K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Microbiology (Sem. III & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Microbiology (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

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समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

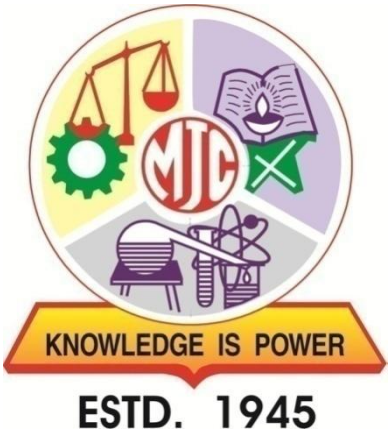
Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (S.Y. B.Sc. Microbiology)

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2025-26]

Preface

Skilled human resources is a prerequisite in higher education, and it is necessary to acquire a thorough knowledge of theoretical concepts and hands-on laboratory methods. The Moolji Jaitha College (Autonomous) has adopted a department-specific model as per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. The Board of Studies in Microbiology and Biotechnology of the college has prepared the syllabus forthe Second-year undergraduate ofMicrobiology. The syllabus develops theoretical and practical knowledge in various fields of microbiology. The syllabus contents have been prepared to encompass both the fundamental and applied aspects of various microbiology disciplines.Additionally, in the first year, students will be educatedabout the skills related to microbial isolation, identification, and testing, which will enhance their employability.

The overall curriculum, spanning three to four years, covers general microbiology, biomolecules and microbial metabolism, molecular biology and microbial genetics, medical microbiology and immunology, industrial and applied microbiology, and environmental microbiology, as well as various biotechniques. Furthermore, the syllabus is meticulously structured to cater to the present and future needs of the Industrial Sector, research field, Environmental Area, and entrepreneurship, ensuring that our graduates are well-prepared for real-world challenges. The curriculum strongly emphasises imparting hands-on skills, with more experiments that run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

Hence, the Board of Studies in Microbiology and Biotechnology, in its meeting held on 22 March 2025, resolved to accept the revised syllabus for S.Y. B.Sc. (Microbiology) based on the Choice-Based Credit System (CBCS) of the UGC, NEP-2020, and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognise the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Microbiology Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	Isolation, identification and characterization of various microbes from diverse habitats.
2	Impact of various groups of microbes on atmosphere, plant, human and animal health.
3	Principle and applications of various bio-analytical tools and techniques
4	Structure, properties, pathways and applications of biomolecules in various fields
5	Biochemical mechanisms, regulation and application of enzymes in various sectors
6	Applications of microbes in various fields such as agriculture, industry, medicine, etc.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours **Or** Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	**UG Certificate**
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	**8**	**8**	**8**	**6**	**---**	**10**	**4**	**44**	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	**UG Diploma**
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-3(2P)	AEC-4(2T) (MIL)	CC-4(2T) ۞FP(2)	22	
	Cum. Cr.	**12**	**---**	**10**	**---**	**4**	**6**	**4**	**8**	**44**	
	Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.										

***** Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

۞ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject II (M-2) Minor	Subject III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum. Cr.	**24**	**8**	---	---	---	**8**	---	**4**	**44**	
	Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	**28**	**8**	**4**	**---**	**---**	**---**	**4**	**44**	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	**20**	**8**	**4**	**---**	**---**	**---**	**12**	**44**	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **OE**/**GE**- Open/Generic elective, **VSC**- Vocational Skill Course, **SEC**- Skill Enhancement Course, **VSEC**- Vocation and Skill Enhancement Course, **AEC**- Ability Enhancement Course, **IKS**- Indian Knowledge System, **VEC**- Value Education Course, **T**- Theory, **P**- Practical,**CC**-Co-curricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project, **CEP**- Community Extension Programme, **ENG**- English, **CI**- Constitution of India, **MIL**- Modern Indian Language

- Number in bracket indicates credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of S.Y. B.Sc. (Microbiology)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester III, Level – 5.0											
DSC-5	DSC	MIB-DSC-231	Fundamentals of Microbial Biochemistry	2	2	---	2	20	---	30	---
DSC-6	DSC	MIB-DSC-232	Basic Medical Microbiology and Bio-techniques	2	2	---	2	20	---	30	---
DSC-7	DSC	MIB-DSC-233	Practical on Biochemistry and Biotechniques	2	---	4	4	---	20	---	30
SEC-1	SEC	MIB-SEC-231	Techniques of Microbial Identification	2	2	---	2	20	---	30	---
CEP	CEP	MIB-CEP-231	Community Engagement Program	2	---	4	4	50	---	---	---
MIN-1	MIN	MIB-MIN-231	Basic Biochemistry	2	2	---	2	20	---	30	---
MIN-2	MIN	MIB-MIN-232	Foundation of Medical Microbiology and Techniques	2	2	---	2	20	---	30	---
MIN-3	MIN	MIB-MIN-233	Practical on Biotechniques	2	---	4	4	---	20	---	30
OE-4	OE	MIB-OE-231	Microbes and Environmental Interactions	2	2	---	2	20	---	30	---
Semester IV, Level – 5.0											
DSC-8	DSC	MIB-DSC-241	Elementary Genetics and Immunology	2	2	---	2	20	---	30	---
DSC-9	DSC	MIB-DSC-242	Basic Industrial Microbiology	2	2	---	2	20	---	30	---
DSC-10	DSC	MIB-DSC-243	Practical on Industrial Microbiology and Immunology	2	---	4	4	---	20	---	30
SEC-2	SEC	MIB-SEC-241	Methods in Microbial analysis	2	2	---	2	20	---	30	---
SEC-3	SEC	MIB-SEC-242	Practical on Microbial identification and analysis	2	---	4	4	---	20	---	30
FP	FP	MIB-FP-241	Field Project	2	---	4	4	50	---	---	---
MIN-4	MIN	MIB-MIN-241	Basic Biotechnology	2	2	---	2	20	---	30	---
MIN-5	MIN	MIB-MIN-242	Practical on Basic Biotechnology	2	---	4	4	---	20	---	30
OE-5	OE	MIB-OE-241	Sustainable agriculture with microbes	2	2	---	2	20	---	30	---

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
    - External examination will be of 1½ hours duration
    - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
    - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
    - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method

carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT.The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation condition is required.
- There shall be 05 marks for journal and viva voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-III

S.Y. B.Sc. Microbiology (Major)
Semester-III
MIB-DSC-231: Fundamentals of Microbial Biochemistry

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint students with basic concepts of carbohydrates. • To understand the concepts related to protein. • To introduce the basics of lipids. • To learn about nucleic acid	
Course outcomes	After completion of this course, students will be able to • Cognizant the basic structure, classification and functions of carbohydrates. • Understand the classification and structure of proteins and amino acids. • Aware of the structure and functions of lipids. • Compare forms and functionsof DNA and RNA	
Unit	**Contents**	**Hours**
Unit I	**Carbohydrates** • Carbohydrates: Definition and general functions • General Classification: Mono, Oligo and Polysaccharide • Reactions of Monosaccharides: o Tautomerization or enolization, Reducing properties, Oxidation, reduction, Dehydration, Osazone formation • Structure and roles of microbiological carbohydrates: o Monosacharides-Glucose: Pyranose and furanose structures, Anomers—mutarotation o Disaccharide-Maltose, Sucrose and Lactose o Homopolysaccharide: starch and cellulose o Heteropolysaccharide: Peptidoglycan	7
Unit II	**Amino Acids and Proteins** **Amino Acids** o General structure amino acids o Classification of amino acids based on o structure, Polarity, Nutritional capacity, and metabolic fate o Selenocysteine – the 21st amino acid o Properties of amino acids: Physical and chemical **Proteins** o Definition, general functions and Properties of protein o Concept of protein denaturation o Classification of protein based on o Functions, chemical nature, and Nutrition o Structural levels of protein organization: o Primary structure: peptide bond o Secondary: α-helix, β- pleated sheets o Tertiary structure o Quaternary structure and bonds responsible for protein structure	**8**
Unit III	**Lipids** • Lipid: Definition and general function • Classification of lipids: simple, compound/ complex, derived • Fatty acids: Occurrence, saturated v/s unsaturated fatty acids, Nomenclature • Structure and significance of fatty acids: o Triglycerols: Structure, properties, and Tests to check purity of fats and oils o Phospholipids: Concept,Glycerophospholipids and Sphingomyelins o Glycolipids and steroids (e.g. Cholesterol), Amphipathic Lipids	**7**

Unit IV	**Nucleic acid**
	• **Nucleic acid**
	  ○ Structural constituents of nucleic acids: nucleoside and nucleotide
	• **DNA**
	  ○ Structure (Watson and Crick Model), Chargaff's Rule,
	  ○ Conformations of DNA double helix and unusual structures of DNA
	  ○ The size of DNA molecule- Unit of length
	• **RNA**
	  ○ Structure of RNA
	  ○ Types and functions: mRNA, tRNA and rRNA
	  ○ Concept of ribozymes
		8

References

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- Moat, A. and Foster, J. (2002) Microbial Physiology, 4th ed., Wiley Interscience Publications, NY.
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S.Y. B.Sc. Microbiology (Major)
Semester-III
MIB-DSC-232: Basic Medical Microbiology and Bio-techniques

Total Hours: 30 **Credits: 2**

Course objectives	• To complement the students with the basic knowledge of medical microbiology • To study concept of microbial pathogenesis • To study the advanced microscopic techniques • To be aware of the bio-analytical techniques	
Course outcomes	**After completion of this course, students will be able to** • Cognizant of different basic terminologies related to medical microbiology. • Exemplify types of infections, stages of pathogenesis and antigen-antibody • Understand advanced microscopy, including its principles, workings, and applications. • Understand the Principles, methods, and applications of bioanalytical techniques.	
Unit	**Contents**	**Hours**
Unit I	**Concepts in Medical Microbiology** • Normal flora of the human body • Concept of Human microbiome • Portal of entry of pathogen • Stages of infectious diseases • Virulence factors: Invasiveness and Toxigenicity • Pattern of disease: chronic and acute • Signs, symptoms and syndrome • Laboratory diagnosis • Prophylaxis • Treatment • Epidemiology • Concept of outbreak with example of COVID-19 • Introduction to CDC and WHO; their efforts in various epidemics, pandemics and diagnosis and control of community infection	7
Unit II	**Microbial Pathogenesis** • Types of Microorganisms: Saprophytes, Parasites, Commensals, Pathogens, Opportunistic pathogens • Types of Infections: Primary, secondary, reinfection, cross and nosocomial • Stages of Pathogenesis of Infections: o Factors affecting the outcome of infection o Transmission of Infection: Sources of infections, modes of transmission, susceptible host • Immunity: Concept, Types (Innate, Acquired, Local and Herd) • Nonspecific and specific Immune response • Antigen and Antibody: o Concept of antigen o Types of Antigen o Antigenic Properties: Epitopes, Isoantigens, Haptens, Superantigens o Antibodies: Structure and its types	**8**
Unit III	**Advance Microscopy** • Principle, working, ray diagram and applications of : ▫ Phase contrast microscopy ▫ Fluorescence microscopy ▫ Transmission Electron microscopy (TEM)	**8**

	▫ Scanning Electron microscopy (SEM) ▫ Scanning Tunneling Microscopy (STM) • Specimen preparation for TEM: Negative staining, thin sectioning (ultra-microtomy) • Specimen preparation for SEM: Surface replicas, Freeze etching, shadow casting	
Unit IV	**Bioanalytical technique** • Principal, method and applications of ▫ Colorimetry and Spectrophotometry ▪ Concept of electromagnetic radiation ▪ Absorption spectrum, Beer's and Lambert's law ▪ UV/ Visible spectrophotometry ▫ Chromatography ▪ Paper and Thin layer ▫ Electrophoresis: ▪ Agarose gel, Poly acrylamide gel (PAGE), SDS-PAGE	**7**

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- Marimuthu R. (2008) Microscopy and microtechnique, MJP publisher, Chennai

S.Y. B.Sc. Microbiology (Major)
Semester-III
MIB-DSC-233: Practical on Biochemistry and Biotechniques

Total Hours: 60 **Credits: 2**

Course Objectives	• To study the structural details of microbial cell • To analyse the water quality, microflora of skin • To study various microbial enzymes and biotechniques	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the staining methods to visualize the microbial cell ▪ Analyze water quality, skin flora ▪ Perform screening of microbe for enzyme and analyze using biotechniques	
Sr. No.	**Contents**	**Hours**
1	Perform Cell wall staining by any suitable method.	**4**
2	Perform Flagella staining by any suitable method.	**4**
3	Perform Volutine granules staining by any suitable method.	**4**
4	Perform Nucleus staining by any suitable method.	**4**
5	Study of skin microflora using swab technique	**4**
6	Perform presumptive Coliform test to checkpotability of water (MPN).	**4**
7	Perform a confirmed and completed Coliform test to assess the potability of the water.	**4**
8	Detection of microbial enzymes from microbes: Amylase, Lipase, Gelatinase.	**4**
9	Detection of microbial enzymes from microbes: Catalase, Urease, Coagulase.	**4**
10	Perform any one Enzyme activity assay (amylase/ protease/ cellulase)	**4**
11	Qualitative test for sugar, protein and lipids	**4**
12	Preparation of standard curve of protein using Folin-Lowery method	**4**
13	Separation of amino acid by paper chromatography	**4**
14	Handling and calibration of pipette, volumetric flask and pH meter and demonstration of handling of micropipette	**4**
15	Demonstration of UV-Vis spectrophotometer / Phase contrast microscope	**4**

Study Resources

- Alcamo, I.E. (2001) Laboratory Fundamentals of Microbiology, Jones and Bartlett,
- Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi.
- Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York.
- Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi.
- Harley, J.P. and Prescott, L.M (1996) Laboratory Exercise in Microbiology, 3rd edition, WCB/McGraw Hill.
- Jayaraman, I. (2011) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi.
- Norris, J.R. (1972) Methods in Microbiology Vol. I, 1st Edn. Academic Press Inc., London.
- Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi.
- Plummer, D.T. (2017) An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi.
- Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Anne's Book India, New Delhi.

S.Y. B.Sc. Microbiology (Major)
Semester-III
MIB-SEC-231: Techniques of Microbial Identification

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To aquent basic knowledge of bacterial identification ▪ To study various methods for fungal identification ▪ To learn techniques used for the detection of protozoa, algae and virus ▪ To get aware of advanced techniques in microbial identification	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the skill of bacterial identification ▪ Aware of the identification of fungi and get an understanding of detection for microbes from samples ▪ Comprehend the newer microbial identification techniques ▪ Know the advancedtechniques in microbial identification.	
Unit	**Contents**	**Hours**
Unit I	**Identification of Bacteria** • Application Areas of Bacterial Identification o Medical Diagnostics, Pharmaceutical Industry, Food Safety & Water Testing, Environmental Microbiology • Bergey's System of Bacterial Classification: structure, scheme and Overview • Morphological types and staining techniques for identification • Cultural, colonial and growth characteristics • Fermentation and biochemical properties • Resistance to antibiotics • Rapid identification methods	8
Unit II	**Identification of Fungi** • Applications of Fungal Identification • Introduction to classification of fungi • Morphology of fungi and spore types • Microscopic & Staining Techniques o Field notes, drawings and photographs o Wet mount: lactophenol and KOH preparation o Slide culture • Culture-Based Identification: Common Fungal Culture Media • Biochemical tests o Germ tube test, Urease Test, Carbohydrate Assimilation & Fermentation Tests	8
Unit III	**Detection of microbes from pathological and ecological samples** • Collection & Handling of Fecal Samples • Macroscopic and Microscopic Examination o Examination of a faecal specimen for parasite and protozoa o Saline and iodine wet mount, lactophenol cotton blue and Leishman staining • Culture Media and Identification of *Entamoeba histolytica* • Observation of diatoms, flagellates, blue-green algae • Detection of a bacteriophage using plaque assay • Cytopathic effect in tissue culture	**7**

Unit IV	**Advanced Techniques for microbial identification** Principle, method and significance of following technaiques • PCR technique for DNA amplification • 16 s / 18 s rRNA technique • Biolog microbial identification system and Automated biochemical tests • Serological and Biosensor-Based techniques • Nucleic acid probes • Introduction to MALDI-TOF MS	**7**

Study Resources

- Atlas, R. M. (1997). Principles of Microbiology, 2nd edition, W.M.T. Brown Publishers, Dubuque, USA.
- Cappucino, J, & Sherman, N.(2010). Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Delhi.
- Parija. S. C.(2005). Text Book of Practical Microbiology,1st edition, Ahuja Publishing House, New Delhi.
- Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi.
- Harley, J. P. & Prescott, L. M. (2002). Laboratory Exercises in Microbiology, 5th edition,The McGraw-Hill Co., NewYork.
- Benson, H. (2001). Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, NewYork.
- Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi.

S.Y. B.Sc. Microbiology (Major)
Semester-III
MIB-CEP-231: Community Engagement Program

Total Hours: 60 **Credits: 2**

In alignment with the National Education Policy (NEP) 2020, Moolji Jaitha College (Autonomous), Jalgaon is introducing the Community Engagement Program at the undergraduate level. The NEP 2020 emphasizes holistic development, inclusivity, and integrating vocational education with academic learning, aiming to nurture socially responsible individuals. Inspired by NEP 2020, the Community Engagement Program aims to produce knowledgeable, compassionate, and proactive graduates, contributing to a more just, equitable, and sustainable society. This course fosters a strong connection between education and socioeconomic problems of real-world. Students will learn about the challenges faced by vulnerable households and appreciate local wisdom and lifestyles.

Objectives

- To engage students in activities that promote emotional, social, and intellectual growth, fostering a well-rounded approach to personal and academic development.
- To provide hands-on experiences that complement classroom learning, enabling students to apply their knowledge in socioeconomic problems of real-world.
- To instil a sense of responsibility towards the community by encouraging students to actively participate in social and environmental initiatives, appreciate rural culture, lifestyle, and wisdom.

Learning Outcomes

After completing this course, students will be able to

- Understand the cultures of both rural and urban areas, their respective ethos, and the socioeconomic realities they face.
- Develop a sense of empathy with the local community, appreciating the significant contributions it makes to society and the economy.
- Learn to value the local community wisdom and identify opportunities for contributing to the community's socioeconomic improvements.

Activities

- Conduct workshops and interactive sessions on emotional intelligence and social skills.
- Organize debates, discussions, and intellectual challenges that stimulate critical thinking and socioeconomic problem-solving using the concerned subjects.
- Organize field visits that enable students to work on real-world problems, such as environmental conservation, rural and urban planning, or community health initiatives.
- Organize internships or service-learning opportunities with local businesses, NGOs, or government agencies.
- Facilitate project-based learning activities that require students to use their academic knowledge to develop solutions to community issues.
- Engage students in community service activities that address local social and environmental issues.
- Organize cultural exchange programs or field trips to rural areas to foster an appreciation of rural culture and wisdom.
- Facilitate collaborative projects involving students, educators, and community members to develop solutions for local challenges, promoting teamwork and collective problem-solving.
- Conduct educational sessions on the status of various agricultural and development programs, as well as the challenges faced by vulnerable households, ensuring inclusivity and accessibility for all students.

S. No.	Module Title	Module Content	Assignment submission	Teaching/ Learning Methodology
1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values concerning community, nature and resources, elaboration of	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-	– Classroom discussions – Field visit – Assignment

		"soul of India lies in villages', rural infrastructure.	family relations in that village.	
2	**Understanding rural and local economy and livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods, artisans, rural entrepreneurs, rural markets, and migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	– Field visit – Group discussions in class – Assignment
3	**Rural and local Institutions**	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written / audio-visual).	– Classroom – Field visit – Group presentation of assignment
4	**Rural and National Development Programmes**	History of rural development and current national programmes in India: SarvaShikshaAbhiyan, BetiBachao, BetiPadhao, Ayushman Bharat, Swachh Bharat, PM AwaasYojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), AtmaNirbhar Bharat, etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special focus on the urban informal sector and migrant households.	– Classroom – Each student selects one program for field visit – Written assignment

Note: The modules are suggestive in nature and students can opt any one activities for community engagement program and field project based on topic appropriate to their regional community context.

Assessment:

• Readings from related literature including e-content and reflections from field visits should be maintained by each student in the form of Field Diary (20 Marks)

• Submission of assignments based on modules assignment submission (details mentioned above) (20 Marks)

• Oral/ Group discussion/ Presentation (10 Marks)

S.Y. B.Sc. Microbiology (Minor)
Semester-III
MIB-MIN-231: Basic Biochemistry

Total Hours: 30 **Credits: 2**

Course Objectives	• To acquaint students with basic concepts of carbohydrates. • To understand the concepts related to protein. • To introduce the basics of lipids. • To learn about nucleic acid	
Course Outcomes	**After completion of this course, students will be able to** • Cognizant of the basic structure, classification and functions of carbohydrates. • Understand the classification and structure of proteins and amino acids. • Aware of the structure and functions of lipids. • Compare forms and functions of DNA and RNA	
Unit	**Contents**	**Hours**
Unit I	**Carbohydrates** • Carbohydrates: Definition and general functions • General Classification: Mono, Oligo and Polysaccharide • Reactions of Monosaccharides: o Tautomerization or enolization, Reducing properties, Oxidation, reduction, Dehydration, Osazone formation • Structure and roles of microbiological carbohydrates: o Monosacharides-Glucose: Pyranose and furanose structures, Anomers—mutarotation, o Disaccharides-Maltose, Sucrose and Lactose, o Homopolysaccharide: starch and cellulose o Heteropolysaccharide: Peptidoglycan	7
Unit II	**Amino Acids and Proteins** • **Amino Acids** o General structure and properties (Physical and chemical) of amino acids o Classification of amino acids based on structure, Polarity, Nutritional capacity, and metabolic fate o Selenocysteine – the 21st amino acid • **Proteins** o Definition and general functions of protein o Properties of proteins and denaturation concept o Classification of protein based on Functions, chemical nature, and Nutrition o Structural levels of protein organization: o Primary structure: peptide bond o Secondary: α-helix, β- pleated sheets o Tertiary structure o Quaternary structure and bonds responsible for protein structure	**8**
Unit III	**lipids** • Lipid: Definition and general function • Classification of lipids: simple, compound/ complex, derived • Fatty acids: Occurrence, saturated v/s unsaturated fatty acids, Nomenclature • Structure and significance of fatty acids: o Triglycerols: Structure, properties, and Tests to check the purity of fats and oils o Phospholipids: Concept, Glycerophospholipids and Sphingomyelins o Glycolipids and steroids (e.g. Cholesterol) o Amphipathic Lipids	**7**

Unit IV	**Nucleic acid** • **Nucleic acid** o Structural constituents of nucleic acids: nucleoside and nucleotide • **DNA** o Structure (Watson and Crick Model), Chargaff's Rule, o Conformations of DNA double helix and unusual structures of DNA o The size of DNA molecule- Unit of length • **RNA:** o Structure of RNA o Types: mRNA, tRNA and rRNA o Concept of ribozymes	**8**

Study Resources

- Nelson, D L and Cox, M. M (2017) Lehninger Principles of Biochemistry, 6th ed., . (eds.) WH Freeman and Co., New York.
- Moat, A. and Foster, J. (2002) Microbial Physiology, 4th ed., Wiley Interscience Publications, New York.
- Stryer, L. (2001) Biochemistry, 5th ed., WH Freeman and Co., New York.
- Stanier R Y, Ingraham J L, Wheelis M L, Painter P R (1995) General Microbiology, 5th Edition, MacMillan Press Ltd., London.
- Prescott, L. M., Hartley, J. P. and Klein, D. A. (1993) Microbiology, 2nd Ed., W. M. C. Brown Publ., England
- Nicholas, C. P. and Lewis, S. (1999) Fundamentals of Enzymology, 3rd ed., Oxford University Press Inc. New York
- Caldwell, D. R. (1995) Microbial Physiology and Metabolism, Brown Publishers, London
- Satyanaryana U (2005) Biochemistry, Books and Allied P Ltd., Kolkata

S.Y. B.Sc. Microbiology (Minor)
Semester-III
MIB-MIN-232: Foundation of Medical Microbiology and Techniques

Total Hours: 30 **Credits: 2**

Course Objectives	• To complement the students with the basic knowledge of medical microbiology • To study the concept of microbial pathogenesis • To study the advanced microscopic techniques • To be aware of the bio-analytical techniques	
Course Outcomes	**After completion of this course, students will be able to** • Cognizant of different basic terminologies related to medical microbiology. • Exemplify types of infections, stages of pathogenesis and antigen-antibody • Understand advanced microscopy concerning principles, workings, and applications. • Understand the Principles, methods, and applications of bioanalytical techniques.	
Unit	**Contents**	**Hours**
Unit I	**Concepts in Medical Microbiology** • Normal flora of the human body • Concept of Human microbiome • Portal of entry of pathogen • Stages of infectious diseases • Virulence factors: Invasiveness and Toxigenicity • Pattern of disease: chronic and acute • Signs, symptoms and syndrome • Laboratory diagnosis • Prophylaxis • Treatment • Epidemiology • Concept of outbreak with example of COVID-19 • Introduction to CDC and WHO; their efforts in various epidemics, pandemics and diagnosis and control of community infection	7
Unit II	**Microbial Pathogenesis** • Types of Microorganisms: Saprophytes, Parasites, Commensals, Pathogens, Opportunistic pathogens • Types of Infections: Primary, secondary, reinfection, cross and nosocomial • Stages of Pathogenesis of Infections: o Factors affecting the outcome of infection o Transmission of Infection: Sources of infections, modes of transmission, susceptible host • Immunity: Concept, Types (Innate, Acquired, Local and Herd) • Antigen and Antibody: o Concept of antigen o Determinants of Antigenicity o Antigenic Properties: Epitopes, Isoantigens, Haptens, Superantigens o Antibodies: Structure and its types	**8**
Unit III	**Advance Microscopy** • Principle, working, ray diagram and applications of : ▫ Phase contrast microscopy ▫ Fluorescence microscopy ▫ Transmission Electron microscopy (TEM) ▫ Scanning Electron microscopy (SEM)	**8**

	▫ Scanning Tunneling Microscopy (STM) • Specimen preparation for TEM: Negative staining, thin sectioning (ultra-microtomy) • Specimen preparation for SEM: Surface replicas, Freeze etching, shadow casting	
Unit IV	**Bioanalytical technique** Principal, method and applications of ▫ Colorimetry and Spectrophotometry ▪ Concept of electromagnetic radiation ▪ Absorption spectrum, Beer's and Lambert's law ▪ UV/ Visible spectrophotometry ○ Chromatography: Paper and Thin layer ▫ Electrophoresis: Agarose gel, Poly acrylamide gel (PAGE), SDS-PAGE	**7**

Study Resources

- Kathy Talaro and Barry Chess (2012) Foundations in Microbiology, The McGraw-Hill Companies, Inc., New York.
- Tortora, Funke and Case (2010) Microbiology, Brenjamin Cummings Inc., California
- Stanier, R.Y., Ingraham, J.L., Wheelis M.L., Painter R.K. (1995) General Microbiology, MacMillan Press Ltd. London.
- Frobisher M. (1974) Fundamentals of Microbiology, Hinsdill, Crabtree and Goodheart Ed., WB Saunder's Co. USA.
- Modi H. A. (1995) Elementary Microbiology 1 and 2, EktaPrakashan, Ahmedabad
- Wilson K and Walker J (2006)Principles and techniques of practical biochemistry (5th Ed.): Cambridge University Press, Cambridge,
- Frontmatter. (2018). In A. Hofmann & S. Clokie (Eds.), Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (pp. I-Iv). Cambridge: Cambridge Uni. Press
- Upadhyay A, Upadhyay K., Nath N. (1998) Biophysical chemistry: Principal and techniques, Himalaya Publishing House. Mumbai
- Sivasankar B (2005) Bioseparations: Principal and techniques, Prentice-Hall of India Ltd. Delhi
- Bajpai P. K. (2006) Biological instrumentation and methodology, S. Chand, New Delhi
- Marimuthu R. (2008) Microscopy and microtechnique, MJP publisher, Chennai

S.Y. B.Sc. Microbiology (Minor)
Semester-III
MIB-MIN-233: Practical on Biotechniques

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To study the structural details of microbial cell ▪ To analyse the water quality, microflora of skin ▪ To study various microbial enzymes and biotechniques	
Course Outcomes	**After completion of this course, students will be able to** ▪ Understand the staining methods to visualize the microbial cell ▪ Analyze water quality, skin flora ▪ Perform screening of microbe for enzyme and analyze using biotechniques	
Sr. No.	**Contents**	**Hours**
1	Perform Cell wall staining by any suitable method.	**4**
2	Perform Flagella staining by any suitable method.	**4**
3	Perform Volutine granules staining by any suitable method.	**4**
4	Perform Nucleus staining by any suitable method.	**4**
5	Study of skin microflora using swab technique	**4**
6	Perform presumptive Coliform test to checkpotability of water (MPN).	**4**
7	Perform a confirmed and completed Coliform test to assess the potability of the water.	**4**
8	Detection of microbial enzymes from microbes: Amylase, Lipase, Gelatinase.	**4**
9	Detection of microbial enzymes from microbes: Catalase, Urease, Coagulase.	**4**
10	Perform any one Enzyme activity assay (amylase/ protease/ cellulase)	**4**
11	Qualitative test for sugar, protein and lipids	**4**
12	Preparation of standard curve of protein using Folin-Lowery method	**4**
13	Separation of amino acid by paper chromatography	**4**
14	Handling and calibration of pipette, volumetric flask and pH meter and demonstration of handling of micropipette	**4**
15	Demonstration of UV-Vis spectrophotometer / Phase contrast microscope	**4**
Study Resources	▪ Alcamo, I.E. (2001) Laboratory Fundamentals of Microbiology, Jones and Bartlett, ▪ Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi. ▪ Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York. ▪ Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi. ▪ Harley, J.P. and Prescott, L.M (1996) Laboratory Exercise in Microbiology, 3rd edition, WCB/McGraw Hill. ▪ Jayaraman, I. (2011) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi. ▪ Norris, J.R. (1972) Methods in Microbiology Vol. I, 1st Edn. Academic Press Inc., London. ▪ Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi. ▪ Plummer, D.T. (2017) An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi. ▪ Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Anne's Book India, New Delhi.	

S.Y. B.Sc. Microbiology (Open Elective)
Semester-III
MIB-OE-231: Microbes and Environmental Interactions

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint students with basic concepts of Microbial Ecology and Interactions • To highlight the importance of air microbiology. • To impart the knowledge of soil microbiology. • To describe the critical preventative and monitoring microbiological quality of water.	
Course outcomes	**After completion of this course, students will be able to** • Learn the importance of microbial interaction in the ecosystem • understand the skill sets in assessment and enumeration of air • Aware of the biogeochemical cycles and ecological aspects of microbiology. • Understand the concepts of pollution, indicator bacteria, water and air-borne diseases	
Unit	**Contents**	**Hours**

Unit I	**Microbial Ecology and Interactions**
	• Concept of microbial ecology and types of microbial interactions
	  ○ Positive and Negative: Mutualism, Cooperation, Commensalism, Predation, Ammensalism
	• Concept, establishment (Direct and Re-infection) and importance of symbiosis
	• Examples of Microbial interactions:
	  ○ Legume-rhizobium, Lichen, Ruminantsymbiosis
		8

Unit II	**Air microbiology** • Terminologies in aero microbiology: Bio-aerosols, droplet nuclei, air-borne microbes, allergens • Significance in human health, environmental, food and pharmaceutical industries, and surgical operations. • Techniques for microbial sampling of air from various sources, aerosol sampling, fate of aerosols • Airborne transmission of microbes, their diseases and preventive control measures	**7**
Unit III	**Soil microbiology** • Soil horizons, classification of soils and Rhizosphere microflora • Biogeochemical cycles: C, P, N, S • Enumeration of soil microflora by different techniques	8
Unit IV	**Water microbiology** • Water ecosystem: Freshwater, Marine water • Microflora of water • Assessment of water and potability of water: TVC, MPN • Indicator bacteria: *E. coli* • Waterborne diseases and their control measures: Cholera, Typhoid	**7**

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- Maier R. M., pepper, I. L. and Gerba, C. P. (2009) Environmental Microbiology, 2nd ed., Academic Press, NY.
- Salle, S. J. (1974) Fundamental Principals of Bacteriology, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- SubbaRao, N. S. (1999) Soil Microbiology, 4th edn., Oxford and IBH Publ. Co., New Delhi.
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- Bums, R. G. and Slater, J.H. (1982) Experimental Microbial Ecology, Blackwell Scientific Publ., Oxford.
- Atlas, R. M. and Bartha, R. (2000) Microbial Ecology, 4th ed., Benjamin/Cumming Science Publ.,

SEMESTER-IV

S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-DSC-241: Elementary Genetics and Immunology

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint students with basic concepts of microbial genetics. • To understand the basics of mutation and its repair mechanism. • To introduce the basics of microbial infection and immunology. • To study the antigen and antibody reactions	
Course outcomes	**After completion of this course, students will be able to** • aware of the basic concepts of genomics related to pro and eukaryotic • understand the concepts of genetic code, mutation and repair mechanism • aware of the essential topics related to infection and immunology • Apply appropriate immunological reactions for diagnosis	
Unit	**Contents**	**Hours**
Unit I	**Genes and chromosomes** • Concepts in basic genetics: gene, allele, genome, genotype, phenotype, cistron, intron, exon, haploid, diploid, partially diploid, homologous, and heterologous. • Prokaryotic genetic material: o Typical structure of chromosome o Plasmid: Concept, types and properties • Eukaryotic chromosome o Structural organization o Concept of : Euchromatin and Heterochromatin o Chromosome variation: Euploidy, Aneuploidy, Polyploidy o Genetic code and its properties	8
Unit II	**Mutations** • Concept and significance of mutation • Types of mutation: Base pair substitutions (transition, transversion), deletion, inversion, insertions missense, nonsense, neutral, silent, frameshift, reverse and suppressor mutations • Spontaneous mutations: mechanism • Induced mutations: Physical o Radiation: UV, Gamma, and X-rays, o Chemical: Base analogues, deaminating agents, alkylating agents, intercalating agents) • Methods to study/screen mutation: o Fluctuation test, Replica plate technique, Ames test o Repair of Mutation: photoactivation, excision repair	**7**
Unit III	**Immune Cells and organs** • Immune cells: stem cell, T cell, B cell, NK cell, Macrophages, Dendritic cell • Organs involved in the immune response: o Primary (Bone marrow, thymus), o Secondary (lymph node, spleen, peyer's patches) • Immune response: Non-specific, specific immune response, Humoral and cell-mediated • Various lymphoid tissues: MALT, NALT, GALT, and BALT. • Lymphocyte traffic and recirculation	**8**

Unit IV	**Antigen-Antibody Reactions**
	• General Features:
	  o Physicochemical Properties: Affinity, Avidity, Specificity, Cross-Reactivity
	• Stages of Antigen-Antibody Reactions: Primary and Secondary
	• Types of Antigen-Antibody Reactions:
	  o Precipitation: Features and its types
	  o Agglutination: Features and its types- Slide agglutination test, Antiglobulin (Coombs') test & Latex agglutination test
	  o Complement-Dependent Serological Tests
	  o Concept of Opsonization
	  o Immunofluorescence: Direct and indirect
		7

References

- Wiley, J M, Sherwood, L M and Woolverton, C J. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International, New York.
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- Parija S.C. (2012), Textbook of Microbiology and Immunology, 2nd Edition, ELSEVIER, *A division of* Reed Elsevier India Private Limited, New Delhi
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- Kayser F.H. et al (2005), Medical Microbiology, Thieme Stuttgart, New York

S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-DSC-242: Basic Industrial Microbiology

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint students with basic concepts of industrial microbiology. • To understand the process parameters and types of fermentation • To infer the upstream processes in fermentation • To make the students know about inoculum development	
Course outcomes	**After completion of this course, students will be able to** • Understand the process of screening important microbes and designing fermentation media. • Understand the basic design of a fermenter and the overall fermentation process. • Be acquainted with diverse upstream processing before fermentation process • Apply an appropriate approach for inoculum development.	
Unit	**Contents**	**Hours**
Unit I	**Basics of fermentation technology and media** • Characteristics of industrial strains • Screening of industrially essential microorganisms: Primary and Secondary screening examples: vitamin, antibiotic producers • Microbial culture: o Culture collection centres and their role: National (NCIM) International (ATCC) o Preservation of microorganisms: Soil culture, Oil overlay, Liquid nitrogen freezing, Lyophilization o Working and stock culture • Fermentation media: o Basic composition o Criteria for selection and screening of media o Types of media: synthetic, complex and natural o Major raw materials: Carbohydrates, oils & fats, Corn steep Liquor, Soy meals, Molasses, Sulphite liquors, o Minor ingredients: growth factors, precursors, buffers, water, antifoam agent	8
Unit II	**Fermentation equipment and process** • Fermenter: o Criteria for fermenter design o Structure of a Typical Fermenter and its parts Impeller, baffles, sparger, stuffing box, tc o Measurement and control of fermentation parameters: pH, temperature, dissolved oxygen, foaming and aeration • Fermentation and related process : o Submerged: Batch, Continuous, Fed-batch o Solid state fermentation: concept, characteristics and applications o Anaerobic versus aerobic fermentation o Immobilized cell/enzyme bioreactor o An overview of general fermentation process with one example	**7**
Unit III	**Upstream processing-I** • Need for aseptic conditions in the fermentation process o Consequences of contamination in fermentation o Measures to avoid contamination • Fermentation media sterilization: o Batch sterilization: Del factor, Methods, Advantages and Disadvantages o Continuous sterilization: Direct and Indirect Heat Exchangers • Filter sterilization: Sterilization of air by Filtration	**8**

	• Methods of strain improvement: o Biosynthetic feedback control pathways o Modification of permeability, e.g. Glutamate fermentation o Mutation for primary metabolite production: o Auxotrophic mutants, e.g. Penicillin selection method o Analogue-resistant mutants, e.g. Gradient plate technique o Revertants: Concept and example o r-DNA technology: Steps involved and Examples	
Unit IV	**Upstream processing-II** • Criteria for selection of culture as inoculum o Development of Inoculum for yeast processes: Brewing and Bakers' yeast • Development of Inoculum for bacterial process, e.g. Vit.B_{12} production (pilot scale) • Development of Inoculum for mycelial processes: o Sporulation on media and use of the spore inoculum o Inoculum development for vegetative fungi o Aseptic inoculation of industrial fermenters	**7**

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- Crueger&Aneja (2017) Crueger's Biotechnology : A Textbook Of Industrial Microbiology, PanimaPubl Co., New Delhi
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S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-DSC-243: Practical on Industrial Microbiology and Immunology

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To study screening methods for industrially important microbes ▪ To understand the recovery and analysis of fermented products ▪ To study the immuno techniques and diagnostic microbiology	
Course Outcomes	**After completion of this course, students will be able to** ▪ Understand the basics of screening of microbes for industry ▪ Recover and anlyze the fermentation product ▪ Detect blood groups and perform cross-matching. ▪ Infer the diagnostic/ immune techniques in medical microbiology	
Sr. No.	**Contents**	**Hours**
1	Screening of antibiotic-producing microbes by Crowded plate technique	4
2	Screening of organic acid-producing microbes using the indicator dye method.	4
3	Estimation of Acetic Acid in Vinegar by the Titrimetric Method.	4
4	Determination of alcohol concentration in given fermented broth	4
5	Recovery of organic acid from fermentation broth	4
6	Detection of organic acid using Paper chromatography / Thin Layer chromatography	4
7	Cultivation of fungi using solid-state fermentation (Plate method)	4
8	Determination of ABO and Rh blood group	4
9	Study of blood cross-matching for transfusion.	4
10	Total WBC count using haemocytometer from whole blood	4
11	Haemoglobin estimation from given blood	4
12	Immobilization of whole microbial cell	4
13	Demonstration of lyophilization process	4
14	Demonstration of a typical fermenter	4
15	Field visit / industrial visit to effluent treatment plant	4
Study Resources	▪ Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi. ▪ Dubey, R.C. and Maheshwari D.K. (2023) Practical Microbiology, S. Chand and Co., New Delhi. ▪ Harley, J.P. and Prescott, L.M. (1996) Laboratory Exercise in Microbiology, 3rd ed., WCB/McGraw Hill Publ. Co., London ▪ Jayaraman, I. (2011) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi. ▪ Norris, J.R. (1972) Methods in Microbiology Vol. I, 1st edition, Academic Press Inc., London. ▪ Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi. ▪ Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Ane's Book India, New Delhi.	

S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-SEC-241: Methods in Microbial analysis

Total Hours: 30 **Credits: 2**

Course Objectives	• To illustrate the different methods for the isolation and cultivation of microbes • To relate control of microbes with an aseptic condition • To learn disinfection as a process to control microbes • To understand sterilization as a process to control microbes	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Know microbial techniques for isolation of pure cultures of bacteria, fungi, algae and virus ▪ Deduce the kills related to aseptic handling of microbial cultures ▪ Apply the knowledge to control microbes using disinfection ▪ Use various methods for sterilization	
Unit	**Contents**	**Hours**
Unit I	**Microbial testing of food and dairy** o Importance of Microbial Testing o Sampling of food/ dairy products o Types of Microbial Testing (Bacterial, Yeast and Mold, Viral, Spoilage Organisms, Pathogen, Indicator Organisms) o Common Microbes in Dairy Products o Testing Methods: Culture-based Methods (Serial dilution and agar plate technique, SPC, etc.), Breed count o Resazurin, MBRT, phosphatase test o Mycotoxin detection o Advances in Microbial Testing: Automated Systems, On-site Testing o Testing Standards and Guidelines	7
Unit II	**Microbial testing of air and soil** o Air testing o Impingement of air in medium o Active:Impaction Air Samplers, Filtration Method o Passive monitoring (settling velocity) o Molecular and Biochemical Methods: PCR, Metagenomics o Soil testing o Sampling technique for Soil o Culture-Based Methods o Total viable count o Microbial Biomass Carbon (MBC) and Nitrogen (MBN) o Enzyme Activity Tests of soil	7
Unit III	**Microbial testing of water** o Significance of Microbial Water Testing o Microscopic examination and staining techniques o MPN: Preseptive, confirmed, completed test o Standard plate count o Fecal Streptococci/Enterococci Testing o DO, BOD, and COD testing o TDS, TSS, TS testing o Membrane filtration	**8**
Unit IV	**Microbial testing of Pharma product** o Good Manufacturing Practices (GMP) o Good Laboratory Practices (GLP) o Environmental Monitoring in Pharma Facilities	**8**

	○ Sampling of pharma product ○ Regulatory aspects of quality control and Quality assurance ○ Sampling and specification of raw materials and finished Products ○ Rapid Microbial Detection Methods ○ Introduction to Regulatory Guidelines & Standards ○ Bacterial Endotoxin and Sterility Testing	

Study Resources

- Prescott, L. M., Hartley, J. P. & Klein, D. A., (1993). Microbiology, 2nd Ed., W. M. C. Brown Publ, England
- Tortora, G. J., Funke, B. R. and Case, C. L., (2004). Microbiology, 8thEd., Person Education (Low Price edition), Delhi
- Pawar, C. B., &Daginawala, H. F. (1998). General Microbiology, Vol.I and II, 1stedition, Himalaya PublishingHouse, Mumbai.
- Pelczar, M. J., Chan, E. C. S. & Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company, Penguin, USA.
- PatilUlhas, Kulkami, J. S., Chaudhari, A. B. &Chincholkar, S. B. (2016). Foundations in Microbiology, 9th ed., NiraliPrakashan, Pune.
- Modi, H. A. (2014). Elementary Microbiology, Vol.1and2, AksharPrakashan, Ahmedabad.

S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-SEC-242:Practical on Microbial identification and analysis

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To acquaint basic knowledge of bacterial and fungal identification ▪ To learn techniques used for the detection of protozoa and algae ▪ To know the microbial test used in food and dairy industry ▪ To learn about microbial testing of air, soil and water	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the skill of bacterial and fungal identification ▪ Get an understanding of detection techniques for microbes from samples ▪ Inculcate the skills used in the food and dairy industry ▪ Acquaint skills related to microbial analysis of air, soil and water	
Sr. No.	**Contents**	**Hours**
1	Preperation of SOP for Weighing balance and autoclave	4
2	Demonstration of good laboratory practices	4
3	To cultivate and study the colonial morphology of any given fungus	4
4	Estimation of Fat in the given milk sample	4
5	Morphological study of yeast using Germtube test	4
6	Microscopic observation of diatoms, flagellates, blue-green algae from stagnant water	4
7	Study of the motility of given bacteria by swarming growth technique	4
8	Enumeration of bacteria from food /milk samples using standard plate count	**4**
9	Determination of efficacy of milk pasteurization using the Phosphatase test	**4**
10	Analysis of laboratory air using an air sampler	**4**
11	Determination of solids of wastewater	**4**
12	To determine the Dissolved Oxygen (DO) of sewage water	**4**
13	Bacterial detection using differential coliform test	**4**
14	Demonstration of LAF and biosafety cabinet	**4**
15	Documentation and report writing in the microbiological industry (anyone)	**4**

Study Resources

- Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi.
- Cappucino, J. & Sherman, N. (2010) Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Delhi.
- Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi.
- Harley, J. P. & Prescott L. M. (2002). Laboratory Exercises in Microbiology, 5th edition,The McGraw-Hill Co., NewYork.
- Parija S. C. (2005). Text Book of Practical Microbiology,1st edition, Ahuja Publishing House, New Delhi.

S.Y. B.Sc. Microbiology (Major)
Semester-IV
MIB-FP-241: Field Project

Total Hours: 60 **Credits: 2**

Objectives

- To provide students with practical exposure in rural and urban socioeconomic contexts.
- To develop students abilities to apply subject knowledge to address real world problems
- To foster critical thinking and innovative approaches to solve socioeconomic issues.

Outcomes

After completing this course, students will be able to

- Participate actively in field projects that benefit local communities and promote sustainable development practices.
- Analyse the socio-economic data using appropriate methods showcasing improved problem-solving skills and technical proficiency.
- Demonstrate the ability to apply theoretical knowledge to real-world situations effectively and exhibit communication skills.

Course structure

The course is divided into four probable phases

I] Orientation and preparation

- Introduce the course, objectives and expectation
- Overview of socioeconomic development issues in a rural and urban context
- Training on working methodology and data collection techniques
- Review existing literature related to topic to understand the background and context.

II] Work plan and Field visit

- Visit the potential sites to get a sense of the environment and logistical requirements.
- Create a detailed project plan that outlines the steps, timeline, resources required, and roles of team members.
- Obtain necessary approvals (Ethical/ local authorities/organizations/communities)
- Gather materials and resources (recording devices, cameras, notebooks and supplies)
- Conduct a Preliminary Survey and choose appropriate methods for data collection and analysis (e.g., surveys, interviews, observations).

III] Data collection and analysis

- Pilot test to identify issues with data collection.
- Collect data systematically to ensure consistency and accuracy.
- Keep detailed records of all data (field notes, recordings, photographs,etc)
- Organize and analyse the data (manual/ software)

IV] Interpretation and Reporting

- Interpret your findings in the context of objectives.
- Write and submit a comprehensive report detailing your methodology, findings, analysis, and conclusions. (Include visuals - charts, graphs, and photographs).
- Prepare a presentation to share findings with peers/ instructors/ community.

Assessment

- Field work participation, field notebook, teamwork etc. (10 Marks)
- Data Collection and Analysis (15 Marks)
- Field project report (15 Marks)
- Presentation of Findings (10 Marks)

S.Y. B.Sc. Microbiology (Minor)
Semester-IV
MIB-MIN-241: Basic Biotechnology

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint students with basic concepts of industrial microbiology. • To understand the process parameters and types of fermentation • To infer the upstream processes in fermentation • To make the students know about inoculum development	
Course outcomes	**After completion of this course, students will be able to** • Understand the process of screening important microbes and designing fermentation media. • Understand the basic design of a fermenter and the overall fermentation process. • Be acquainted with diverse upstream processing before fermentation process • Apply an appropriate approach for inoculum development.	
Unit	**Contents**	**Hours**
Unit I	**Basics of fermentation technology and media** • Characteristics of industrial strains • Screening of industrially essential microorganisms: Primary and Secondary screening examples: vitamin, antibiotic producers • Microbial culture: o Culture collection centres and their role: National (NCIM) International (ATCC) o Preservation of microorganisms: Soil culture, Oil overlay, Liquid nitrogen freezing, Lyophilization o Working and stock culture • Fermentation media: o Basic composition o Criteria for selection and screening of media o Types of media: synthetic, complex and natural o Major raw materials: Carbohydrates, oils & fats, Corn steep Liquor, Soy meals, Molasses, Sulphite liquors, o Minor ingredients: growth factors, precursors, buffers, water, antifoam agent	8
Unit II	**Fermentation equipment and process** • Fermenter: o Criteria for fermenter design o Structure of a Typical Fermenter and its parts: Impeller, baffles, sparger, stuffing box, tc o Measurement and control of fermentation parameters: pH, temperature, dissolved oxygen, foaming and aeration • Fermentation and related processes: o Submerged: Batch, Continuous, Fed-batch o Solid state fermentation: concept, characteristics and applications o Anaerobic versus aerobic fermentation o Immobilized cell/enzyme bioreactor o An overview of general fermentation process with one example	**7**
Unit III	**Upstream processing-I** • Need for aseptic conditions in the fermentation process o Consequences of contamination in fermentation o Measures to avoid contamination • Fermentation media sterilization: o Batch sterilization: Del factor, Methods, Advantages and Disadvantages o Continuous sterilization: Direct and Indirect Heat Exchangers • Filter sterilization: Sterilization of air by Filtration	**8**

	• Methods of strain improvement: o Biosynthetic feedback control pathways o Modification of permeability, e.g. Glutamate fermentation o Mutation for primary metabolite production: o Auxotrophic mutants, e.g. Penicillin selection method o Analogue-resistant mutants, e.g. Gradient plate technique o Revertants: Concept and example o r-DNA technology: Steps involved and Examples	
Unit IV	**Upstream processing-II** • Criteria for selection of culture as inoculum o Development of Inoculum for yeast processes: Brewing and Bakers' yeast • Development of Inoculum for bacterial process, e.g. Vit.B_{12} production (pilot scale) • Development of Inoculum for mycelial processes: o Sporulation on media and use of the spore inoculum o Inoculum development for vegetative fungi o Aseptic inoculation of industrial fermenters	**7**

References

- Casida, L.E (1998) Industrial Microbiology New Age International Publishers, New Delhi
- Crueger, W. and Crueger, A. (2000) Biotechnology: A Textbook of Industrial Microbiology, PanimaPubl Co., New Delhi
- Stanbury, P.F., Whitaker, A. and Halt G. (1995) Principles of Fermentation Technology, Pergamon Press, New York.
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- Modi H.A., (2009), 'Fermentation Technology', Vol.1 & 2, Pointer publications, India

S.Y. B.Sc. Microbiology (Minor)
Semester-IV
MIB-MIN-242: Practical on Basic Biotechnology

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To study screening methods for industrially important microbes ▪ To understand the recovery and analysis of fermented products ▪ To study the immune techniques and diagnostic microbiology	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the basics of screening of microbes for industry ▪ Recover and analyse the fermentation product ▪ Detect blood groups and perform cross-matching. ▪ Infer the diagnostic/ immune techniques in medical microbiology	
Sr. No.	**Contents**	**Hours**
1	Screening of antibiotic-producing microbes by Crowded plate technique and	4
2	Screening of organic acid-producing microbes using the indicator dye method.	4
3	Estimation of Acetic Acid in Vinegar by the Titrimetric Method.	4
4	Determination of alcohol concentration in given fermented broth	4
5	Recovery of organic acid from fermentation broth	4
6	Detection of organic acid using Paper chromatography / Thin Layer chromatography	4
7	Cultivation of fungi using solid-state fermentation (Plate method)	4
8	Determination of ABO and Rh blood group	4
9	Study of blood cross-matching for transfusion.	4
10	Total WBC count using haemocytometer from whole blood	4
11	Study of double diffusion technique by Ouchterlony	4
12	Dot enzyme-linked immunosorbent assay (Dot ELISA).	4
13	Demonstration of cell immobilization	4
14	Demonstration of a typical fermenter	4
15	Field visit / industrial visit to effluent treatment plant	4
Study Resources	▪ Aneja, K.R (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 3rd edition, WishwaPrakashan, New Delhi. ▪ Benson, H. (2001) Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York. ▪ Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi. ▪ Harley, J.P. and Prescott, L.M. (1996) Laboratory Exercise in Microbiology, 3rd ed., WCB/McGraw Hill Publ. Co., London ▪ Jayaraman, I (1981) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi. ▪ Norris, J.R. (1969) Methods in Microbiology Vol. I, 1st edition, Academic Press Inc., London. ▪ Parija, S.C. (2007) Textbook of Practical Microbiology, Ahuja Publishing House, New Delhi. ▪ Plummer, D.T. (2017) An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi. ▪ Sharma, K. (2007) Manual of Microbiology Tools and Techniques, Ane's Book India, New Delhi	

S.Y.B.Sc. Microbiology (Open Elective)
Semester-IV
MIB-OE-241:Sustainable agriculture with microbes

Total Hours: 30 **Credits: 2**

Course objectives	• To acquaint the students with concepts of soil health • To make students aware of the use of biofertilizers • To study methods and agents for bio-control • To understand the role of rDNA technology in agriculture	
Course outcomes	**After completion of this course, students will be able to** • Determine the quality of soil • Prepare biofertilizers • Use biocontrol agents in the agricultural field • Apply knowledge of rDNA technology in agriculture	
Unit	**Contents**	**Hours**
Unit I	**Concepts in Soil Health** • Nature and composition of soil • Life in the soil • Functions of microbes in soil • Soil health:Characteristics of a healthy soil, Common soil constraints • Improvement of soil health	8
Unit II	**Biofertilizers** • Types of biofertilizers: o N_2-fixing bacteria o Phosphorus solubilizing microorganisms (PSM) o Phosphorus mobilizers o Zinc and Silicate solubilizers o Plant growth-promoting rhizobacteria (PGPR) o Fungi as biofertilizers: *Mycorrhiza* • Importance of Biofertilizers • Quality Control of Biofertilizers: e.g. *Rhizobium*	**7**
Unit III	**Biocontrol agents** • Concept of bio-control agent • Need and merits of Biological Control • Basic mode of Action of Biocontrol agents • Examples and applications of biocontrol agents	**8**
Unit IV	**rDNA technology in agriculture** • Principle of Recombinant DNA Technology • Basic tools of recombination DNA technology: Restriction Enzymes, Vectors, hosts, Gene Cloning and transfer • Applications in agriculture	**7**

References

- Dubey, R.C. and Maheshwari D. K (2023) Practical Microbiology, S. Chand and Co., New Delhi.
- Das, H. K. (2005), Textbook of biotechnology, Wiley Dream tech India Pvt. Ltd
- Satyanarayana, U. (2005), Biotechnology, Books and Allied (P) Ltd. Kolkata.
- Maier R.M., Pepper, I.L. &Gerba, C.P. (2009) Environmental Microbiology, 2nded., Academic Press,
- SubbaRao, N.S. (1999) Soil Microbiology, 4th edn., Oxford and IBH Publ. Co., New Delhi.
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- Alexander, M. (1977) Introduction to Soil Microbiology, John Wiley and Sons Inc. New York.
- Bums, R.G. and Slater, J.H. (1982) Experimental Microbial Ecology, Blackwell Scientific Publ., Oxford.
- Atlas, R.M. and Bartha, R. (2000) Microbial Ecology, 4th ed., Benjamin/Cumming Science Publ., USA

Skills acquired and Job prospects for the Microbiology students

Microbiology is one of the most significant subjects exhibiting its impact in human health, industrial production of antibiotics, vaccines, enzymes, fine chemicals, energy sector and social sector like waste treatment, etc. The degree program in Microbiology teaches students how microorganisms are part of human life and how they are helpful in various applications. A significant attraction of the course is its combination of in-depth scientific knowledge with practical laboratory skills and career opportunities across all sectors.

After completing a three-year degree course in Microbiology, students will be well-versed in laboratory skills and transferable skills essential for working in the industrial sector, including laboratories and higher studies.

Laboratory Skills:

- Laboratory safety practices
- Skillful handling of microbial cultures and aseptic techniques
- Proficient handling of fermenters and their parts
- Molecular kit-based and protocol-based analysis
- Advanced techniques like- Chromatography, Electrophoresis, Spectrometry
- Some medical diagnostic techniques like the Widal test, microbial analysis of food and dairy products
- Analysis and interpretation of results and logical thinking

Transferable Skills:

During the course, students will develop skills beyond laboratory skills that are transferable across multiple career areas. These are:

- Analytical skill, Observational skill
- Planning and Time management
- Mathematical and IT skills
- Creative thinking, Problem-solving
- Report writing skill, Presentation skill

Job Opportunities:

Private Sector:

Microbiologists can work in the quality control, quality assurance, and R&D divisions of companies such as pharmaceutical companies, Chemical manufacturing companies, Food and Beverage (including brewing), Health and Beauty Care, and medical instrument companies, as well as agricultural industries and research laboratories.

Public Sector:

It includes National Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries, etc.

Job profiles:

The industrial job profiles may include Microbiologist, Biologist, Biotechnologist, Laboratory Technician, Quality Control and Assurance, and Research and Development, among others. They may also work as scientists, research associates, or officers in clinical biology, pharmaceuticals, biomedicine, forensic science, food and dairy, breweries, and wineries.

Opportunities in higher studies

After completing a B.Sc. in Microbiology, students may continue their studies with an M.Sc. in Microbiology, Biotechnology, or Biochemistry and pursue further higher education. Even students can pursue other courses where graduation is essential.