, Louis Pasteur, Joseph Lister, Elie Metchnikoff, Waksman, Paul Ehrlich, Edward Jenner, Flemming). **Spontaneous generation approval** (Theories of Aristotle, John Needham), **Spontaneous generation disproval** (Theories of Francesco Redi, Lazzaro Spallanzani, Theodore Schwann, George Friedrich Schroder and Theoder von Dusch, Louis Pasteur, John Tyndall). **Germ theory of disease** (Fracastoro's reason for disease transmission, Oliver Wendell Holmes, the contagiousness of purpureal fever Koch's postulates). **Discovery of microbial effects on organic and in organic matter** (Theodore Schwann, Louis Pasteur, Winogradsky, Beijerinck). **Scope of Microbiology** (Medical microbiology, Public health microbiology, Immunology, Agricultural microbiology, Medical Ecology, Food and dairy microbiology, Industrial microbiology, Genetic engineering). **Microbiology in twentieth century** (Tatum, Beadle, Luria and Delbruck, Mac Leod and Mac Carty).

UNIT II **(LECTURE HOURS: 12)**

CONTROL OF MICROORGANISMS IN THE ENVIRONMENT

Physical-Moist Heat-Autoclave (Principle, Apparatus Description), **Dry heat -** Hot air Oven (Apparatus, Working Principle), **Filtration** (Membrane filters, HEPA Filters), **Pasteurization** (Definition, Application, Types- UHT, HTST), **Tyndallization** (Definition, Process, Temperature, Effect), **Radiations** (UV radiations, Ionizing radiations, Microwave, Radio waves), **Chemical agents** (Alcohols, Aldehydes, Phenols, Halogens, Hypochlorite), **Biological agents** (Predators, virus, toxin).

UNIT III **(LECTURE HOURS: 12)**

LABORATORY CULTURE OF MICROBES

Chemical and physical types (Synthetic and complex media, liquid and solid media), **Functional types of media** (Enriched, differential, selective and their mechanism), **Transport media** (Stuart's media), **Media for anaerobes** (Robert son cooked meat media). **Cultivation of anaerobes** (Wrights tube method). **Enrichment and isolation of pure culture** (Enrichment cultures, streak plate, spread plate, pour plate). **Maintenance and preservation of cultures** (Serial culture, mineral oil, lyophilization, cryopreservation, silica, soil).

UNIT IV **(LECTURE HOURS: 12)**

MICROSCOPY

Lenses and bending of light (Refractive index, bending of light by prism, lens function). **Bright field microscope** (Working principle, magnification and application). **Microscope resolution** (Numerical aperture, Numerical aperture in microscope, oil immersion objective). **Dark field microscope** (Working Principles and Applications). **Phase contrast microscope** (Working Principles and Applications). **Fluorescent Microscope** (Working Principles and Applications). **Transmission electron microscope** (Working Principle, Applications, Sample Preparation). **Scanning electron microscope** (Working Principle, Applications)

UNIT V **(LECTURE HOURS: 10)**

STAINS AND STAINING

Stains properties (Chemical composition). **Stain types** (Acidic, Basic and neutral stain), **Smear preparation** (Principle and Procedure), **Staining type- Simple staining** - Methylene blue staining. **Differential staining-Gram staining and Acid fast** (Principle and procedure), **Special staining-capsule and endospore** (Principle and procedure).

TEXT BOOKS:

T1. ESSENTIALS OF MICROBIOLOGY , Edition:1st , Ajana Book House , Dr. S Rajan (2016)

T2. MICROBIOLOGY , Edition:1st , Mc Graw-Hill , Pelczar, Jr., Michael (2001)

T3. PRESCOTT'S MICROBIOLOGY , Edition:9th , Mc Graw-Hill , Sherwood and Willey and Woolverton (2014)

T4. PRINCIPLES OF MICROBIOLOGY , Edition:1st , Moshby- Year Book, Inc , Atlas M Ronald (1995)

T5. MICROBIOLOGY: AN INTRODUCTION , Edition:13TH , Pearson Publishers , Gerard Tortora, Berdell Funke, Christine Case (2018)

REFERENCE BOOKS:

R1. MICROBIOLOGY: A HUMAN PERSPECTIVE , Edition:1st , Mc Graw-Hill , Nester Eugene (2001)

R2. TOPLEY AND WILSON'S MICROBIOLOGY AND MICROBIAL INFECTIONS (VOLUME - 1) , Edition:1st , Mc Graw-Hill , W. W. C. Topley, and Graham S. Wilson (2006)

Course Title : **PRINCIPLES OF MICROBIOLOGY (P)**	Course Code : 13P
Semester : **I**	Course Group : DSC – I
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **02**
Map Code : M (PRACTICAL EXPERIMENTS)	Total Contact Hours : **60**
CIA : **40 Marks**	SEE # : 60 **Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

1. Laboratory precaution - Identificatiion of contributors in Microbiology- Alexander Flemming, Leeuwenhoek, Louis Pasteur, Robert Koch
2. Preparation of cleaning solution
3. Sterilization and sterility testing- Autoclave, Hot air oven, Laminar air flow, Phenol co efficient test
4. Pasteurization of milk
5. Cultural characteristics of microorganisms- Demonstration
6. Serial dilution
7. Culture media preparation and preservation of cultures
8. Pure culture techniques-spread, pour and streak plate
9. Anaerobic cultivation-Wright's tube method
10. Specimen preparation-Microbial culture and spores
11. Instrumentation and working of Binocular light microscope digital imaging
12. Instrumentation and working of Phase contrast microscope
13. Instrumentation and working of Fluorescence microscope
14. Staining of bacteria- Smear preparation and simple staining
15. Gram staining
16. Capsule staining- negative staining
17. Capsule staining- positive staining
18. Spore staining

REFERENCE BOOKS:

R1. MICROBIOLOGY A LABORATORY MANUAL , Edition:12th 2020 , Benjamin-Cummings Publishing Company , James G. Cappuccino, and Natalie Sherman (1999)

R2. Kannan N HANDBOOK OF LABORATORY CULTURE MEDIA, Reagents, Stains and Buffers, 2003

R3. PRESCOTT'S MICROBIOLOGY , Edition:9th , Mc Graw-Hill , Sherwood and Willey and Woolverton (2014)

COURSE CONTENT

Course Title : **APPLIED BIOCHEMISTRY (T)**	Course Code : 13B
Semester : **II**	Course Group : DSC – II
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **6 Credits**
Map Code : C (THEORY – CONCEPTS)	Total Contact Hours: **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

COURSE OUTCOME: BIOCHEMISTRY

No.	Course Outcome(Cos)	POs & PSOs	Cl. Ses	CL
CO1	Compare and contrast the structure and function of the carbohydrates and its metabolism	PO1 & PSO1	16	U
CO2	Recognize the structure of an amino acid and the peptide bond that connects di, tri, and polypeptides. Understand the protein denaturation and renaturation and study the effect of heat on protein structure and function	PO1 & PSO 2	14	U
CO3	Analyze the physical, chemical properties, functions and metabolism of lipids	PO1 & PSO 2	12	U & R
CO4	Identify the components of nucleotide and study the structure and functions of two types of nucleic acids DNA and RNA.	PO1 & PSO 3	18	U & An
CO5	Establish the classification, sources, physiological functions and deficiency symptoms of disorders of bio molecules and its metabolism.	PO1, PSO1 & PSO3	15	U & An
CO6	Illustrate the immune system and its response with its antigen and antibody interactions.	PO1 & PSO 3	15	U & An

UNIT I **(LECTURE HOURS: 18)**

BUFFERS

Definition (Resists change in pH). **Buffer system in blood** (Bicarbonate buffer system). **Monosaccharides** - Classification, cyclic structure and anomeric forms, Haworth projection formula. **Disaccharides**-Introduction and classification, source structure **Polysaccharides and storage polysaccharides**-Introduction and classification, source structure and functions of starch and glycogen, **Structural Polysaccharides**-Source structure and functions of cellulose. **Glycolysis**-Aerobic and anaerobic oxidation. **Tri Carboxylic Acid cycle** - Reactions of TCA. **Disorders of carbohydrate metabolism**-Glycosuria and diabetes mellitus.

ACTIVTY- Chart models on metabolism of carbohydrate.

UNIT II **(LECTURE HOURS: 18)**

AMINO ACIDS

Introduction-Definition and structure. **Classification** on functional groups, amino acids as ampholytes. **Peptide bonds** - Structure and properties, identification of N and C terminal residues

PROTEINS

Introduction - Definition, classification and functions. **Structure of proteins** - Strong and weak bonds, primary, secondary, tertiary and quaternary structures. **Denaturation and renaturation of proteins** - Physical and chemical agents,

coagulation, refolding, isoelectric point. **Protein metabolism** -Deamination, urea cycle, decarboxylation, transamination

ACTIVITY Animation model for structure of proteins.

UNIT III **(LECTURE HOURS: 18)**

LIPIDS

Introduction - Definition and classification. **Simple lipids** (Fats, oils and waxes). **Physical and chemical properties** (Solubility, specific gravity, melting point, color and order, hydrolysis, saponification). **Compound lipids** - Structure and functions of phospholipids, glycolipids lipoproteins. **Derived lipids** - Saturated, unsaturated and essential fatty acids. **Lipoproteins and Steroids** - Types of lipoproteins and cholesterol structure. **Fatty acids** - Introduction- long chain organic acids and types. **Oxidation of fatty acids** - Beta oxidation, dehydration, hydration and thiolytic cleavage. **Disorders of lipoprotein metabolism** - Atherosclerosis, fatty liver.

ACTIVITY-Chart model for types of lipid.

UNIT IV **(LECTURE HOURS: 18)**

NUCLEIC ACIDS

Introduction (Definition and types). **Purines and pyrimidines** - Structure of adenine, guanine, thymine, uracil and cytosine. **DNA Double helix** - Watson Crick model, Chargoff rule. **DNA types** - A, B and Z forms. **RNA** - Structure- A strand of RNA and types. **Central dogma of life** - Information flow via replication, transcription and translation. **DNA replication** - Initiation, elongation and termination **Transcription** - Initiation, elongation, termination. **Translation** - Initiation, elongation, termination.

ACTIVITY- PPT for replication mechanism in DNA.

UNIT V **(LECTURE HOURS: 18)**

ENZYMES

Introduction - Definition and classification. **Active site** - Introduction-binding site and catalytic site. **Mode of action** - Lock and. key model and induced fit theory. **IMMUNOLOGY- Introduction** - Antigen-antibody. **Immune response** - Cell mediated and antibody mediated immune response.

ACTIVITY- Chart work on lock and key model for active site.

TEXT BOOKS:

T1. BIOCHEMISTRY , Edition:4th , W H Freeman and Company , Lubert Stryer(1995)

T2. PRINCIPLES OF BIOCHEMISTRY , Edition:4th , Cox publisher , Lininger (2004)

REFERENCE BOOKS:

R1. FUNDAMANTALS OF BIOCHEMISTRY , Edition:1ST , S Chand ad company Ltd , J L JAIN (2005)

COURSE CONTENT

Course Title : **MICROBIAL DIVERSITY (T)**	Course Code : 23A
Semester : **II**	Course Group : DSC – III
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **04**
Map Code : C (THEORY – CONCEPTS)	Total Contact Hours : **60**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

COURSE OUTCOME: MICROBIAL DIVERSITY

No.	Course Outcome (Cos)	POs & PSOs	Cl. Ses	CL
CO1	Categorize the microbial community in the environment and daily life	PO1 & PSO1	12	R
CO2	Distinguish the role of microbes from other existing microorganisms	PO1 & PSO1	08	U
CO3	Identifying the methods of interpretation under epidemiology	PO1 & PSO1	10	U
CO4	Elaborating the control of microbes in environment	PO1 & PSO2	10	Ap
CO5	Establishing the unique mechanism of existing and new microbes under isolation	PO1 & PSO2	10	Ap
CO6	Exercise the concepts in unique circumstances	PO1 & PSO2	10	Ap

UNIT I **(LECTURE HOURS: 13)**

Microbial Taxonomy

General introduction and overview (Definition of basic terms used in taxonomy-taxonomy, classification, nomenclature, identification, systematics). **Microbial evolution and diversity** (Fossilized bacteria, three major domain- Bacteria, Archaea, Eukarya). **Endosymbiotic hypothesis** (evidence for the emergence of prokaryotes). **Taxonomic ranks** (Non overlapping hierarchical arrangement, Typical example, binomial nomenclature). **Phylogenetic classification** (Classification based on mutual similarity of phylogenetic groups). **Phenetic classification** (Classification based on mutual similarity of phenetic groups). **Numerical taxonomy and dendrogram** (Classification based on numerical analysis with the aid of computer). **Major characteristics used in taxonomy-Classical characteristics** - Phylogenetic information, morphological, physiological and metabolical, ecological, genetic analysis. **Major characteristics used in taxonomy-Molecular characteristics** - Comparison of proteins, nucleic acid base composition, nucleic acid hybridization, nucleic acid sequencing

UNIT II **(LECTURE HOURS: 13)**

Bacterial classification

Deinococci and Non proteo bacteria Gram negative - *Aqiufex*, *Aquificae*, Hydrogenobacteria, Chemolithotrophs, Thermophilic, *Thermotogae*, *Deinococcus thermus*. **Phylum *Chlamydiae*, Phylum *Spirochates* and *Bacteroidetes*** - Chlamydial life cycle, Spirochaete morphology important characteristics and major properties **Bergey's manual of systematic bacteriology** - Major divisions in second edition. **Gram positive bacteria- The low G+C Gram positives** - General introduction class mollicutes (Mycoplasmas). **Class Clostridia and class Bacilli** - Characters of the members of this class. **The high G+C gram positives bacteria** - General properties of Actinomycetes.

UNIT III **(LECTURE HOURS: 10)**

Archae, Eubacteria, Photosynthetic bacteria and viruses

Photosynthetic oxygenic bacteria and anoxygenic bacteria - *Cyanobacteria*, purple sulfur and non-sulfur, green sulfur and non-sulfur bacteria. **Archaea bacteria** - Salient features and classification. **Viruses** - General properties and principles.

UNIT IV **(LECTURE HOURS: 10)**

Fungi

General characteristics of fungi - Distribution, importance, structure, nutrition and metabolism. **Characteristics of fungal division- Zygomycota** - Reproduction and life cycle. **Ascomycota** - Reproduction and life cycle. **Basidiomycota** - Reproduction and life cycle. **Slime molds and water molds** - Reproduction and life cycle. **Yeast life cycle** - Phases in the cycle.

UNIT V **(LECTURE HOURS: 10)**

Protozoa

General characters of protozoa, classification and representative types - *Sarcomastigophora, Apicomplexa, Microspora, Ciliospora*. **Algae- General characteristics of algal division** - *Chlorophyta, Euglenophyta, Chrysophyta, Phaeophyta, Rhodophyta, Pyrrophyta*.

TEXT BOOKS:

T1. MICROBIOLOGY , Edition:7 , Mc Graw Hill , Chan ECS and Harley J P and Klein C A and Kreig R and Pelczar.

T2. PRESCOTT'S MICROBIOLOGY , Edition:9th , Mc Graw-Hill , Sherwood and Willey and Woolverton (2014)

REFERENCE BOOK:

R1. Bergey's Manual of Systematic Bacteriology. 9TH edition Williams and Wilkins 2012 .

Course Title: **MICROBIAL DIVERSITY (P)**	Course Code : 23P
Semester : **II**	Course Group : DSC – III
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **02**
Map Code : D (PRACTICAL – APPLICATION)	Total Contact Hours : **60**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

1. Growth of aerobes and anaerobes
2. Isolation and enumeration of Bacteria from soil
3. Determination of motility in bacteria- Hanging drop method
4. Isolation and enumeration of Actinomycetes from soil
5. Isolation and identification of photosynthetic algae *Spirulina*
6. Isolation and identification of photosynthetic algae *Oscillatoria*
7. Isolation of Halophilic bacteria from sea water
8. Isolation and enumeration of Fungi from soil
9. Cultivation of fungi- Fungal slide culture technique
10. Microscopic observation of mold by Stereo microscope
11. Morphological observation of algae from water using inverted phase contrast microscope
12. Identification of protozoans- *Entamoeba histolytica*, *Ascaris lumbricoides*, *Taenia solium*, *Plasmodium* sp., *Paramecium*,

REFERENCE BOOKS:

R1. James G. Cappuccino. Microbiology practical: A Laboratory Manual, 12th Edition. 2020.

R2. ANEJA K R Laboratory Manual of Microbiology and Biotechnology, 2016

R3. Kannan N, Handbook of Laboratory Culture Media, Reagents, Stains and Buffers, 2003

COURSE CONTENT

Course Title: **BIOSTATISTICS (T)**	Course Code : 23B
Semester : **II**	Course Group : DSC –VI
Teaching Scheme in Hrs (L:T:P): **5:1:0**	Credits : **06**
Map Code : C (THEORY – CONCEPTS)	Total Contact Hours: **90**
CIA : **25 Marks**	SEE # : **75 Marks**
Programme: **B Sc MICROBIOLOGY**	**# - Semester End Exam**

COURSE OUTCOME: BIOSTATISTICS

No.	Course Outcome(Cos)	POs & PSOs	Cl. Ses	CL
CO1	To understand the formulation of research problem and drafting the research work	PO1 & PSO4	15	U
CO2	To acquire knowledge on sample collection techniques	PO1 & PSO4	15	R
CO3	To understand the various data analysis techniques	PO1 & PSO4	15	E
CO4	To analyze the relationship among statistical data	PO1 & PSO4	15	E
CO5	To inspire and make independent researchers	PO1 & PSO4	15	E
CO6	To correlate the biological data's and interpret in the understanding methods	PO1 & PSO4	15	E

UNIT I **(LECTURE HOURS: 20)**

Introduction to Biostatistics

Basic concepts (Definition and functions). **Collection of data (**Primary data and secondary data), Methods of collection of data. **Classification and tabulation-** Classification (Objectives and types). Tabulation (Roles of table, parts of table and roles of tabulation). **Diagrammatic and graphical representation (**One dimensional diagram - Bar diagram and its types, pie diagram). **Diagrammatic representation** - Pictogram, cartogram.

Activity- Collection of Newspaper cuttings related to statistics.

UNIT II **(LECTURE HOURS: 20)**

Sampling-Methods of Sampling (Theory and related problems). **Simple random sampling** (theory and related problems). **Stratified random sampling** (theory and related problems). **Systematic sampling** (theory and related problems). **Cluster sampling** (theory and related problems). **Sampling and non-sampling error** (theory and related problems).

Activity- Practical performance of sampling.

UNIT III **(LECTURE HOURS: 15)**

Measures of central tendency

Mean (Related problems), Median (Related problems), **Mode (**Related problems). **Measures of dispersion**

Range (Related problems). **Quartile deviation** (Related problems). **Standard deviation (**Related problems)

Activity- Calculate the measures of central tendency for the number of students in your college campus based on

gender

UNIT IV **(LECTURE HOURS: 15)**

Correlation

Definition (Basic concepts and types). **Methods- Scatter diagram** (Related problems). **Karl Pearson Co efficient of correlation and rank correlation** (Related problems). **Regression- Definition** (Basic concepts). **Construction of regression equation** (Related problems).

Activity- Case study based on correlation of academic performance of students before and after attending Slow learners and peer support program

UNIT V **(LECTURE HOURS: 20)**

Test of hypothesis

Test of significance (Procedure and errors). **Tests of significance for small sample** (Student *t* test)

Chi square test (Related problems), **F distribution** (Related problems). **Analysis of Variance** (Related problems)

Activity- Preparation of chart for testing hypothesis.

TEXT BOOKS:

T1. Statistical Methods , Edition:44 , Sultan Chand and Sons , Gupta S P (2014)

T2. Biostatistics And Research Methods: Edition 4, 2006 Sundar Rao P S S , Richard, 2006.

REFERENCE BOOKS:

R1. Statistics theory and practice , Edition:4 , Chand and Co , Bagavathi and Pillai (2007)

R2. Primer of Biostatistics: Edition: 4 , 1997 ,Stanton A Glantz, 1997

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Course Title: **MICROBIAL PHYSIOLOGY AND METABOLISM (T)**	Course Code: 33A
Semester: **III**	Course Group : **DSC V**
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : **4 Credits**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSc-MICROBIOLOGY** **# - Semester End Exam**	

COURSE CONTENT

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No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	CL
CO1	Recognize the nutritional requirements of microorganism	PO1& PS01	10	U
CO2	Determine the growth kinetics of microbes relevant to the nutrition	PO1& PS03	10	An
CO3	Emphasize the energy generation and synthesis of cellular components from the small molecules	PO1& PS03	10	An
CO4	Categorize the biosynthetic pathways in microbes	PO1& PS03	10	An
CO5	Determine the one carbon fixation mechanism	PO1& PS03	10	An
CO6	Determine the nature of Microbial metabolism-built, breakdown and assembly reactions	PO1& PS03	10	An

UNIT I **(LECTURE HOURS: 08)**

Nutritional requirements of microorganisms

Common nutrient requirements (Macro nutrient, micro nutrient and trace elements). **Nutritional types of microorganisms**. **Requirements for Carbon, hydrogen and oxygen** - photolithoautotroph, photoorganoheterotroph, chemolithoaututroph, chemoorganoheterotroph. **Transport of nutrients- Diffusion** (Passive and facilitated diffusion), **Active transport** (ABC transporters, uniport, symport and antiport mechanism), **Group translocation** (Phosphoenolpyruvate sugar phosphotransferase system).

UNIT II **(LECTURE HOURS: 10)**

Growth curve

Different phases of growth (Lag, log, stationary, death phase). **Growth kinetics** (Mean growth rate constant and determination of generation time). **Open culture system**. **Continuous culture** (Chemostat and turbidostat). **Factors influencing microbial growth**, **Solutes and water activity** (Classification based on salt concentration and its adaptation), **pH** (Classification based on pH ranges and adaptation), **Temperature** (Classification based on temperature ranges), **Oxygen concentration** (Classification based on oxygen concentration and adaptation), **Pressure** (Classification based on pressure and adaptation), **Radiation** (Effect of UV radiation and visible light and adaptation).

UNIT III **(LECTURE HOURS: 10)**

Aerobic respiration

Central metabolic pathways Embden Meyerhoff Parnas pathway, Hexose monophosphate pathway, Entner-Doudoroff pathway. Tri Carboxylic acid Cycle, Electron transport chain, oxidative phosphorylation, ATP generation. **Anaerobic respiration**-Inorganic compounds as final electron acceptor (Nitrate, sulphate and carbon di oxide).

Fermentation-Alcoholic fermentation (Mechanism and end product formation), **Lactic acid fermentation** -Homo lactic and hetero lactic fermentation, **Mixed acid fermentation** (Mechanism and end product formation), **Butanediol fermentation** (Mechanism and end product formation).

UNIT IV **(LECTURE HOURS: 10)**

Biosynthesis of Cell wall

Gram positive cell wall structure and synthesis (Peptidoglycan, teichoic acid and lipoteichoic acid synthesis), **Gram negative cell wall structure and synthesis** (Peptidoglycan, lipopolysaccharide synthesis). **Biosynthesis of nucleotides-Pyrimidine biosynthesis** (Cytosine, thymine and uracil), **Purine biosynthesis** (Adenine and guanine). **Sporulation-Endospore** - Structure and stages in sporulation.

UNIT V **(LECTURE HOURS: 10)**

Carbon dioxide fixation

Calvin cycle - Carboxysome, carboxylation, reduction and regeneration phase, **Reductive TCA cycle** - Enzymes involved and pathway, **Photosynthesis-Light reaction in cyanobacteria** (Photosynthetic pigments, oxygenic photosynthesis, photosystem I and II, cyclic and non-cyclic photophosphorylation).

Light reaction in green and purple bacteria - Anoxygenic photosynthesis. Bacteriochlorophylls, difference between green and purple bacterial photosynthesis and NAD reduction. **Bioluminescence-Mechanism** (Bioluminescent bacteria, symbiotic association, luciferase and emission of light).

TEXT BOOKS :

T1. Microbiology , Edition:7 , BROWN PUBLISHERS , Harley, J.P. AND C.A.Klein AND Prescott, L.M(2020)
T2. Microbial Physiology Edition :4 /Wiley-Liss, Inc./ Albert G. Moat, John W. Foster, Michael P. Spector 2002

REFERENCE BOOKS:

R1. Principles of Microbiology, Ronald M Atlas, MC Graw Hill Publishers, 2nd edition, 1996.

Course Title : **MICROBIAL PHYSIOLOGY AND METABOLISM (T)**	Course Code: 33P
Semester : **III**	Course Group : **DSC V**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. Indole production test Citrate utilization test
2. Growth curve
3. Effect of salt concentration on the growth of microorganism
4. Effect of pH on the growth of microorganism
5. Effect of temperature on the growth of microorganism
6. Carbohydrate fermentation
7. Triple sugar iron agar test
8. Methyl red test
9. Voges Proskauer test
10. Determination of cell wall inhibition by penicillin
11. Chlorophyll extraction from blue green algae

REFERNCE BOOKS:

R1. Microbiology A Laboratory Manual , Edition:12th 2020 , Benjamin-Cummings Publishing Company , James G. Cappuccino, and Natalie Sherman (1999).

R2. Handbook of Laboratory Culture Media, Reagents, Stains and Buffers, Kannan N, 2003

COURSE CONTENT

Course Title: **BIOINSTRUMENTATION METHODS AND ANALYSIS**	Course Code: 33B
Semester: **II**	Course Group : **DSC IV**
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : **4**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # :**75 Marks**
Programme: **BSc MICROBIOLOGY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	BLOOM'S TAXONOMY LEVEL
CO1	Developing the skill to measure the concentration of ions.	PO1& PS01	12	U
CO2	Determine the working of analytical instruments	PO1& PS01	10	An
CO3	Elucidate the concentration of solutes in a solution	PO1& PS01	10	U
CO4	Determine the force of moving object leading to the separation of biomolecules	PO1& PS01	10	Ap
CO5	Separation and distribution of components between two phases	PO1& PS01	10	Ap
CO6	Analyse the activity of nuclear reaction in biosciences	PO1& PS01	08	An

UNIT I **(LECTURE HOURS: 15)**

pH STUDIES AND ELECTROCHEMISTRY INSTRUMENTATION

Basic concepts of pH (definition, Principle), Instrumentation - glass and reference electrodes, (operation and calibration, Applications). **Buffer solutions** (Principles- Henderson- Hasselbalch equation, buffering capacity, preparation, selection of buffer). **pH indicator** (Principles- change of color based on pH, Applications, examples). **Conductivity meter** (Principles, Instrumentation and Applications). **Biosensor** (Principle, types and applications) -**Amphoteric substance** (biochemical processes, biological processes)

UNIT II **(LECTURE HOURS: 10)**

MEASUREMENT OF BIOMOLECULES

Colorimetry (Principle-Beer's & Lamberts law - Role of concentration of chromogen, Thickness of solution). **Instrumentation** (Parts of instrument, Light source, Filter, Cuvette, Photocell) **Operation** (Operating rules, Warm up, Adjusting 100% Transmittance). **Deviations of Beer Lamberts Law** (Deviation due to instrument, Deviation due to sample). **Spectrophotometry-Principle** (Regions of electromagnetic radiation, Measurement of molecules, Rayleigh scattering). **Instrumentation** (Light source, Monochromator, Optical system, Phototube, recorder). **Applications** (Measurement of concentration of solute, Unknown biomolecule, rate of biochemical reactions). **Infrared, UV and Visible spectroscopy** - Regions of EMR, Percent transmittance, Absorption bands.

UNIT III **(LECTURE HOURS: 10)**

SEPARATION OF BIOMOLECULES

Centrifugation- Basic principles (Stokes law, Centrifugal force, process of separation). **Instrumentation** (Components, Electric motor, Drive shaft, Rotor, Types). **Types** (Low speed, High speed, Ultracentrifuge). **Methods of centrifugation-Differential centrifugation** (Sedimentation rate of particle, Different size, Different density). **Density gradient centrifugation**-Zonal centrifugation, Isopycnic centrifugation. **Applications**-Separation of antigen, antibody, Isolation of plasmid DNA, Harvest of Microbial cells, Detection of conformational changes.

UNIT IV **(LECTURE HOURS: 11)**

ISOLATION OF COMPOUNDS

Chromatography (Principle, Distinct phases, Mobile phase, Stationary phase). **Paper chromatography**-Preparation of sample, solvent development, detection and measurement and applications. **Thin layer chromatography** - Preparation of thin layer, sample application, plate development. **Affinity chromatography** - Biological interactions, Sample, ligand molecules, specific and nonspecific elution. **Column chromatography** (Commonly used matrices, packing of column, loading sample, detector and fraction collection). **Ion exchange chromatography** (Charged particles, cation and anion exchange resins, types, elution). **Gel permeation chromatography** (Separation on the basis of molecular size, shape, Gel preparation, storage). **Gas chromatography** (Instrumentation, stationary phase, mobile phase, carrier gas, FID, TC). **High performance liquid chromatography (**Instrumentation, Solvent reservoir, pumping system, injection port, column, detector, collection of eluents).

UNIT V **(LECTURE HOURS: 14)**

SEPARATION OF NUCLEIC ACIDS AND RADIATION

Electrophoresis (Principles, Electrophoretic Mobility, Electric field Strength, velocity of molecules), **Instrumentation** (Apparatus, Cathode, anode, Power supply). **Types** (Agarose Electrophoresis, SDS PAGE, Immunoelectrophoresis). **Isoelectric focusing** (Isoelectric point, Net charge, Its role). **Applications**-Separation of DNA, Proteins. **Radioactivity** (Atom, Isotope, Radioisotope- Mass number, Atomic number, Neutron, Proton, Electron). **Types of radioactive decay** (Decay by Negatron, positron, alpha particle, X ray, Gamma ray emission). **Detection and measurement of radioactivity** (Ionization of gases, excitation of solids, Liquids, Scintillation, Autoradiography). **Uses of radioisotopes** (Metabolic pathway, Radiodating, analytical applications).

TEXT BOOKS:

T1. Wilson K. Walker (1995). Practical Biochemistry, Principles and Techniques, Cambridge University Press
T2. Rodney Boyer (2006) Modern experimental biochemistry, 3rd edition, Dorling Kindersley (India) Pvt.Ltd.
T3. Veerakumari L, Bioinstrumentation, MJP publishers (2015)
T4. L E Casida J R Industrial Microbiology: 2nd edition, 2016

REFERENCE BOOK:

R1. David T Plummer, An introduction to practical biochemistry, (1998) 3th Edition.
R2. Peter F Stanbury, Fallan Whitaker, Stephen J Hall, Principles of Fermentation Technology, Butterworth-Heinemann is an imprint of Elsevier, 2016.

COURSE CONTENT

Course Title: **BIOINSTRUMENTATION METHODS AND ANALYSIS (P)**	Course Code: 33Q
Semester: **II**	Course Group : **DSC IV**
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits : **2**
Map Code: H (PRACTICAL EXPERIMENTS)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE #:**60 Marks**
Programme: **BSc MICROBIOLOGY**	**# - Semester End Exam**

1. Buffer preparation
2. Determination of pH
3. Estimation of protein-Lowry *et al* method
4. Estimation of protein- Bradford's Method
5. Estimation of reducing sugar by DNS assay
6. Extraction of pigment from plant sample/ Algal sample
7. Paper Chromatography
8. Thin layer chromatography
9. Agarose gel electrophoresis
10. Sodium Dodecyl Sulphate- Polyacrylamide Gel Electrophoresis (SDS-PAGE)

REFERANCE BOOK:

R1. Palanivel. P., Analytical biochemistry and Separation technique- A laboratory Manual, Twenty First Century Publications, 4th edition, 2000.

R2. Rodney Boyer, Modern experimental biochemistry, 3rd edition, Dorling Kindersley (India) Pvt.Ltd. 2006

COURSE CONTENT

Course Title: **ENVIRONMENTAL MICROBIOLOGY (T)**	Course Code : 33 E
Semester: **III**	Course Group : **DSE-I**
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : **4**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	CL
CO1	Principles of microbial diversity and interaction with the environment	PO1& PS01	10	U
CO2	Acquaintance of geochemical cycles from the biological point of view.	PO1& PS01	10	An
CO3	Recognition of hazardous and toxic compound biodegradation in ecosystem	PO1& PS01	10	An
CO4	Awareness on air microbiology to develop of pollution free environment.	PO1& PS01	10	An
CO5	Develop microbiological techniques associated with water and air sanitation	PO1& PS01	10	Ap

UNIT I **(LECTURE HOURS: 12)**

MICROBIAL INTERACTION - Interaction among microbial populations

Positive associations (Mutualism- Phycobiont-Cyanobacteria (Chlorophyta, Xanthophytes), Mycobiont- Ascomycota, Basidiomycota), Proto-cooperation / Synergism (soil bacteria or fungi, and the plants that occur growing in the soil). Commensalism (Explanation with Examples of fungi and bacteria). **Negative associations** (Antagonism, Competition, Parasitism, Predation). **Interactions between microorganisms and plants-Interactions with plant root** (Rhizosphere and Mycorrhizae with examples). **Microbial diseases of plants-**Emerging and re-emerging diseases of plants (Viral diseases, Bacterial diseases, Fungal diseases)

UNIT II **(LECTURE HOURS: 12)**

Microbial contributions to animal nutrition

Predation of microorganisms by animals-Feeding strategies (grazing and filter feeding), **Cultivation of microorganisms by animals for food and food processing** (Cellulose, microbial biomass). **Commensal and mutualistic intestinal symbionts-**Gastrointestinal microbes (*Bacteroides*, *Fusobacterium*, *Bifidobacterium*, *Eubacterium*), **Digestion with in rumen** (Bacterial and archaeal population in rumen), **Fungal predation on animals** (Nematode and Rotifer trapping fungi), **Other symbiotic relationships, Symbiotic light production** (Example studies on Luminescent bacteria).

UNIT III **(LECTURE HOURS: 12)**

Carbon cycle-Carbon transfer through food webs (Food web showing carbon transfer in trophic levels), **Carbon cycling with in habitats** (Methanogenesis and methylotrophy, Acetogenesis), **Carbon Cycling** - Microbial degradation of polysaccharides, lignin.

Nitrogen cycle-Fixation of molecular nitrogen (Ammonification, Nitrification, Nitrate reduction, Denitrification), **Iron**

cycle-Oxidation and reduction reactions (Interconversion of ferrous and ferric, microbial siderophores). **Phosphorus cycle-**Transfer of inorganic to organic phosphate (Phosphines, ghostly light phenomenon)

UNIT IV **(LECTURE HOURS: 12)**

Treatment of solid wastes-Different methods of solid waste treatment (Incineration, Gasification and Pyrolysis, Dumps and Landfills), Biological Waste Treatment, **Treatment of Liquid Wastes-**Different methods of solid waste treatment (Primary, secondary and tertiary treatment), **Treatment and safety of water supply** - Water quality testing.

Bioremediation-Approaches to bioremediation (Environmental modification, microbial seeding, bioengineering, bioremediation of contaminated soils and aquifers). **Air microbiology-**Droplet nuclei, Aerosol (Definition. Various forms of aerosols, effect on climate). **Assessment of air quality and Air sampling devices**-collection of samples, assessment of samples, Impingement, impaction. **Air borne pathogens** (Bacteria, fungi, virus).

UNIT V **(LECTURE HOURS: 12)**

Xenobiotics

Persistence and biomagnification of xenobiotic molecules (Xenobiotic definition, accumulation and degradation). **Recalcitrant halocarbons-**Haloalkyl propellants and solvents (Degradation of TCE, PCE and PCP). **Petroleum hydrocarbons-**Petroleum hydrocarbons as pollutant (Principal pathways of petroleum hydrocarbon biodegradation). **Recalcitrant halogenated pesticides-**Biodegradation of pesticides (Pathways of pesticide biodegradation). **Microbial accumulation of heavy metals**-Microbial methylation (Mercury methylation).

TEXT BOOKS:

T1. Microbial Ecology: Fundamentals and Applications , Edition:3 , Benjamin/Cummings, , Ronald M. Atlas (1998)

T2. A Text Book of Environmental Science, Thangavelu ArumugamSapna K, Edition:1, Walnut Publication, 2020

REFERENCE BOOKS:

R1. Alexander A M. Introduction to Soil Microbiology, 5th edition John Wiley and sons, 1987
R2. Alexander, A M. Microbiology Ecology, John Willy & Sons... 1974

Course Title: **ENVIRONMENTAL MICROBIOLOGY (P)**	Course Code : 33 S
Semester: **III**	Course Group : **DSE-I**
Teaching Scheme in Hrs (L: T:P): **0:0:4**	Credits : 0**2**
Map Code: M (PRACTICAL– APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

1. Examination of soil microbes and their relationship to each other and soil particles
2. Isolation, observation, and quantification of filamentous soil fungi using dilution and plating techniques
3. Isolation, observation, and quantification soil bacteria, and examination of antibiotic resistance in selected isolates.
4. Most Probable Number (MPN) technique.
5. Determination of Oxidation of Sulfur in Soil Determination of microbial transformations of inorganic nitrogen compounds in soil
6. Estimation of BOD
7. Estimation of COD
8. Observation of *Penicillium* sp and *Aspergillus* sp
9. Isolation of Bacteria from the laboratory environment

REFERENCE BOOKS:

T1. Mitchell R 1974, Introduction to Environmental Microbiology, Prentice Hall Inc., Englewood Cliffs.

T2. Kannan N Handbook of Laboratory Culture Media, Reagents, Stains and Buffers, 2003

COURSE CONTENT

Course Title: **IMMUNOLOGY (T)**	Course Code: 43 A
Semester: **IV**	Course Group : DSC VII
Teaching Scheme in Hrs (L:T:P): **4:0:0**	Credits : **4**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	CL
CO1	To understand the types and functions of the cells & organs of the immune system	PO1 & PSO1	10	R
CO2	To study the structure and reactions of the Immunogens	PO1 & PSO1	10	U
CO3	To understand the production of antibody and the mechanism of the complement in our body	PO1 & PSO3	10	An
CO4	To exquisite the hypersensitivity and immune response to infectious diseases	PO1 & PSO2	10	Ap
CO5	To bring out the awareness of diagnosis and prophylaxis and their techniques.	PO1 & PSO2	10	Ap
CO6	To train up the students in the area of immune technology	PO1 & PSO2	10	Ap

UNIT I **(LECTURE HOURS: 14)**

Introduction of immune system

History and Theories of Immunology (Side chain theory and Clonal selection theory). **Types of Immunity-Innate Immunity, Acquired Immunity** (Differences, Examples). **Cells of Immune System-**Hematopoiesis, Lymphoid cells and Myeloid cells (Examples and Diagram). **Organs of the Immune System-**Primary and Secondary lymphoid organs (Thymus, Bone marrow, Lymph node, Spleen). **Immunohematology-ABO Blood Grouping, Transfusions** (Genetics and ABO Compatibility)

UNIT II **(LECTURE HOURS: 10)**

IMMUNOGENS, ANTIGENS AND ANTIBODIES-ANTIGENS

Antigens (Antigenicity, Properties, Immunogenicity versus Antigenicity, factors influencing immunogenicity). **Epitopes** (B cell and T cell epitopes). **Haptens, Adjuvants** (Definition and Role). **Antibodies** (Structure, Function, Types). **Monoclonal Antibody Production** (Hybridoma Technology). **Properties** (Antigen Antibody binding, Antibody affinity, Antibody avidity, Antibody specificity and cross reactivity).

UNIT III **(LECTURE HOURS: 12**

Complement system

Complement (Structure, Components, properties and functions). **Complement pathways and Biological consequences** (Classical and Alternative pathways). **Major Histocompatibility complex-MHC** (Structure, functions and Classes of MHC). **Transplantation-HLA and Tissue Transplantation** (Immunological basis of Graft rejection, Tissue typing methods, Graft versus host reaction and reaction). **Antigen Processing and Presentation** (Antigen presenting cells, Pathways-Cytosolic and Endocytic, Endogenous, Exogenous and Non -peptide antigens).

UNIT IV **(LECTURE HOURS: 12)**

HYPERSENSITIVITY AND AUTOIMMUNITY

Type I Hypersensitivity (Anaphylactic response, Explanation with diagram). **Type II Hypersensitivity** (Transfusion reactions, Hemolytic diseases of New born), **Type III Hypersensitivity** (Immune complex diseases and their types), **Type IV Hypersensitivity** (Delayed hypersensitivity reaction and explanation). **Autoimmunity** (Autoimmune disorders-Systemic and Localized).

UNIT V **(LECTURE HOURS: 12)**

IMMUNOLOGICAL TECHNIQUES AND THEIR PRINCIPLES

Precipitation and Agglutination (Precipitation reactions in fluids and gels, Passive agglutination and agglutination inhibition), **ELISA** (Principle, Procedure and Types), **Radio Immunoassays** (Definition, Procedure and Types), **Immunodiffusion** (Mancini and Ouchterlony Immunodiffusion), **Immunoelectrophoresis** (Counter current and Rocket Immunoelectrophoresis), **Immunoprecipitation Reactions-ASO** (Principle, Diagram).

Text Books:

T1- Essential Immunology | Edition:4 | Blackwell Scientific Publishers | Roitt I.M(1998)

T2 - Immunology | Edition:2 | W.H Freeman and Co Newyork | Kuby J (1997)

TEXT BOOKS:

T1. Essential Immunology, Edition:4, Blackwell Scientific Publishers , Roitt I.M(1998)

T2. Immunology, Edition:2, W.H Freeman and Co Newyork , Kuby J (1997)

T3. Immunology and Microbiology Dulsy Fatima Saras publications. 2018

REFERENCE BOOKS:

R1. IMMUNOLOGY: An Introduction, Edition:4, Saunders College Publishing. Philadelphia, Tizzard R.I(1983)

R2. Review of Medical Microbiology, Edition:9, Lange review Series (NY: McGraw-Hill) , Levinson W (2006)

R3. The Immune System, Edition:2, New York: Current Trends/Garland , Levinson W (2006)

Course Title: **IMMUNOLOGY (P)**	Course Code: 43 P
Semester: **IV**	Course Group : **DSC VII**
Teaching Scheme in Hrs (L: T:P): **0:0:4**	Credits : 02
Map Code: M (PRACTICAL – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

1) Observation of Blood cells -RBC
2) Observation of Blood cells -WBC (TC& DC)
3) Cultivation of Bacterial antigen
4) Complement fixation test -Coombs test
5) Blood Grouping
6) ELISA
7) WIDAL - Qualitative test
8) WIDAL -Quantitative test
9) ASO
10) Single Radial Immunodiffusion
11) Counter current electrophoresis

REFERENCE BOOKS:

R1. PRACTICAL IMMUNOLOGY, 4th Edition Frank C. Hay, Olwyn M. R. Westwood,Wiley-Blackwell,2008

R2. LABORATORY MANUAL IN IMMUNOLOGY AND BIOTECHNOLOGY Ashish s Verma,S Chand publications, 2014.

R3. MICROBIOLOGY A LABORATORY MANUAL , Edition:12th , Benjamin-Cummings Publishing Company , James G. Cappuccino, and Natalie Sherman, 2020.

R4. LABORATORY-IMMUNOLOGY Jack Bradshaw, 2nd edition, Saunders college publishing ,1994

COURSE CONTENT

Course Title: **BACTERIOLOGY AND VIROLOGY (T)**	Course Code : 43B
Semester: **IV**	Course Group : **DSC VIII**
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : 04
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	CL
CO 1	This course provides learning opportunities of morphology, cultural characteristics, Antigenicity, Pathogenesis, Clinical symptoms, Laboratory diagnosis, Prevention and Treatment of Gram-positive microorganism	PO1 & PSO2	10	U
CO 2	To understand the morphology, cultural characteristics, Antigenicity, Pathogenesis, Clinical symptoms, Laboratory diagnosis, Prevention and Treatment of Gram-positive microorganism	PO1 & PSO2	10	Ap
CO 3	Helps to understand the morphology, Pathogenesis, Clinical symptoms, Laboratory diagnosis, Prevention and Treatment of representative viruses	PO1 & PSO2	10	Ap
CO 4	Discern the morphology, symptoms, replication and reproduction of plant virus	PO1 & PSO2	10	Ap
CO 5	To know the morphology, pathogenesis and lab diagnosis of Animal virus	PO1 & PSO3	10	R
CO 6	It also provides opportunities to develop informatics and diagnostic skill, including the use and interpretation of laboratory tests in the diagnosis of infectious disease	PO1 & PSO3	10	Ap

UNIT I **(LECTURE HOURS: 12)**

BACTERIOLOGY -GRAM POSITIVE BACTERIA

Staphylococcus aureus, Streptococcus pyogenes, ***Corynebacterium diphtheria***, ***Clostridium tetani***, ***Bacillus anthracis***, ***Mycobacterium tuberculosis*** (Morphology, cultural characteristics, antigenicity, pathogenesis, clinical symptoms, laboratory diagnosis, prevention and treatment).

UNIT II **(LECTURE HOURS: 12**

BACTERIOLOGY - GRAM NEGATIVE BACTERIA

Escherichia coli, ***Klebsiella pneumonia***, ***Salmonella typhi***, ***Shigella*** **species**, ***Vibrio cholerae,*** *Pseudomonas* **species** (Morphology, cultural characteristics, antigenicity, pathogenesis, clinical symptoms, laboratory diagnosis, prevention and treatment).

UNIT III **(LECTURE HOURS: 12)**

VIROLOGY

***Hepatitis* virus**, *Rabies* **virus**, *Influenza* **virus**, *Mumps*, Polio **virus**, Measles **virus** (Morphology, pathogenesis, clinical symptoms, laboratory diagnosis, prevention and treatment).

UNIT IV **(LECTURE HOURS: 12)**

PLANT VIRUS

Tobacco mosaic virus, **Bunchy top of banana**, **Satellite viruses**, **Viroid**, **Double stranded DNA viruses**, **Assay methods (**Morphology, pathogenesis, symptoms, transmission and lab diagnosis).

UNIT V **(LECTURE HOURS: 12)**

ANIMAL VIRUSES

Prions, **Rinder pest**, **Blue tongue**, **Raniket Dion**, **Foot and mouth disease Oncogenic virus-Papilloma virus** (Morphology, pathogenesis, symptoms, transmission and lab diagnosis). **Antiviral agents** - Action and mechanism of antiviral drug)

TEXT BOOKS:

T1. An introduction to infectious disease , Edition:4th , Elsevier publication , John C Sherris, 2002

T2. Text book of Microbiology , Edition:6th , Orient Longman , Ananthanarayanan R Panicker C ,1994

T3. Text Book of Microbiology , Edition: 3rd , CBS , D. R. Arora (2008)

T4. An Introduction to Viruses , Edition: 4th , Vikas Publishing House Pvt Ltd., , A. Biswas and S. K. Biswas, 2006.

REFERENCE BOOKS:

R1. Diagnostic Microbiology , Edition:9 , Baron and Finegold,C.V Moshby publication , BaileyScotts(1994)

R2. Medical Microbiology , Edition:2 , Churchill Livingston , Mackie Mc Cartney (1994)

R3. Medical Microbiology , Edition:8 , McGraw Hills Medical Publication Division ,Jawets and Melnickanda Adelberg(1990)

R4. Principles of Bacteriology, Virology and Immunity , Edition:8 , Topley &Wilson's , Leslier H Collier AND TomParker M (1990)

R5. Medical Microbiology , Edition: 5th , Elsevier-Mosby , Murray, Rosenthal, and Pfaller (2005)

Course Title: **BACTERIOLOGY AND VIROLOGY (P)**	Course Code : 43 Q
Semester: **IV**	Course Group : **DSC VIII**
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits :**2**
Map Code: M (PRACTICAL– APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. Laboratory methods of identification of *Staphylococcus aureus*
2.Laboratory methods of identification of *Streptococcus pyogenes*
3.Laboratory methods of identification of *E. coli*
4.Laboratory methods of identification of *Klebsiella*
5.Laboratory methods of identification of *Salmonella*
6. Laboratory methods of identification of *Shigella*
7.Laboratory methods of identification of Pseudomonas
8.Isolation of coliphage from sewage sample
9. Titration of coliphage
10.Isolation of plant virus from mosaic disease plant
11. Induction of plant viral infection in healthy plant
12. Observation of plant tumors

REFERENCE BOOKS:

R1. T1. Microbiology A Laboratory Manual , Edition:12th , Benjamin-Cummings Publishing Company , James G. Cappuccino, and Natalie Sherman, 2020.

R2: Manual of Clinical Microbiology , Edition: 1st , Wiley Publishing , James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock, 2015.

R3. Text book of Microbiology for MLT , Edition: 2nd , Arya Publications , Dr. C P Baveja and Dr. V. Baveja 2016.

COURSE CONTENT

Course Title: **AGRICULTURAL MICROBIOLOGY (T)**	Course Code : 43 E
Semester: **IV**	Course Group : **DSE-II**
Teaching Scheme in Hrs (L:T:P): **4:0:0**	Credits : **4**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To understand the differences among various soil elemental sources and microbes	PO1 & PSO1	10	U
CO2	To analyze the symptoms of the plant diseases and identify the causal agents.	PO1 & PSO2	10	R
CO3	To apply mass cultivation concepts and develop skills in biofertilizers production	PO1 & PSO2	10	Ap
CO4	To create control measures for the crop pest and diseases using microbes	PO1 & PSO2	10	Ap
CO5	To distinguish differential disease resistance mechanisms in plants against bacterial, fungal and viral pathogens	PO1 & PSO2	10	Ap
CO6	To develop skills in mushroom cultivation and vermicomposting	PO1 & PSO2	10	Ap

UNIT I **(LECTURE HOURS: 12)**

SOIL ENVIRONMENT- Soil and its properties-Microbial composition (Soil microflora, Bacteria, Actinomycetes, Fungi, Algae, Protozoa, Viruses), **Sampling Techniques-** Soil dilution and plating, plate method, immersion tube technique (Explanation). **Role of Microorganisms In organic matter decomposition** (factors influencing soil microbial population, decomposition of organic matter- cellulose, hemicellulose, lignin).

Rhizosphere-Rhizosphere microorganisms, Siderophores (Rhizosphere effect, microorganisms causing siderophores), **PGPM- Plant growth promoting microorganisms, PGPB** (Mechanism, application, Soil-plant-microbe interrelationship), **Endophytes-Classification and application** (Mechanism of plant growth promotion).

UNIT II **(LECTURE HOURS: 12)**

Plant diseases

Principles - Symptoms and Control measures, **Fungal plant diseases-** ***Tikka, Fusarium wilts, Sclerotium rolfsii and Macrophomina phaseolina*** (Symptoms and Control measures). **Bacterial plant diseases- Blight of rice, Citrus canker, Xanthomonas** (Symptoms and Control measures). **Viral and Mycoplasmal plant disease-Bud necrosis of groundnut, Citrus mosaic, Little leaf of Brinjal, Tomato leaf curl** (Symptoms and Control measures). **Principles of plant disease control-Protection** (Disease of field, vegetable, orchard and plantation crops of India, control, causes and classification of plant diseases).

UNIT III **(LECTURE HOURS: 12)**

Biofertilizers

Introduction - Biofertilizers using nitrogen fixing microbes - phosphate solubilizations (*Rhizobium, Azotobacter, Azospirillum, Azolla, Anabaena* (Blue green algae). Selection of species, distribution, multiplication, methods of application). **Mycorrhizae types-Ecto and Endo mycorrhizae** (Structure and function).

Cultivation and Production of *Rhizobium, Pseudomonas fluorescens, Frankia, Azospirillum, Azolla, Cyanobacteria* (carrier based inoculants, methods of application, quality control).

UNIT IV **(LECTURE HOURS: 12)**

Biopesticides- Introduction (Definitions), **Bacterial Biopesticides**- ***Bacillus thuringiensis, B. sphaericus, B. popillae*** (Effects, Mechanism of action and application). **Biocontrol of plant pathogens**-Microbial control of plant pathogens (useful genes from microorganisms for agriculture, herbicide resistant, insecticide resistant, viral resistant). **Biological control**-***Trichoderma, Baculovirus, NPV Virus, Metarhizium, Verticillium*** (Uses, Methods of application).

UNIT V **(LECTURE HOURS: 12)**

Molecular plant microbe interaction - Biofilm formation (Formation - Biochemistry and interactions).

Invasion of plant tissue-Resistance mechanisms (against attack by plant pathogens)**. Molecular detection of plant pathogens- Fungi, bacteria, viruses, Koch's postulates** (techniques involved - molecular technique, nucleic acid-based method-PCR)**. Recycling of agricultural wastes. Biogas, bioethanol and other value-added products** (microbiology and biochemistry)**. Bioproducts for sustainable agriculture**

Genetically modified end products (Golden rice, protein rich products, edible vaccine). **Mushroom cultivation and Vermicomposting**. **Introduction, properties, benefits, application** (Spawn selection, substrate used and operation of maintenance).

TEXT BOOKS:

T1 -Agricultural Microbiology , Edition:2 , Prentice Hall of India ,Bagyaraj D.J AND Rangaswami G, 1996.

T2 - Principles of Plant microbial Interaction , Edition: , Springer ,Benlugtenburg, 2014.

REFERENCE BOOKS:

R1 -Rangasamy, G and D J Bagyaraj, Agricultural microbiology, Asia Publishing House, New Delhi.

R2 - Agricultural Microbiology , Edition:1 , Crescent publishing corporation ,Umashankar Prasad, 2017.

R3 - Soil Microbiology , Edition:1 , Saraswati Purohit for student Edition, India , S.S Purohit and Tanuja Singh (2010)

R4 - Soil Microbiology, Ecology and Biochemistry , Edition:4 , Elsevier , Eldor A Paul , 2015Tanuja Singh (2010)

R4 - Soil Microbiology, Ecology and Biochemistry | Edition:4 | Elsevier | Eldor A Paul (2015)

Course Title: **AGRICULTURAL MICROBIOLOGY (P)**	Course Code : 43 S
Semester: **IV**	Course Group : **DSE-II**
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits :**2**
Map Code: M (PRACTICAL– APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

Practical manual

1.Isolation of Rhizobium from root nodules

2. Identification of fungal species from spoiled fruits

3. Identification of fungal species from spoiled vegetables

4. Isolation of Azotobacter from soil sample

5. Isolation of Azospirillum from soil sample

6. Isolation of Azolla

7. Comparison of microbial population in agricultural soil and sand

8. Isolation of VAM fungi from plant

9. Isolation of pathogenic fungi from sugarcane

10. Mass production of *Azospirilla*

11. Preparation of commercial biofertilizer -*Azospirillium*

12. Observation of biofilm by *Bacillus*

REFERENCE BOOKS:

R1. Agricultural microbiology, Rangasamy, G and D J Bagyaraj, 2nd edition, PHI Learning Pvt. Ltd, New Delhi. 2007

R2. Handbook of Laboratory Culture Media, Reagents, Stains and Buffers, Kannan N Panima Publishing Corporation, 2003

R3. Practical Microbiology: A Laboratory Manual, Senthil Kumar B, Panima Publishing Corporation, 2018

COURSE CONTENT

Course Title: **MYCOLOGY AND PARASITOLOGY (T)**	Course Code : 53A
Semester: **V**	Course Group : **DSC IX**
Teaching Scheme in Hrs (L: T:P): **5:1:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	Awareness on fungal infection and clinical importance of etiological agents causing mycoses	PO1 & PSO2	10	U
CO2	Differentiate mycoses from other microbial infections with its signs and symptoms	PO1 & PSO2	10	Ap
CO3	Acquire awareness to distinguish types of protozoal parasites and their life cycle in the hos	PO1 & PSO2	8	Ap
CO4	Distinguish gastrointestinal, genitourinary and hemoflagellates from other parasitic protozoans	PO1 & PSO2	10	Ap
CO5	Analyze the clinical samples for parasitic infections	PO1 & PSO3	5	An
CO6	Analyze the clinical samples for protozoan infections	PO1 & PSO3	5	An

UNIT I **(LECTURE HOURS: 14)**

MYCOLOGY AND MYCOSES

Fungal morphology (Yeast, molds, vegetative structures), **Cell structure(** Capsule, cell wall, plasmalemma, cytosol, Woronin bodies), **Reproduction in fungi** (Asexual and sexual reproduction, spores and conidia, conidiogenesis and types, conidial ontogeny, mycelial sterilia), **Fungal dimorphism, growth and nutrition** (Yeast and mold form types), **Superficial cutaneous mycoses- *Malassezia furfur*-Malasseziosis** (Mycology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), ***Hortaea werneckii*-Tinea nigra** (Mycology, epidemiology, pathogenesis and pathology, clinical features, laboratory, diagnosis, treatment and prophylaxis), ***Trichosporon* species-White Piedra** (Mycology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), ***Piedraia hortae*-Black Piedra** (Mycology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis).

ACTIVITY

Fungal structures by cotton and wool models, Animations and models of fungal reproduction, Collection of mycoses pictures.

UNIT II **(LECTURE HOURS: 15)**

MYCOSES

Dermatophytosis-*Trichophyton spp*., (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), ***Microsporum* spp.,** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), ***Epidermophyton* spp.,** (Morphology,

epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), **Subcutaneous mycosis-Mycetoma** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis) **Systemic mycosis-Histoplasmosis** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), **Blastomycosis** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis).

Opportunistic mycosis- Candidiasis, Cryptococcosis (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), **Aspergillosis** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis), **Mucor mycosis** (Morphology, epidemiology, pathogenesis and pathology, clinical features, laboratory diagnosis, treatment and prophylaxis).

ACTIVITY

Collection different types of mycoses pictures, case studies related to fungal infections

UNIT III **(LECTURE HOURS: 14)**

PARASITOLOGY

General introduction to parasitology (Parasites, hosts, zoonosis, host parasite relationships, life cycle of parasites, sources of infections, pathogenesis, immunity in parasitic infection, immune evasion, vaccination), **Protozoa-Amoebae-*Entamoeba histolytica*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), ***Flagellates (Gastrointestinal and genitourinary flagellates)- Giardia lamblia (gastrointestinal flagellates)*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), ***Trichomonas vaginalis -Genitourinary flagellates*** *(History and distribution ,morphology, life cycle, pathogenesis and* clinical features, laboratory diagnosis, treatment and prophylaxis), ***Trypanosoma brucei gambiense*** **- Hemoflagellates** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), ***Leishmania donovani*** **-Hemoflagellates (**History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Apicomplexa parasite-** ***Plasmodium falciparum*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis).

ACTIVITY

Collection of different types of parasite pictures, case studies related to parasitic infections

UNIT IV **(LECTURE HOURS: 15)**

PARASITIC INFECTIONS

Ciliated Protozoa: ***Balantidium coli*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Cestodes:** ***Taenia solium*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis),

Trematodes-*Schistosoma haematobium* (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Nematodes:** ***Ascaris lumbricoides*** – (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Nematodes:** ***Ancyclostoma duodenale*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Nematodes:** ***Trichinella spiralis*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis), **Nematodes:** ***Wuchereria bancrofti*** (History and distribution, morphology, life cycle, pathogenesis and clinical features, laboratory diagnosis, treatment and prophylaxis).

ACTIVITY

Collection of preserved specimen parasites, case studies related to parasite infection

UNIT V **(LECTURE HOURS: 14)**

DIAGNOSIS AND TREATMENT

Mycology-Diagnosis of fungal diseases (Sites and types of specimen, collection and transport of specimens, Diagnosis based on molecular methods), **Antifungal therapy** (Antifungal antibiotics, synthetic antifungals, Miscellaneous

antifungals), **Parasitology - Diagnostic methods in parasitology** (Examination of stool, blood, urine/body fluids, sputum, tissue/muscle biopsy, urogenital specimen, culturing methods (Malaria parasites), animal inoculation and xenodiagnoses)

ACTIVITY

Antifungal and antiprotozoal drug collection and display in laboratory, charts related to diagnostic methods

TEXT BOOKS:

T1 - Paniker's Textbook of Medical parasitology , Edition:8 , Jaypee Brothers Medical Publisher New Delhi, , CK Jayaram Paniker and Sougata Ghosh, 2018.

T2 - Text Book of Medical Mycology , Edition:4 , The Health Science Jaypee Brothers Medical Publish , Jagdish Chander, 2018.

REFERENCE BOOKS:

R1 - Principles of Diagnostic Medical Microbiology , Edition:26 , McGraw Hill , Jawetz, Melnick, and Adelberg's 2018.

R2. Text Book of Diagnostic Microbiology: 5th edition, Connie R Mahon, Donald C Lehman, George Manuselis, 2015.

Course Title: **MICROBIAL GENETICS (T)**	Course Code : 53A
Semester: **V**	Course Group : **DSC X**
Teaching Scheme in Hrs (L:T:P): **4:0:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

COURSE CONTENT

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To remember the basis of DNA as genetic material of microbes and its application mechanism	PO1 & PSO2	10	U
CO2	To understand the role of RNA, transcription and genetic code	PO1 & PSO1	10	R
CO3	To understand the process of translation and post translational modification	PO1 & PSO1	10	R
CO4	To understand the gene regulation and operon concept	PO1 & PSO2	10	Ap
CO5	To understand the types of mutation and the natural repair mechanism	PO1 & PSO2	10	Ap
CO6	To understand the types of mutation and the natural repair mechanism	PO1 & PSO2	10	Ap

UNIT I **(LECTURE HOURS: 12)**

PROKARYOTIC NUCLEIC ACID-DNA

DNA as genetic material (Griffith experiment, Avery, Mc Leod, Mc Carty experiment and Blender experiment), **Structure of DNA** (Watson and Crick model of double stranded DNA) **Different forms of DNA** (A form, B form, C form and Z form)

REPLICATION MECHANISM

Meselson and Stahl experiment (Determination of mode of replication- semiconservative), **Mechanism and enzymes involved in replication** (Theoretical models of DNA replication, semiconservative replication, discontinuous replication, primer synthesis, elongation, summary of events at replication fork, termination, enzymology), **Models of replication** (D loop and rolling circle).

UNIT II **(LECTURE HOURS:12)**

Prokaryotic nucleic acid-RNA-Structure of RNA (mRNA, rRNA, tRNA). **Mechanism of transcription**
RNA polymerase (Structure and function), **Initiation** (Role of promoters, open promoter complex formation), **Elongation (**Addition of nucleotides to growing chain, peptide bond formation), **Termination** (Rho dependent and Rho independent). **Genetic code-Salient features of genetic code** (Triplet code, degeneracy, Wobble hypothesis, universal nature etc.,).

UNIT III **(LECTURE HOURS: 12)**

TRANSLATION IN PROCARYOTES-Activation of amino acids (Charging of tRNA) **Initiation** (Role of initiation factors, preinitiation and initiation complex formation) **Elongation** (Positioning of second tRNA, peptide bond formation and translocation), **Termination** (Role of termination factors and termination codons), **Post translational modifications** (Removal of formyl methionine, side chain modifications, formation of disulfide bonds, cleavage and rearrangement of

polypeptide chain).

OPERON CONCEPT-Lac operon (Organization of lac operon genes, induction, negative and positive control), ***Trp* operon** (Organization, Repression, negative and attenuation control mechanism).

UNIT IV **(LECTURE HOURS: 12)**

Mutation-Types of mutation (Point, silent, neutral, missense, nonsense, reversion and suppressor mutation), **Occurrence of mutation** (Spontaneous and induced mutation) **Carcinogenicity test** (Ames test). **DNA repair-Light dependent repair** (Photo reactivation), **Light independent repair** (Excision, recombination and SOS repair).

UNIT V **(LECTURE HOURS: 12)**

GENETIC EXCHANGE

Transformation mechanism (Transformation of chromosomal and plasmid DNA), **Conjugation mechanism** (F+F- and Hfr cells, conjugation between F+ and F-, Hfr and F- and F' and F-), **Linkage mapping** (Interrupted matting experiment), **Transduction** (Generalized and specialized transduction), **Recombination** (Holiday model of recombination)

TEXT BOOKS:

T1 - Molecular Biology, Edition:1, Jones & Bartlett Publishers , David Freifelder 1986

T2 - Principles of genetics, Edition:6 , CM Brown publisher New York , Robert H Tamarin 2001

REFERENCE BOOKS:

R1 - Biochemistry , Edition:5 , W H Freeman and company , and Stryer 2002

R2 - Essentials of Genetics , Edition:4th , John Wiley and Sons Inc., New York , Cummings M R and Klug W S 1996

R3 - Principles of Genetics , Edition:8th , John Wiley and sons Inc., , Eldon John Gardner and Michael J Simmons and Peter Snustad 1992

Course Title: **MICROBIAL GENETICS (P)**	Course Code : 53P
Semester: **V**	Course Group : **DSC X**
Teaching Scheme in Hrs (L: T:P): 0**:0:4**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : 60 **Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

PRACTICALS

Isolation of genomic DNA from bacteria (*Escherichia coli*) - Performance and result

Isolation of total RNA from bacteria (*Escherichia coli*) - Performance and result

Isolation of plasmid DNA - Performance and result

Induction of Lac operon - Performance and result

Physical mutagenesis-UV irradiation - Performance and result

Chemical mutagenesis- EMS - Performance and result

Replica plating technique- Auxotrophic mutants - Performance and result

Gradient plate technique - Performance and result

Conjugation of compatible bacteria - Performance and result

Ames test for carcinogenesis test - Performance and result

REFERENCE BOOKS:

R1. Ashish s Verma Laboratory Manual in Immunology and Biotechnology, S Chand publications, 2014.

R2. Rajan S, Selvi Christy R experimental procedures in life sciences, 2015.

COURSE CONTENT

Course Title: **Recombinant DNA Technology (T)**	Course Code :
Semester: **V**	Course Group : **DSE III**
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To understand the role of various enzymes used in genetic engineering	PO1 & PSO1	8	U
CO2	To understand the role of various enzymes used in genetic engineering	PO1 & PSO1	10	R
CO3	To remember the techniques involved in cloning and error free selection of successful recombinants	PO1 & PSO3	8	E
CO4	To understand the principles and methods of various blotting methods , genomic libraries and screening	PO1 & PSO2	6	Ap
CO5	To understand the principles and methods of various blotting methods , genomic libraries and screening	PO1 & PSO3	10	E

UNIT I **(LECTURE HOURS: 08)**

INTRODUCTION TO GENE MANIPULATION

Methods and applications (Cloning applications in various fields). **DNA MANIPULATING ENZYMES AND THEIR USES IN MOLECULAR BIOLOGY-Nucleases** (Endonuclease and Exonuclease), **Ligase** (Mechanism of action and application), **Restriction endonuclease** (Nomenclature, classification and application), **DNA polymerase, DNA dependent RNA polymerase** (Mechanism of action and types), **Reverse transcriptase, Terminal transferase** (Mechanism of action), **T4polynucleotide kinase and phosphatases** (Mechanism of action).

UNIT II **(LECTURE HOURS: 10)**

CLONING VECTORS AND THEIR APPLICATION

Plasmids (Properties and general characteristics of pBR322 and derivatives), **Phagemids** (Properties and general characteristics of Lambda and M13 phages), **Cosmids** (Properties and general characteristics), **Yeast vectors** (Properties and general characteristics), **Plant vector**-Ti plasmid (Properties and general characteristics), **Animal vector** - SV40(Properties and general characteristics)

UNIT III **(LECTURE HOURS: 14)**

CLONING STRATEGIES

Chemical synthesis of DNA (Phosphoramitide method), **Amplification of DNA (**Polymerase chain reaction), **Restriction digestion** (Blunt end and sticky end), **Ligation** (Linkers, adaptors and homopolymer tailing).

UNIT IV **(LECTURE HOURS: 10)**

SELECTION OF RECOMBINANTS

Direct screening of recombinants- Radio labelling (Method to search for desired DNA in a clone using radio labelled

and non-radio labelled DNA and RNA probes), **Blotting techniques- Southern blotting** (Immobilization of DNA on a solid support), **Northern Blotting** (Immobilization of RNA on a solid support), **Western blotting** (Immobilization of proteins), **Dot blot and Zoo blot** (Detection of fractioned and unfractionated DNA or RNA Nucleic acid probe from one species to hybridize with DNA fragment of another species). **Indirect screening- DNA sequencing techniques** (Maxim Gilbert and Sangar Coulson method).

UNIT V **(LECTURE HOURS: 6)**

GENE LIBRARY AND SCREENING OF RECOMBINANTS

Construction of Genomic library (Isolation of target DNA, restriction of fragments, cloning, screening of library), **Construction of cDNA library** (Isolation of mRNA, Synthesis of first strand, synthesis of cDNA, Insertion into vector and screening) **Screening with oligo probe and antibodies** (Screening for an expression of gene in cDNA library with primary antibodies), **DNA finger printing** (DNA profiling used in forensic science).

SITE DIRECTED MUTAGENESIS

Site directed mutagenesis (Methods used to make specific and intentional changes to the DNA sequence of a gene and any gene product).

TEXT BOOKS:

T1. An introduction to gene cloning , Edition:5 , Champman and Hall , BrownT A 1995

T2. Principles of Gene Manipulation and Genomics, Primrose S B Twyman R M, Edition 7, 2014

REFERENCE BOOKS:

R1**.** Recombinant DNA Technology, Edition:1, Keya Chaudhuri, TERI press, New Delhi, 2015

R2. Recombinant DNA: EDITION 3, James D Watson, Michael Gilman, Jan Witkowsk, W.H. Freeman 2007.

R3. Genes VII, Benjamin Lewin, Oxford University Press, 2000

Course Title :**Recombinant DNA Technology (P)**	Course Code : 53Q
Semester : **V**	Course Group : **DSE III**
Teaching Scheme in Hrs (L:T:P) : 0**:0:4**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA:**40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. **Restriction digestion of DNA**
2. **Ligation of DNA- Sticky end cloning**
3. **Elution of DNA**
4. **Selection of recombinants- Preparation of *E. coli* competent cells**
5. **Selection of recombinants- Blue white screening**
6. **Selection of recombinants - antibiotic resistant marker by replica plating**
7. **Southern blotting**
8. **Western blotting**
9. **Transduction**

REFERENCE BOOKS:

R1: Laboratory Manual for Genetic Engineering, John Vennison S, PHI Learning private limited, New Delhi, 2009 S

R2. Laboratory Manual in Immunology and Biotechnology, Ashish s Verma S Chand publications, 2014

10. COURSE CONTENT

Course Title : **EDC-ELECTIVE MICROBES-HEALTH AND DISEASES**	Course Code : 5EQ
Semester : **V**	Course Group : DSE
Teaching Scheme in Hrs (L:T:P) : **5:1:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **90**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To understand the basics of microorganism and their application in human society	PO1 & PSO1	15	U
CO2	To understand the negative role of microbe and their mechanism of transmission	PO1 & PSO1	15	R
CO3	To analyse the immune defense mechanism against pathogen	PO1 & PSO1	15	U
CO4	To understand the mechanism of infection caused by by microbes	PO1 & PSO1	15	R
CO5	To understand the application of microbes in food preparation and beverages	PO1 & PSO1	15	U
CO6	To understand the application of microbes in recycling of waste wate	PO1 & PSO1	15	U

UNIT I **(LECTURE HOURS: 18)**

INTRODUCTION AND SCOPE OF MICROBIOLOGY

General features of bacteria (Morphology and properties), **General features of fungi** (Morphology and properties), **General features of virus** (Morphology and properties), **General features of algae** (Morphology and properties), **General features of protozoa** (Morphology and properties), **Scope of Microbiology** (Scope in different fields of microbiology)

UNIT II **(LECTURE HOURS: 18)**

INFECTIOUS DISEASES

Phases of infection (Incubation period, prodromal, illness, period of decline), **Classification of infectious diseases (**Air borne, water borne, food borne, vector borne), **Sources of infections** (Human, animal, inanimate reservoirs), **Mode of transmission** (Direct and indirect, vector borne transmission), **Mechanism of pathogenesis** (Portals of entry, adherence, penetration and damage to host).

UNIT III **(LECTURE HOURS: 18)**

IMMUNITY BASIC CONCEPTS

Types of immunity (Specific and nonspecific immunity), **Cell mediated immunity** (T cells and phagocytosis), **Humoral immunity** (Antibody mediated - types of antibody). **Vaccination** (Types and vaccination schedule), **Inflammation** (Process and symptoms), **Antigen antibody reaction** (Outline of precipitation, agglutination reactions).

UNIT IV **(LECTURE HOURS: 18)**

HUMAN AND MICROBIAL INTERACTIONS-

Indigenous microflora (List of normal flora of various parts of human body and its role). **Hospital Acquired Infections-Nosocomial infections** (sources, mode of transmission, prevention). **Infectious Diseases Of Microbes-Bacterial, viruses, fungal and parasitic infections** (Tuberculosis, Hepatitis, Aspergillosis, Amoebiasis).

UNIT V **(LECTURE HOURS: 18)**

BENEFICIAL ROLE OF MICROBES

Fermented vegetables (Pickles and sauerkraut), **Fermented dairy products** (Yoghurt and cheese making process), **Production of alcoholic beverages** (Wine and beer), **Microbes as food** (Mushroom and spirulina production), **Waste water treatment** (Methods of treatment).

Text Books:

T1 - Microbiology - A Human perspective | Edition:3 | McGraw Hill, New York | Anderson D G and Nester E W AND Roberts Jr .C (2001)

T2 - Microbiology for the health sciences | Edition:4 | J B Lippincott company | Gwendolyn R W Burton (1992)

Reference Books:

R1- Microbiology | Edition:5 | McGraw Hill, New York | Chan E C S AND Kreig and Michael Pelzer (1993)

Course Title: FOOD MICROBIOLOGY (T)	Course Code : 63A
Semester: **VI**	Course Group : DSC XI
Teaching Scheme in Hrs (L: T:P): **4:0:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

COURSE CONTENT

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl.Ses	CL
CO1	To recognize the factors affecting the growth of microorganism in food	PO1 & PSO1	10	U
CO2	To pinpoint the principles and methods of food preservation	PO1 & PSO1	10	R
CO3	To recognise the specific types of microbial spoilage in food	PO1 & PSO1	10	U
CO4	To understand the methods in food fermentation	PO1 & PSO2	10	Ap
CO5	To identify the food borne diseases and prevention methods	PO1 & PSO3	10	An
CO6	To identify the standards to ensure the food quality	PO1 & PSO3	10	An

UNIT I **(LECTURE HOURS: 12)**

FACTORS AFFECTING THE GROWTH OF MICRORGANISM IN FOOD

Intrinsic Factors (Nutrient content, pH, antimicrobial agents, water activity and redox potential), **Extrinsic factor** (Relative humidity, gaseous atmosphere, temperature), **Implicit factor** (Specific growth rate, mutualism, commensalism, amensalism), **Processing factor** (Slicing, washing, packing, irradiation and pasteurization). **Important microorganism in food-Bacteria** (Bacterial genera important in food), **Important microorganism in food-Yeast** (Group of yeast, true yeast and false yeast), **Important microorganism in food-Mold** (Group of molds, *Penicillium, Aspergillus* and others).

UNIT II **(LECTURE HOURS: 12)**

PRINCIPLES OF FOOD PRESERVATION METHODS

General principle and application (Principle methods of food preservation), **Asepsis** (Aseptic methods in food industry, packaging), **Maintenance of anaerobic condition** (Replacement of air by carbon di oxide, usage in packed food), **Low temperature** (Common storage, cold storage, frozen storage), **High temperature** (Heating below and above at 100°C), **Drying** (Treatment of foods before drying, methods of drying, factors involved, procedures after drying), **Radiation** (Food preservation by microwave radiation, UV radiation and ionizing radiation), **Chemical preservatives** (Propionate, benzoate, sorbate, acetate, nitrate, Sulphur di oxide, sulphides, ethylene, propylene oxide, sugar, salt, wood smoke, spice).

UNIT III **(LECTURE HOURS: 12)**

SPOILAGE OF FOOD

Fitness and unfitness of food for consumption (Criteria for fitness of food), **Causes of food spoilage** (Growth and activity of microorganism, insects, action of enzymes chemical reactions, physical changes), **Classification of foods by spoilage** (Stable, nonperishable foods, semi perishable foods and perishable foods), **Spoilage of vegetables** (Bacterial soft rot, grey mold rot, Rhizopus rot), **Spoilage of fruits** (Soft rot and others), **Spoilage of eggs** (Defects in fresh eggs, changes

not by microorganism, undamaged eggs, spoilage by bacteria and fungi), **Spoilage of milk** (Gas production, proteolysis, ropiness, changes in milk fat, alkaline production, flavor and color change), **Spoilage of canned foods** (Spoilage by thermophilic spore former, spoilage by mesophilic and non-spore former, gas former and non-gas formers, spoilage by molds).

UNIT IV **(LECTURE HOURS: 12)**

FOOD FERMENTATION-FERMENTED VEGETABLES

Production of sauerkraut – (Cabbage- DE leaf, core, trim, shredding, salt addition, fermentation, packing),

Production of pickle (Production of dill pickle and salt stock pickle).

FERMENTED DAIRY PRODUCTS

Production of yoghurt (Milk, heat treatment, inoculation with starter fermentation) **Production of cheese** (Milk homogenization, inoculation, fermentation) **Spoilage of cheese** (Bacteria, yeast and mold).

UNIT V **(LECTURE HOURS: 12)**

FOOD BORNE INFECTION AND INTOXICATION

Food poisoning-*Clostridium botulinum* (Food intoxication), **Mycotoxin** (Types of mycotoxin), **Food borne infection** - *E coli*, *Clostridium perfringens*, *Shigella.*

MICROBIOLOGICAL EXAMINATION OF FOOD

Methods of microbial analysis (Indicator organism, plating methods, cultural techniques, direct examination and others) **Quality control in food microbiology units- GMP** (Quality control of raw materials, food handlers, personal hygiene, equipment disinfection), **Quality control in food microbiology units- HACCP** (Identify the potential hazard assess the risk determine critical control point steps to control hazard establishing and monitoring system).

TEXT BOOKS:

T1 - Food Microbiology, Edition:5, Tata Mc Graw Hill Publishing, Frazier W C AND West Hoff D 1971

T2. Food Microbiology, MJP Publishers, VIJAYA RAMESH K 2009

REFERENCE BOOKS:

R1 - Modern Food Microbiology, Edition:4, Van Nostrand Reinhold Co., Jay J M 1991.

R2-Food Microbiology, Edition: New age International Limited, Adams M R and Moss M D 1995

Course Title: FOOD MICROBIOLOGY (P)	Course Code : 63P
Semester: **VI**	Course Group : DSC XI
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. Microbial analysis of spoiled food bread bacteria and fungi
2. Microbial analysis of spoiled food vegetables bacteria and fungi
3. Microbial analysis of spoiled food fruits bacteria and fungi
4. Microbial quality analysis of milk
5. Microbial examination of curd
6. Methods of microbial analysis
7. Preparation of starter cultures
8. Preparation of yoghurt
9. Preparation of pickle

Reference Books:

R1: Kannan N HANDBOOK OF LABORATORY CULTURE MEDIA, Reagents, Stains and Buffers, 2003

R2. MICROBIOLOGY A LABORATORY MANUAL, Edition:12th, Benjamin-Cummings Publishing Company, James G. Cappuccino, and Natalie Sherman 2020.

COURSE CONTENT

Course Title: **INDUSTRIAL MICROBIOLOGY (T)**	Course Code: 63B
Semester: **VI**	Course Group: DSC XII
Teaching Scheme in Hrs (L:T:P): **4:0:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To recognise the industrially important strains and methods of screening and development	PO1 & PSO1	10	R
CO2	To understand the types of fermentation and fermenter	PO1 & PSO1	10	R
CO3	To formulate the media for fermentation process	PO1 & PSO1	10	U
CO4	To understand different methods of inoculum development	PO1 & PSO2	10	Ap
CO5	To understand the methods of recovery and purification of intracellular and extracellular products	PO1 & PSO2	10	Ap
CO6	To produce industrially important products using microorganisms	PO1 & PSO2	10	Ap

UNIT - I **(LECTURE HOURS: 12)**

Screening methods -primary screening (Methods involved, crowded plate, improved crowded plate, auxanography, enrichment culture), **Secondary screening** (Methods involved, features, disc diffusion methods). **Strain development for improved yield-Mutation** (Different methods of mutation, auxotrophic mutants, feedback resistant mutants, antibiotic resistant mutant), **Recombination** (Recombination in bacteria, actinomycetes, fungi), **Protoplasmic fusion** (Methods of fusion, advantages over other methods, examples for protoplasmic fusion). **Preservation and maintenance** (Culture preservation by serial subculturing, mineral oil, lyophilization, liquid nitrogen storage).

UNIT - II **(LECTURE HOURS: 12)**

Fermentation-Submerged and solid-state fermentation (Use of substrate for solid and submerged state fermentation, applications of solid-state fermentations, difference between solid and submerged state fermentation).

Fermentors-Types of fermentor-CSTR (Conventional stirred tank reactor- structure and parts, operation), **Air lift fermentor** (Air lift fermentor with inner loop, outer loop, multiple airlift fermentor), **Tower fermentor** (Structure, vertical, packed and multi stage tower fermentor), **Mode of operation** (Temperature control, pH control, oxygen supply, aeration and agitation).

UNIT - III **(LECTURE HOURS: 12)**

Upstream processing

Ideal characteristics of medium (Availability of raw materials, chemical composition, avoidance of foaming, buffering capacity, toxicity, cost effectiveness), **Raw materials in medium** (Saccharine materials, nitrogenous materials, cellulosic materials and starchy materials),**Components of medium** (Minerals, Chelators, growth factors, antifoaming agents, precursors, inhibitors, inducers), **Media formulation (**Standardization for carbon, nitrogen sources, growth rate, specific growth rate, substrate utilization constant, yield coefficient), **Industrial sterilization** (Batch and continuous sterilization of

fermentor- plate heat exchangers and steam injection and flash cooling), **Inoculum development for bacteria and fungi** (Inoculum development for bacteria- step wise addition, Development of inoculum for fungi- rolling bottle technique).

UNIT - IV **(LECTURE HOURS: 12)**

Recovery and Purification of intracellular and extracellular products - Disintegration of microorganisms-Physico mechanical methods, chemical methods, biological methods (Liquid shear, solid shear, agitation with abrasives, ultrasonication, Osmotic shock, alkali treatment, treatment with detergents, enzyme treatment), **Removal of insoluble-Foam separation** (Method, instrument used, use of foam in separation of cells, enrichment ratio), **Precipitation** (Different precipitating agents used, its use in purification of product), **Filtration** (Theory of filtration, Methods of filtration, batch and continuous filtration). **Purification and concentration of the product-Solvent extraction** (Principle of solvent extraction, single stage, concurrent and counter current solvent extraction, solvent recovery), **Chromatography** -Basic principle of chromatography, methods of chromatography, adsorption chromatography, ion exchange, gel permeation, HPLC, affinity. **Finishing of the product-**Drying, freeze drying, crystallization (Drying, advantages, lyophilization, advantages, methods of crystallization).

UNIT - V **(LECTURE HOURS: 12)**

Industrial production of microbiological products

Production of Wine and Beer (Alcoholic beverage production, production methods, wine and beer defects). **Production of vitamins**-Vitamin B12 and riboflavin production (Culture used, fermentor, medium, mode of operation, methods of product recovery, purification and concentration of product). **Production of Streptomycin** (Culture used, fermentor , medium, mode of operation, methods of product recovery, purification and concentration of product). **Production of Amylase** (Culture used, fermentor, medium, mode of operation, methods of product recovery, purification and concentration of product). **Production of Spirulina and its uses** (Methods of spirulina production, uses in food industry, medicines). **Mushroom cultivation** (Cultivation of *Pleurotus* species).

TEXT BOOKS:

T1 - Biotechnology - A text book of Industrial Microbiology , Edition:2 , Sinauer Associates, Inc., Sunderland, Massachusett , Cruegar A and Cruegar, W(1990)

T2 - INDUSTRIAL MICROBIOLOGY , Edition:4 , Mc MILLAN Ind Ltd , Patel A.H(1996)

T3 - Principles of Fermentation Technology , Edition:2nd edition , Pergamon press , Stanbury P F and Whitaker A (2005)

REFERENCE BOOKS:

R1 Microbiology, Edition:5th , Tata Mac Graw Hill Publishing Co., New Delhi , James Cappuccino Sherman (1978)

Course Title: **INDUSTRIAL MICROBIOLOGY (P)**	Course Code : 63Q
Semester: **VI**	Course Group :DSC XII
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60 Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. Screening of antibiotic producing bacteria from soil by crowded plate technique
2. Enrichment culture technique - cellulose producing organisms
3. Screening of enzyme producers - Amylase producing bacteria from soil
4. Inoculum development of bacterial culture for mass production
5. Inoculum development of fungal culture - rolling bottle technique
6. Batch fermentation - mass production of amylase
7. Estimation of amylase enzyme
8. Protease assay - Bradford method
9. Immobilization technique - Calcium alginate method
10. Wine production
11. Estimation of alcohol content

REFERENCE BOOKS:

R1. Microbiology A Laboratory Manual, Edition:12th, Benjamin-Cummings Publishing Company, James G. Cappuccino, and Natalie Sherman 2020.

R2. Kannan N Handbook of Laboratory Culture Media, Reagents, Stains and Buffers, 2003

COURSE CONTENT

Course Title: **Diagnostic Microbiology (T)**	Course Code : 63C
Semester: **VI**	Course Group : DSE V
Teaching Scheme in Hrs (L:T:P): **4:0:0**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **BSC-MICROBIOLOGY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	POs &PSOs	Cl.Ses	CL
CO1	To collect and handling of specimens, transport and storage and interpretation of pathogen from clinical sample.	PO1 & PSO1	12	R
CO2	To inculcate the general methods for identification of microorganisms from clinical specimens.	PO1 & PSO1	12	R
CO3	To understand the biochemical methods for identification of microorganisms from clinical sample	PO1 & PSO1	12	R
CO4	To understand the identification of clinacl specimen based on antigen antibody interaction.	PO1 & PSO1	12	U
CO5	To understand the function of antimicrobial agents and to determine the MIC and MLC concentration.	PO1 & PSO1	12	U

UNIT I **(LECTURE HOURS: 12)**

INTRODUCTION TO CLINICAL SPECIMENS

Type of clinical specimens - Urine (Collection procedures, specimen handling- transport and storage methods- specimen processing - interpretation of pathogen), **Type of clinical specimen- blood** (Collection procedures- specimen handling- transport and storage methods-specimen processing - interpretation of pathogen), **Type of clinical specimen-sputum** (Collection procedures- specimen handling- transport and storage methods- specimen processing - interpretation of pathogen), **Type of clinical specimen-Pus** (Collection procedures- specimen handling- transport and storage methods- specimen processing - interpretation of pathogen), **Type of clinical specimen-stool** (Collection procedures- specimen handling- transport and storage methods- specimen processing - interpretation of pathogen).

UNIT II **(LECTURE HOURS:** 12**)**

GENERAL METHODS OF MICROBIAL IDENTIFICATION

Microscopic examination - Gram staining (Principle, procedure, Observation), **Lactophenol cotton blue staining** - Fungal identification from clinical sample, **Examination of parasite from stool sample** - Iodine wet mount, **Acid fast bacilli staining** (*Mycobacterium* identification)

UNIT III **(LECTURE HOURS:** 12**)**

BIOCHEMICAL METHODS OF IDENTIFICATION

Biochemical methods of identification (Indole, methyl red test, Voges Proskauer test, citrate utilization test). **Enzymatic test** (Urease test, catalase test), **Coagulase test** (Slide and tube test for *Staphylococcus aureus*), **Sugar utilization test** (Glucose, sucrose, maltose, galactose, mannitol utilization test)

UNIT IV **(LECTURE OURS:** 12**)**

SEROLOGICAL TEST

Precipitation & Agglutination reactions - ASO test (Principle, procedure, observation, positive organism), VDRL test (Principle, procedure, observation, positive organism), Western blotting (Principle, procedure, observation, positive organism).

UNIT V **(LECTURE HOURS:** 12**)**

ANTIMICROBIAL AGENTS

Cell wall active agents (Antibiotics inhibition the cell wall synthesis-Penicillin, Ampicillin, Cephalosporins, Cycloserine, Bacitracin and Vancomycin), **Cell membrane active agents** (Polymyxins, Gramicidin and Tyrocidines), **Inhibition of Nucleic acids and Protein synthesis (**Streptomycin, Tetracyclines, Chloramphenicol, Erythromycin) **Susceptibility test** (Kirby Baur test to determine the sensitivity of antibiotics).

TEXT BOOKS:

T1 - A TEXT book of Microbiology, , Edition: , New central book agency Pvt. Ltd, Calcutta. , Chakraborthy, P. (1995)

T2 - Diagnostic Microbiology, , Edition:9 , C V. Moshby Publications. , Bailey and Scotts, AND Baron and Finegold (1994)

REFERENCE BOOKS:

R1 - Review of medical microbiology , Edition:28 , Lange medical publications, USA. , Jawetz, E: Melnic, J.K. and Adelberg, E.A (2001).

Course Title: **Diagnostic Microbiology (P)**	Course Code : 63S
Semester: **VI**	Course Group : DSE V
Teaching Scheme in Hrs (L:T:P): **0:0:4**	Credits : **6**
Map Code: D (THEORY – APPLICATION)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # :60 **Marks**
Programme: **BSC-MICROBIOLOGY** **# - Semester End Exam**	

1. **ISOLATION AND IDENTIFICATION OF BACTERIAL PATHOGENS FROM CLINICAL SAMPLES**
- **Urine sample**
- **Pus sample**
- **Sputum sample**
- **Blood sample**
2. **Acid-fast staining**
3. **Lactophenol cotton blue mounting for fungal species**
4. **KOH mounting**
5. **Identification of pathogenic bacteria from the clinical samples by biochemical methods**
    - **Indole test**
    - **Methyl red, Voges Proskauer**
    - **Citrate test**
    - **Oxidase, Catalase**
    - **Urease and carbohydrate fermentation**
    - **Coagulase Test- Tube and slide test**
6. **Serological test**
    - **ASO titer**
    - **WIDAL**
7. **Western blotting**
8. **Antibiotic Sensitivity Test-Kirby Bauer - Disc diffusion**

REFERENCE BOOKS:

R1: Manual of Clinical Microbiology: edition 5, 1991 Albert Balows William J Hausler, Book News, Inc., Portland
R2. Microbiology, A Laboratory Manual, Edition 6, James G Cappuccino Natalie, 2006.
R3. Medical Microbiology: edition 20, Jawetz Melnick Adelberg, Mc Graw Hill Education, 1995.

COURSE CONTENT

Course Title: **PROJECT WORK REPORT & VIVA VOCE (P)**	Course Code : 63R
Semester :**VI**	Course Group: **DSE – VI**
Teaching Scheme in Hrs (L: T:P): **-**	Credits : **6**
Map Code: **I (PROJECT)**	Total Contact Hours: **- check scheme**
CIA : **40 Marks**	SEE #: **60 Marks**
Programme: **B.Sc Microbiology**	**# - Semester End Exam**

Project work related any of the mentioned Discipline Specific Courses- case studies, in vitro laboratory performance with interpretation of results, Specific core related and interdisciplinary related projects such as Antimicrobial Resistance, Environmental Microbiology, Pathogenicity & Virulence, Biotechnology & Synthetic Biology, Microbiomes, Food Microbiology.

During the VI Semester the Students will be divided into various groups and each group will be assigned a topic. The Project will be submitted at the end of the VI Semester and will be jointly evaluated by the Internal and External Examiner