



Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Microbiology (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of B. Sc. in Microbiology (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

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

Sd/-
Chairman,
Board of Studies

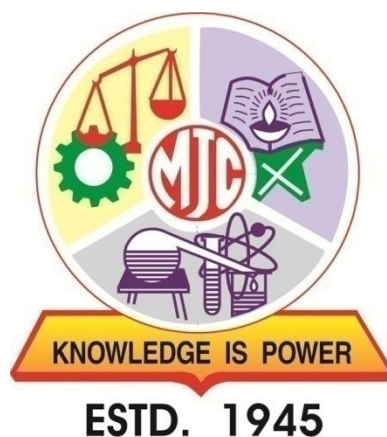
To :

- 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.

Knowledge is Power

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. Honors/Honors with Research
(F.Y.B.Sc. Microbiology)

Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2023-24]

Preface

Skilled human resource is a prerequisite in higher education, and it is to be acquired through thorough knowledge of theoretical concepts and hands-on laboratory methods of the subject. 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 for the first-year undergraduate of Microbiology. The syllabus cultivates theoretical and practical know-how of different fields of Microbiology. The contents of the syllabus have been prepared to accommodate the fundamental aspects of various disciplines of Microbiology and to build the foundation for various applied sectors of Microbiology. Besides this, in the first year, the students will be enlightened with the skill related to microbial identification and testing, which will enhance students' employability.

The overall curriculum of three / four-year covers general microbiology, biomolecules and microbial metabolism, molecular biology and microbial genetics, medical microbiology and immunology, industrial and applied microbiology, environmental microbiology, and also covers various biotechniques. Furthermore, the syllabus is structured to cater to Microbiology's present and future needs in the research field, Industrial Sector, Environmental Sector, Entrepreneurship etc., emphasizing imparting hands-on skills. Hence, the curriculum is endowed with more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

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

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

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 recognize 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.

Program Specific Outcome PSO (B.Sc. Microbiology):

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

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, medical etc.

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

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit										
Level 1	Sem	Major (Core) Subjects		Minor Subjects (MIN)	GE/ OE	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
4.5	I	DSC-1 (2T) DSC-2 (2T) DSC-3 (2P)	—	MIN-1 (2T) MIN-2 (2P)	OE-1 (2T)	SEC-1 (2T) SEC-2 (1P)	AEC-1 (2T) (ENG) VEC-1 (2T) (ES) IKS (1T)	CC-1 (2)	22	UG Certificate 44
	II	DSC-4 (2T) DSC-5 (2T) DSC-6 (2P)	...	MIN-3 (2T) MIN-4 (2P)	OE-2 (2T)	SEC-3 (2T) SEC-4 (1P)	AEC-2 (2T) (ENG) VEC-2 (2T) (CI) IKS (1T)	CC-2 (2)	22	
	Cum. Cr	12	...	8	4	6	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.0	III	DSC-7 (2T) DSC-8 (2T) DSC-9 (2P) DSC-10 (2P)	...	MIN-5 (2T) MIN-6 (2P)	OE-3 (2T) OE-4 (2P)		AEC-3 (2T) (MIL)	CC-3 (2) CEP (2)	22	UG Diploma 88
	IV	DSC-11 (2T) DSC-12 (2T) DSC-13 (2P) DSC-14 (2P)	...	MIN-7 (2T) MIN-8 (2P)	OE- 5 (2T) OE-6 (2P)		AEC-4 (2T) (MIL)	CC-4 (2) FP (2)	22	
	Cum. Cr	28	...	16	10	6	8+4+2	8+2+2	88	
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 and Minor.										
5.5	V	DSC-15 (2T) DSC-16 (2T) DSC-17 (2T) DSC-18 (2P) DSC-19 (2P)	DSE-1 (2T) A/B DSE-2 (2P) A/B	MIN-9 (2T/P)	...	VSC-1 (2T) VSC-2 (2P)	...	OJT/Int(2)	22	UG Degree 132
	VI	DSC-20 (2T) DSC-21 (2T) DSC-22 (2T) DSC-23 (2P) DSC-24 (2P)	DSE-3 (2T) A/B DSE-4 (2P) A/B	MIN-10(2T/P)	—	VSC-3 (2T) VSC-4 (2P)	...	OJT/Int(2)	22	
	Cum. Cr.	48	08	20	10	8+6	8+4+2	8+2+2+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-28 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6(2P) A/B	RM (4T)	—	...	...		22	UG Honors Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-32 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8(2P) A/B		—	...	...	OJT/Int (4)	22	
	Cum. Cr.	76	16	20+4	10	8+6	8+4+2	8+2+2+8	176	
Four Year UG Honors Degree in Major and Minor with 176 credits										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6 (2P) A/B	RM (4T)	...	...	...	RP (4)	22	UG Honors with Research Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8 (2P) A/B		...	...	...	RP (8)	22	
	Cum. Cr.	68	16	20+4	10	8+6	8+4+2	8+2+2+8+12	176	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Note: 2 credit course on Major Specific IKS shall be included under Major subject in FY or SY UG program

DSC : Department-Specific Core course, DSE : Department-Specific elective, GE/OE : Generic/ Open elective, SEC: Skill Enhancement Course; AEC : Ability Enhancement Course; VEC : Value Education Courses; ENG : English; ES: Environmental studies; CI : Constitution of India; IKS : Indian Knowledge System; CC : Co-curricular course; T: Theory; P : Practical; VSEC: Vocational and Skill Enhancement Courses; FP: Field project; MIL: Modern Indian Language

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

F. Y. B. Sc. Microbiology Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
I	DSC	2	2	TH	MIB-DSC-111	Fundamentals of Microbiology with IKS
	DSC	2	2	TH	MIB-DSC-112	Microscopy and Basic Bacteriology
	DSC	2	4	PR	MIB-DSC-113	Practical course on Basic Microbiology
	MIN	2	2	TH	MIB-MIN-111	Basic Microbiology
	MIN	2	4	PR	MIB-MIN-112	Practical course on Basic Microbiology
	OE/GE	2	2	TH	MIB-OE-111	Health and Human Microbiome
	SEC	2	2	TH	MIB-SEC-111	Techniques of Microbial Identification
	SEC	1	2	PR	MIB-SEC-112	Practical course on Microbial Identification
	AEC	2	2	TH	ENGs-AEC-111	English
	VEC	2	2	TH	ES -VEC-111	Environmental studies
	IKS	1	1	TH	IKS-111	Indian knowledge system
	CC	2	2	CC	NCC-CC-111 NSS-CC-111 SPT-CC-111 CUL-CC-111	NCC NSS Sports Cultural
II	DSC	2	2	TH	MIB-DSC-121	Microbial ecology and cytology
	DSC	2	2	TH	MIB-DSC-122	Microbial techniques
	DSC	2	4	PR	MIB-DSC-123	Practical course on Microbial techniques
	MIN	2	2	TH	MIB-MIN-121	Microbes and their control
	MIN	2	4	PR	MIB-MIN-122	Practical course on Microbial techniques
	OE/GE	2	2	TH	MIB-OE-121	Microbial diseases and control
	SEC	2	2	TH	MIB-SEC-121	Methods in microbial testing
	SEC	1	2	PR	MIB-SEC-122	Practical course on Microbial testing
	AEC	2	2	TH	ENGs-AEC-121	English
	VEC	2	2	TH	CI-VEC-121	Constitution of India
	IKS	1	1	TH	IKS-121	Indian knowledge system
	CC	2	2	CC	NCC-CC-121 NSS-CC-121 SPT-CC-121 CUL-CC-121	NCC NSS Sports Cultural

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. while 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.

- External practical examination of SEC will be of 25 marks and there will be no internal exam for SEC practical.

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.

**F.Y.B.Sc.
(Microbiology)
Semester I**

FYBSc (Microbiology)

Semester I

MIB-DSC-111: Fundamentals of Microbiology with IKS

Total Hours: 30

Credits: 2

Course objectives	• To understand the relationship of microbiology in the Indian knowledge system and modern history • To make the student aware of the scope of microbiology • To acquaint concepts in microbial diversity • To understand the various systems used for the classification of microorganisms	
Course outcomes	After successful completion of this course, students are expected to: • Aware of historical developments and contributions of various pioneers • How the subject emerges as a new branch of biology and its current scope • Know the diversity of microorganisms and differences among various microbes • Understand the rules applied for microbial taxonomy	
Unit	Topic Particular	Hours
Unit I	History and IKS in Microbiology ○ Indian Knowledge System in Microbiology ○ Microbiology in Vedas ○ Vedic scientific terms for microorganisms ○ Ancient Indian bacteriology ○ Traditional Indian fermented food ○ Contributions of researchers from Indian origin viz. Ananda Mohan Chakraborty, Subba Rao, Natteri Veeraraghavan, Khem Shahani, R. Ananthanarayan etc. ○ History of microbiology ○ Concept of Spontaneous generation (abiogenesis) and biogenesis. ○ The germ theory of Fermentation and Disease ○ Historical perspective related to Microscopy, Microorganism, Virology, Immunology.	8
Unit II	Scope of Microbiology • Introduction to various branches of microbiology: Bacteriology, virology, phycology, mycology, protozoology • Scope of microbiology in Soil, Agricultural, Geo, Environmental, Food & Dairy, Industrial, Pharmaceutical, Medical Microbiology, Immunology, Molecular biology, Bioinformatics and Nano-technology, Biowarfare etc. • Research institutes/ industries in India related to Microbiology: NIV, MTCC, ARI, NEERI, Serum Institute, Hi Media etc.	7
Unit III	Microbial Diversity • Concept of a prokaryotic and eukaryotic cell • Concept of microbial diversity and diversity index • General characteristics, Morphological features, and significance: ○ Viruses, Virion and Prions ○ Bacteria (Eubacteria, Rickettsia, Mycoplasma, Actinomycetes) and Cyanobacteria ○ Archae ○ Algae ○ Fungi ○ Protozoa	8

Unit IV	Microbial Taxonomy - Whitakers' Five Kingdom system - Carl Woese's three Domain system - Binomial Nomenclature and basic rules - Methods in Microbial Taxonomy: Cultural, Biochemical and Molecular Characteristics, Numerical taxonomy, Chemotaxonomy, Phylogenetic taxonomy, polyphasic approach	7
References - Tortora, G. J., Funke, B. R., & Case, C. L. (2008). Microbiology: An Introduction (9thed.). Pearson Education, New Delhi. - Talaro, K. & Chess, B. (2012). Foundations in Microbiology (8th ed.). The McGraw-Hill Companies, Inc., New York. - Tortora, Funke, and Case (2010) Microbiology, 10th edition, Brenjamine Cummings Inc., California. - Patil U. K., Kulkarni, J. S., Chaudhari, A. B., & Chincholkar, S. B. (2016). Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune - Frobisher, M. Hinsdill, Crabtree, and Goodheart, (1974). Fundamentals of Microbiology, 9th edition, WB Saunder's Co., USA. - Dubey, R. C., & Maheshwari, D. K. (2005). Text Book of Microbiology, S Chand and Co, New Delhi - Kuhad, U., Goel, G., Maurya, P. K., & Kuhad, R. C. (2021). Sukshmjeevanu in Vedas: The Forgotten Past of Microbiology in Indian Vedic Knowledge. Indian Journal of Microbiology, 61, 108-110. - Sircar, N. N. (1991). Ancient Indian Bacteriology. Ancient Science of Life, 10(3), 180. - Frend, C. (2006). Microbiology in the Veda. Vedic sciences, 8(4), 27-34.		

FYBSc (Microbiology)

Semester I

MIB-DSC-112: Microscopy and Basic Bacteriology

Total Hours: 30

Credits: 2

Course objectives	- To understand the basic knowledge of microscopy - To make aware the students concerning stain and staining techniques - To know concepts related to the growth and reproduction of bacteria - To understand the physical and chemical parameters for bacterial growth	
Course outcomes	After successful completion of this course, students are expected to: - Understand the theory in microscopy and their handling techniques - Differentiate microorganisms based on staining - Know the concepts of growth and quantitative measurement of bacterial growth - Know the various physical/ chemical growth requirements of bacteria	
Unit	Topic Particular	Hours
Unit I	Microscopy - Basics of Microscopy: Magnification, Resolution, Numerical Aperture, Illumination System. - Bright-field and Dark field microscope. - Compound Microscope: Principle with Ray diagram,	7

	construction, lens systems, working ○ Immersion oil and its use in a compound microscope ○ Concept and types of aberrations, correction for aberrations ○ Handling and care of the microscope	
Unit II	Staining • Concepts of Dyes and Stains • Types of stain (Acidic, Neutral and Basic) • Mordant and fixative • Theory of Staining (Physical and Chemical) • Preparation and fixation of smear • Methods of Staining ○ Simple (Monochrome and Negative) ○ Differential (Gram and Acid fast) • Staining of organelles: Cell wall, Flagella, Nucleus, Metachromatic/Volutin granules, Capsule, endospore	8
Unit III	Growth and Reproduction of Bacteria • Concept of growth and reproduction, mechanism of binary fission, fragmentation, budding • Mathematical expression of growth, growth curve, generation time and growth rate • Batch culture and typical growth curve of bacterial population and its application, Diauxic growth • Quantitative measurement of bacterial growth: determination of cell number, cell mass and cell activity • Synchronous and continuous culture growth with applications in microbiology Algae, Fungi and Protozoa	7
Unit IV	Microbial Nutrition • Physical parameters affecting growth: pH, temperature, water activity, Oxygen • Types of bacteria based on their adaptations ○ Temperature requirement (psychrophiles, mesophiles, thermophiles, thermophilic, psychrotrophic) ○ pH requirement (acidophiles, neutrophiles and alkaliphiles) ○ Salt/solute and water activity (halophiles, xerophiles, osmophilic) ○ Oxygen requirement (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe) ○ Pressure (barophile). • Elements of Nutrition: Major (C, N, H, O, S & P) and Minor (Salts, growth factors) • Media ingredients (water, peptone, malt extract, meat extract, yeast extract, trace elements, growth factor) • Types of media: complex, synthetic, natural, selective, differential, enriched media • Enrichment culture technique • Concept of Auxotroph and Prototroph • Classification of bacteria based on nutrition: Phototroph (Photo-autotroph, Photo-heterotroph) and Chemotroph (Chemo-autotroph, Chemo-heterotroph)	8

References

- Wiley, J. M., Sherwood, L. M. & Woolverton, C. J. (2013). Prescott's Microbiology. 9th edition. McGraw Hill International, NewYork.
- Madigan, M. T., Martinko, J. M., Dunlap, P. V. & Clark, D. P. (2014). Brock Biology of Microorganisms, 14th edition, Pearson International Edition, NewDelhi.
- Pelczar, M. J., Chan, E. C. S. & Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company, NewYork.
- Tortora, G. J. Funke B. R. & Case, C. L. (2010). Microbiology, 10th edition, Benjamin Cummings Inc, California.
- Patil, U., Kulkarni, J. S., Chaudhari, A. B. & Chincholkar, S. B. (2016). Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune.
- Modi, H. A. (2014) Elementary Microbiology, Vol.1 and 2, Akshar Prakashan, Ahmedabad.

FYBSc (Microbiology)**Semester I****MIB-DSC-113: Practical course on Basic Microbiology****Total Hours: 60****Credits: 2**

Course objectives	• To acquaint basic microbiological instruments and techniques • To study various microorganisms present in the ecosystem • To observe and learn the microbes using various staining techniques • To characterize the microbes using biochemical tests	
Course Outcomes	After successful completion of this course, students are expected to: • Understand the basic microbial practices, instruments, appropriate protective and emergency procedures • Study the comparative characteristics of prokaryotes and eukaryotes • Learn theory and practical skills in microscopy, staining procedures and growth • Comprehend the various methods for the identification of microorganisms	
Sr. No.	Topic Particular	Hours
1	Microbiology Good Laboratory Practices, laboratory rules and first aids.	4
2	To study the principle, working and application of instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, Balance) used in the microbiology laboratory	4
3	Acquainting basic microbiology techniques I: Types of laboratory glassware, Cleaning and washing of Glassware, biosafety measures, disinfection of working table and hands, biological waste Disposal, Use of Microbial culture and its storage	4
4	Acquainting basic microbiology techniques II: Preparation of culture media for bacterial cultivation, Cotton Plugging, Wrapping the items prior to sterilization, sterilization with autoclave, Aseptic handling (LAF/ Bunsen burner), preparation of plates and slants, inoculation of bacterial culture and inoculating needle, labelling of incubation material, preservation.	4

5	Use and Care of Compound Microscope with functions of each part	4
6	Study of microbes with using temporary mounts/ permanent slides • Fungus e.g. <i>Rhizopus</i>/ <i>Penicillium</i>/ <i>Aspergillus</i>/ <i>Fusarium</i> • Algae/BGA e.g. <i>Spirogyra</i>/ <i>Anabena</i>/ <i>Nostoc</i>/ Cyanobacteria • Protozoans e.g. <i>Amoeba</i>/ <i>Entamoeba</i>/ <i>Paramecium</i>/ <i>Plasmodium</i>	4
7	Study of colony characteristics of different bacteria (e.g. <i>Escherichia coli</i> , <i>Staphylococcus aureus</i>)	4
8	Study of Biochemical characterization through IMViC test	4
9	Study of biochemical characterization through TSI and Sugar fermentation	4
10	Study of bacterial morphology using Monochrome Staining	4
11	Study of morphological features of bacteria using Negative Staining	4
12	Study of Gram characteristics of bacteria using Gram's Staining	4
13	Study of acid fast characteristics of bacteria using Acid fast staining (<i>Nocardia</i> spp/ Atypical mycobacteria)	4
14	Effect of pH on growth of bacteria	4
15	Effect of temperature on growth of bacteria	4

References

- 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.
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- 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.(1996), Experiments in Microbiology, 3rd edition,Wishwa Prakashan, New Delhi.

FYBSc (Microbiology)
Semester I
MIB-MIN-111 Basic Microbiology

Total Hours: 30

Credits: 2

Course objectives	- To acquaint concepts in microbial diversity - To make aware the students concerning stain and staining techniques - To know concepts related to the growth and reproduction of bacteria - To understand the physical and chemical parameters for bacterial growth	
Course outcomes	Successful completion of this course, students are expected to: - Know the diversity of microorganisms and differences among various microbes - Differentiate microorganisms based on staining - Know the concepts of growth and quantitative measurement of bacterial growth - Know the various physical/ chemical growth requirements of bacteria	
Unit	Topic particulars	Hours
Unit I	Microbial Diversity - Concept of a prokaryotic and eukaryotic cell - Concept of microbial diversity and diversity index - General characteristics, Morphological features, and significance: - Viruses, Virion and Prions - Bacteria (Eubacteria, Rickettsia, Mycoplasma, Actinomycetes,) and Cyanobacteria - Archae - Algae - Fungi - Protozoa	08
Unit II	Microscopy and staining - Basics of Microscopy: Magnification, Resolution, Numerical Aperture, Illumination System. - Compound Microscope: Principle with Ray diagram, construction, lens systems, working - Immersion oil and its use in a compound microscope - Concepts of Dyes and Stains - Types of stain (Acidic, Neutral and Basic) - Mordant and fixative - Theory of Staining (Physical and Chemical) - Methods of Staining: Simple (Monochrome and Negative), Differential (Gram)	06
Unit III	Growth and Reproduction of Bacteria - Concept of growth and reproduction, mechanism of binary fission, fragmentation, budding - Batch culture and typical growth curve of bacterial population and its application. - Quantitative measurement of bacterial growth: determination of cell number, cell mass and cell activity - Synchronous and continuous culture growth with applications in microbiology	08

Unit IV	Microbial Nutrition - Physical parameters affecting growth: pH, temperature, water activity, Oxygen - Types of bacteria based on their adaptations - Temperature requirement (psychrophiles, mesophiles, thermophiles, thermodurics, psychrotrophs), - pH requirement (acidophiles, neutrophiles and alkaliphiles), - Salt/solute and water activity (halophiles, xerophiles, osmophilic), - Oxygen requirement (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), - Pressure (barophile). - Elements of Nutrition: Major (C, N, H, O, S & P) and Minor (Salts, growth factors) - Media ingredients (water, peptone, malt extract, meat extract, yeast extract, trace elements, growth factor) - Types of media: complex, synthetic, natural, selective, differential, enriched media - Enrichment culture technique	08
References - Wiley, J. M., Sherwood, L. M. & Woolverton, C J. (2013) Prescott's Microbiology. 9th edition. McGraw Hill International, NewYork - Madigan, M. T., Martinko, J. M, Dunlap P. V. & Clark, D. P. (2014). Brock Biology of Microorganisms, 14thedition, Pearson International Edition, NewDelhi, - Tortora, Funke and Case (2010). Microbiology, 10thedition, Brenjamine Cummings Inc, California. - Patil Ulhas, Kulkarni J. S., Chaudhari, A. B. & Chincholkar, S. B. (2016). Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune. - Modi, H. A. (2014) Elementary Microbiology, Vol.1 and 2, Akshar Prakashan, Ahmedabad. - Frobisher, M. Hinsdill, Crabtree and Goodheart (1974). Fundamentals of Microbiology, 9th edition, WB Saunder's Co. USA. - Pelczar, M. J., Chan, E. C. S. & Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company, NewYork.		

FYBSc (Microbiology)

Semester I

MIB-MIN-112 Practical course on Basic Microbiology

Total Hours: 60

Credits: 2

Course objectives	- To acquaint basic microbiological instruments and techniques - To study various microorganisms present in the ecosystem - To observe and learn the microbes using various staining techniques - To characterize the microbes using biochemical tests
Course Outcomes	After successful completion of this course, students are expected to: - Understand the basic microbial practices, instruments, appropriate protective and emergency procedures - Study the comparative characteristics of prokaryotes and eukaryotes - Learn theory and practical skills in microscopy, staining procedures and growth

	Comprehend the various methods for the identification of microorganisms	
Sr. No.	Topic Particular	Hours
1	Microbiology Good Laboratory Practices, laboratory rules and first aids.	4
2	To study the principle, working and application of instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, Balance) used in the microbiology laboratory	4
3	Acquainting basic microbiology techniques I: Types of laboratory glassware, Cleaning and washing of Glassware, biosafety measures, disinfection of working table and hands, biological waste Disposal, Use of Microbial culture and its storage	4
4	Acquainting basic microbiology techniques II: Preparation of culture media for bacterial cultivation, Cotton Plugging, Wrapping the items prior to sterilization, sterilization with autoclave, Aseptic handling (LAF/ Bunsen burner), preparation of plates and slants, inoculation of bacterial culture and inoculating needle, labelling of incubation material, preservation.	4
5	Use and Care of Compound Microscope with functions of each part	4
6	Study of microbes with using temporary mounts/ permanent slides Fungus e.g. <i>Rhizopus</i> / <i>Penicillium</i> / <i>Aspergillus</i> / <i>Fusarium</i> Algae/BGA e.g. <i>Spirogyra</i> / <i>Anabena</i> / <i>Nostoc</i> / <i>Cyanobacteria</i> Protozoans e.g. <i>Amoeba</i> / <i>Entamoeba</i> / <i>Paramecium</i> / <i>Plasmodium</i>	4
7	Study of colony characteristics of different bacteria (e.g. <i>Escherichia coli</i> , <i>Staphylococcus aureus</i>)	4
8	Study of Biochemical characterization through IMViC test	4
9	Study of biochemical characterization through TSI and Sugar fermentation	4
10	Study of bacterial morphology using Monochrome Staining	4
11	Study of morphological features of bacteria using Negative Staining	4
12	Study of Gram characteristics of bacteria using Gram's Staining	4
13	Study of acid fast characteristics of bacteria using Acid fast staining (<i>Nocardia</i> spp/ Atypical mycobacteria)	4
14	Effect of pH on growth of bacteria	4
15	Effect of temperature on growth of bacteria	4

References

- 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. & Maheshwari, D. K. (2004). Practical Microbiology, 1st edition, S.Chand and Co., Delhi.
- Harley, J. P. & Prescott L. M. (2002). Laboratory Exercises in Microbiology, 5th

edition, The McGraw-Hill Co., New York.

- Benson, H. (2001). Microbiological Applications Lab Manual, 8th edition, The McGraw-Hill Companies, New York.
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FYBSc (Microbiology)

Semester I

MIB-OE-111 Health and Human Microbiome

Total Hours: 30

Credits: 2

Course objectives	• To acquaint basic knowledge of human health and body defence • To study balanced diet and concept of hygiene • To learn different systems of human body • To get aware about microbes associated with human	
Course outcomes	After successful completion of this course, students are expected to: • Understand the importance of good health and immunity • Aware about balance nutrition and importance of hygiene • Get the understanding of different human system and their functioning • Comprehend the microbes associated with human	
Unit	Topic particular	Hours
Unit I	Human Health • Introduction to health and its determinant • Immunity: body's defence mechanism • Types of immunity • The cells and organs of the immune system • Concept of antigen and antibody	7
Unit II	Balance nutrition and hygiene • Introduction to nutrition • Types of nutrients – carbohydrates, fats, proteins, vitamins, minerals • Balanced diet, Optimum and good nutrition, malnutrition • Concept of hygiene • Personal, community and medical hygiene • Good practices for hygiene • The consequence of poor hygiene	7
Unit III	Human Anatomy • Respiratory • Gastrointestinal • Central nervous system • Excretory system • Reproductive system • Special senses – skin, eye, ear	8

Unit IV	Human Microbiome • Normal, resident and transient flora • Concept of Pro and prebiotic • The beneficial effect of normal flora • Microflora of human body • Microorganism and infection	8
References • Anantnarayan, P. & Paniker, C. K. J., (2009), Textbook of Microbiology 8thEd, Universities Press, Hyderabad. • Atlas, R. M. (1995). Microorganisms in our world, Mosby Year Book Inc. • Chakraborty, P. (2013). A text book of Microbiology, New Central Book, Agency, Delhi. • Dey, N. C. & Dey, T. K., (1999) Medical Bacteriology and Microbiology, 16th Ed, Allied Agency, Calcutta. • 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. & Case, C. L., (2004), Microbiology, 8thEd., Person Education (Low Price edition), Delhi.		

FYBSc (Microbiology)
Semester I
MIB-SEC-111 Techniques of Microbial Identification
Total Hours: 30 **Credits: 2**

Course objectives	- To acquire 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 about 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 advanced technique in microbial identification.	
Unit	Topic particular	Hours
Unit I	Identification of Bacteria - Bergey's System of Bacterial Classification: structure, scheme and Overview - Morphological types and staining techniques for identification - Cultural, colonial and growth characteristics - Resistance to antibiotics - Fermentation and biochemical properties - Rapid identification methods	8
Unit II	Identification of Fungi - Introduction to classification fungi - Morphology of fungi and spore types - Field notes, drawings and photographs - Wet mount: lactophenol and KOH preparation - Slide culture, germ tube test - Biochemical tests	8
Unit III	Detection of microbes from pathological and ecological samples - Examination of a faecal specimen for parasite and protozoa - Saline wet mount, iodine wet mount, - lactophenol cotton blue and Leishman staining - 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 techniques - PCR technique for DNA amplification 16 s / 18 s rRNA technique - Biolog microbial identification system - Serological techniques - Nucleic acid probes	7

References

- 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. & Maheshwari, D. K. (2004). Practical Microbiology,1st edition, S.Chand and Co., 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. (1996). Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.

FYBSc (Microbiology)**Semester I****MIB-SEC-112 Practical course on Microbial identification****Total Hours: 30****Credits: 1**

Course objectives	• To acquaint basic knowledge of bacterial and fungal identification • To learn techniques used for the detection of protozoa and algae	
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	
Sr. No.	Topic Particular	Hours
1	Preparation of SOP for Balance and autoclave	4
2	MSDS for hazardous laboratory chemicals / solutions	4
3	To cultivate and study the colonial morphological of any given fungus	4
4	Microscopic observation of fungi using KOH mount	4
5	Morphological study of yeast using Germ tube test	4
6	Microscopic observation of diatoms, flagellates, blue-green algae from stagnant water	4
7	To study the motility of given bacteria by swarming growth technique	4
8	Detection of enzymes: Catalase and urease	4

References

- Cappucino, J. & Sherman, N. (2010) Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Delhi.
- Dubey, R. C. & Maheshwari, D. K. (2004). Practical Microbiology,1st edition, S.Chand and Co., 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.

**F.Y.B.Sc.
(Microbiology)
Semester II**

FYBSc (Microbiology)
Semester II
MIB-DSC-121 Microbial ecology and cytology

Total Hours:30

Credits: 2

Course objectives	- To acquaint students with basic concepts of Microbial Ecology and Interactions - To get aware of microbes in extreme environment - To illustrate the prokaryotic cell structure - To elucidate the eukaryotic cell structure	
Course outcomes	After successful completion of this course, students are expected to: - Learn the importance of microbial interaction in the ecosystem - Summarize features and applications of microbes in extreme environment - Understand the structural architecture and differences among bacteria - Apprehend the structural architecture and differences among Eukaryotic cells	
Unit	Topic particular	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 - Mycorrhiza - Lichen - Ruminantsymbiosis - Bacterial bioluminescence	08
Unit II	Microbes in Extreme Environment - General introduction, features, examples, and applications of the following - Thermophiles - Psychrophiles - Acidophiles - Alkaliphiles - Barophiles - Halophiles	06
Unit III	Anatomy of Prokaryotic cell - Ultra-structure of a bacterial cell: cell size, shape and arrangement, - Structure, Function and Chemical Composition of Glycocalyx/ capsule, flagella, Pilli, Cell wall, spheroplasts, protoplasts, and L-forms - Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell - Nucleolus, Nucleoid, Mesosomes, Plasmid, Ribosome, Cytoplasmic	08

	inclusions (volutin granules, PHB granule, glycogen, carbohydrates, Magnetosomes, gas vesicles, carboxysomes, chlorosome and sulphur granules). • Endospore structure and formation	
Unit IV	Anatomy of Eukaryotic cell - Ultra-structure of Fungal, Algal and Protozoal Cell - Structure, Function and Chemical Composition of Flagella, Cell wall, Nucleus, Mitochondria, Chloroplast, Golgi bodies, Ribosome, Lysosome	08
References - Black, J. G. (2008). Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey. - Madigan, M. T. & Martinko, J. M. (2014). Brock Biology of Microorganisms, 14th edition, Parker J. Prentice Hall International, Inc., New Jersey. - Stanier, R. Y, Ingraham, J. L, Wheelis, M. L. & Painter, P. R. (2005), General Microbiology, 5th edition, McMillan, London - Salle, S. J. (1974). Fundamental Principles of Bacteriology, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi. - Willey, J. M, Sherwood, L. M., & Woolverton, C. J. (2013) Prescott's Microbiology, 9th edition, McGraw Hill Higher Education, New Delhi. - Patil, U. K, Kulkarni, J. S, Chaudhari, A. B. & Chincholkar, S. B. (2016) Foundation in Microbiology, 9th edition, Nirali Prakashan, Pune		

FYBSc (Microbiology)
Semester II
MIB-DSC-122: Microbial Techniques

Total Hours: 30

Credits 02

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	Topic particular	Hours
Unit I	Isolation and Cultivation of Microbes - Enrichment methods for bacteria - Cultural techniques for bacteria: Streak plate, Pour plate, Spread plate - Cultivation of anaerobes: Roll tube method, anaerobic jar and anaerobic cabinet/ chamber - Cultivation of fungi, Blue green algae	08

	• Cultivation of animal and plant viruses (living animals, embryonated eggs and cell line cultures). • Cultivation of bacteriophage	
Unit II	Concept of aseptic condition and control of microbes • Aseptic condition: necessity and application • Personal protection equipment • Aseptic inoculation: use of Bunsen burner, LAF, biosafety cabinets • Fumigation, sanitation, desk cleaning, waste disposal • Control of microbes by Low Temperature, Desiccation, Osmotic pressure, Surface tension. • Pasteurization (HTST, UHT)	08
Unit III	Control of Microbes by Disinfection • Disinfection: Concept of disinfectant and characteristic of an ideal disinfectant, Phenol coefficient (Rideal–Walker coefficient) ○ Conditions Influencing the Effectiveness of antimicrobial agents ○ Concept of: Antiseptic, Sanitizer, Germicide, Antibiotics, Microbiocide, Microbiostasis. ○ Mode of action and applications of Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, H₂O₂.	06
Unit IV	Control of Microbes by Sterilization • Concept of sterilization, TDT and TDP • Concept of D, Z and F value • Physical methods: Dry heat (Hot air oven, Incineration), Moist heat (Autoclave, Tyndallisation) and Radiation-(X-rays, Gamma rays and UV rays) • Sterilization by Filtration: Membrane filter, LAF (HEPA), Nucleopore filters • Chemical methods: Ethylene oxide and Formaldehyde • Indicators of Sterilization: Chemical and Biological system • Validation of sterility in autoclave and LAF	08

References

- Pawar, C. B. & Dagainawala, H. F. (1998). General Microbiology, Vol.I and II, 1st edition, Himalaya Publishing House, Mumbai.
- Black, J. G. (2008) Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey.
- Madigan, M. T. & Martinko, J. M. (2014). Brock Biology of Microorganisms, 14th edition, Parker J. Prentice Hall International, Inc., New Jersey.
- Frobisher, M. Hinsdill, R., Crabtree, K. T., & Goodheart, C. R. (1974). Fundamentals of Microbiology, 9th edition, WB Saunders's Co., Many, USA.
- Pelczar, M. J, Chan, E. C. S. & Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company, Penguin, USA.
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- Modi, H. A. (2014). Elementary Microbiology, Vol.1 and 2, Akshar Prakashan, Ahmedabad.

FYBSc (Microbiology)**Semester II****MIB-DSC-123: Practical course on Microbial Techniques****Total Hours: 60****Credits: 2**

Course objectives	• To know the staining procedures for bacterial structures • To learn the isolation and cultivation techniques for bacteria • To understand the microflora monitoring from air, water and soil • To validate the instruments and evaluate the disinfectant	
Course Outcomes	After successful completion of this course, students are expected to: • Stain the bacterial structures using special staining techniques • Use pure culture and selective techniques to enrich and isolate microorganisms. • Enumerate microflora from different ecological samples • Validate and evaluate instruments and disinfectant	
Sr. No.	Topic Particular	Hours
1	Study of motility of bacteria by hanging drop/ swarming growth	4
2	Perform the Capsule staining	4
3	Perform the Endospore staining	4
4	Isolation of bacteria from enriched soil sample by Streak Plate technique	4
5	Isolation of bacteria from water sample by spread plate technique	4
6	Slide culture technique for fungi	4
7	Determination of Colony Forming Unit (cfu) by pour plate method from soil/ water sample	4
8	Use of selective media for bacteria e.g. MacConkeys agar/ EMB agar/SS agar	4
9	Effect of heavy metal (s) on growth of bacteria and demonstration of oligodynamic action	4
10	Study micro-flora of the air using settling velocity	4
11	Microscopic observation of Rhizobacteria from root nodules /mycorrhizal spores from soil	4
12	Evaluation of skin disinfectant (alcohol/ soap/ Dettol) using Rideal–Walker coefficient	4
13	Preparation of standard solutions (Normal/ Molar/ Percentage)	4
14	Validation of autoclave using chemical indicator	4
15	Demonstration of bacterial growth by spectrophotometer	4

References

- Atlas, R. M. (1997). Principles of Microbiology, 2nd edition, W.M.T. Brown Publishers.
- Cappuccino, J. & Sherman, N. (2010). Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Jersey.
- Parija, S. C. (2005). Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi.
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- Aneja, K. R. (1996). Experiments in Microbiology, 3rd edition, Wishwa Prakashan, New Delhi.

FYBSc (Microbiology)
Semester II
MIB-MIN-121: Microbes and their control

Total Hours: 30

Credits 02

Course objectives	- To illustrate the prokaryotic cell structure - To illustrate the different methods for the isolation and cultivation of microbes - To relate control of microbes with an aseptic condition - To learn disinfection and sterilization as a process to control microbes	
Course outcomes	After successful completion of this course, students are expected to: - Understand the structural architecture and differences among bacteria - Know microbial techniques for isolation of pure cultures of bacteria, fungi, algae and virus - Deduce the skills related to aseptic handling of microbial cultures - Apply the knowledge to control microbes using disinfection and sterilization	
Unit	Topic particular	Hours
Unit I	Anatomy of Prokaryotic cell - Ultra-structure of a bacterial cell: cell size, shape and arrangement, - Structure, Function and Chemical Composition of Glycocalyx/ capsule, flagella, Pilli, Cell wall, spheroplasts, protoplasts, and L-forms - Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell - Nucleolus, Nucleoid, Mesosomes, Plasmid, Ribosome, Cytoplasmic inclusions (volutin granules, PHB granule, glycogen, carbohydrates, Magnetosomes, gas vesicles, carboxysomes, chlorosome and sulphur granules). - Endospore structure and formation	08
Unit II	Isolation and Cultivation of Microbes - Enrichment methods for bacteria - Cultural techniques for bacteria: Streak plate, Pour plate, Spread plate - Cultivation of anaerobes: Roll tube method, anaerobic jar and anaerobic cabinet/ chamber - Cultivation of fungi, Blue green algae - Cultivation of animal and plant viruses (living animals, embryonated eggs and cell line cultures). - Cultivation of bacteriophage	08
Unit III	Concept of aseptic condition and control of microbes - Aseptic condition: necessity and application - Personal protection equipment - Aseptic inoculation: use of Bunsen burner, LAF, biosafety cabinets - Fumigation, sanitation, desk cleaning, waste disposal - Control of microbes by Low Temperature, Desiccation, Osmotic pressure, Surface tension. - Pasteurization (HTST, UHT)	08

Unit IV	Control of Microbes by Disinfection and Sterilization - Disinfection: Concept of disinfectant and characteristics of an ideal disinfectant - Concept of: Antiseptic, Sanitizer, Germicide, Antibiotics, Microbiocide, Microbiostasis. - Mode of action and applications of Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals Detergents, H₂O₂. - Physical methods: Dry heat (Hot air oven), Moist heat (Autoclave) and Radiation-(UV rays) - Sterilization by Filtration: Membrane filter, LAF (HEPA), Nucleopore filters - Chemical methods: Ethylene oxide and Formaldehyde	06
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References

- Pawar, C. B., & Dagainawala, H. F. (1998) General Microbiology, Vol.I and II, 1st edition, Himalaya Publishing House, Mumbai.
- Black, J. G. (2008). Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey.
- Madigan, M. T. & Martinko, J. M. (2014). Brock Biology of Microorganisms, 14th edition, Parker J. Prentice Hall International, Inc., New Jersey.
- Frobisher, M., Hinsdill, R., Crabtree, K. T., & Goodheart, C. R. (1974). Fundamentals of Microbiology, 9th edition, WB Saunders' Co., Many, USA.
- Pelczar, M. J., Chan, E. C. S. & Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company, Penguin, USA.
- Patil Ulhas, Kulkarni, J. S., Chaudhari, A. B. & Chincholkar, S. B. (2016) Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune.
- Modi, H. A. (2014). Elementary Microbiology, Vol.1 and 2, Akshar Prakashan, Ahmedabad.

FYBSc (Microbiology)

Semester II

MIB-MIN-122: Practical course on microbial techniques

Total Hours: 60

Credits: 2

Course objectives	- To know the staining procedures for bacterial structures - To learn the isolation and cultivation techniques for bacteria - To understand the microflora monitoring from air, water and soil - To validate the instruments and evaluate the disinfectant
Course Outcomes	After successful completion of this course, students are expected to: - Stain the bacterial structures using special staining techniques - Use pure culture and selective techniques to enrich and isolate microorganisms. - Enumerate microflora from different ecological samples - validate and evaluate instruments and disinfectant

Sr. No.	Topic Particular	Hours
1	Study of motility of bacteria by hanging drop/ swarming growth	4
2	Perform the Capsule staining	4
3	Perform the Endospore staining	4
4	Isolation of bacteria from enriched soil sample by Streak Plate technique	4
5	Isolation of bacteria from water sample by spread plate technique	4
6	Slide culture technique for fungi	4
7	Determination of Colony Forming Unit (cfu) by pour plate method from soil/ water sample	4
8	Use of selective media for bacteria e.g. MacConkeys agar/ EMB agar/SS agar	4
9	Effect of heavy metal (s) on growth of bacteria and demonstration of oligodynamic action	4
10	Study micro-flora of the air using settling velocity	4
11	Microscopic observation of Rhizobacteria from root nodules /mycorrhizal spores from soil	4
12	Evaluation of skin disinfectant (alcohol/ soap/ Dettol) using Rideal–Walker coefficient	4
13	Preparation of standard solutions (Normal/ Molar/ Percentage)	4
14	Validation of autoclave using chemical indicator	4
15	Demonstration of bacterial growth by spectrophotometer	4

References

- Atlas, R. M. (1997). Principles of Microbiology, 2nd edition, WM.T.Brown Publishers, USA.
- Cappuccino, J. & Sherman N. (2010). Microbiology: A Laboratory Manual, 9th edition, Pearson Education Limited, New Jersey.
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FYBSc (Microbiology) Semester II

MIB-OE-121 Microbial diseases and control

Total Hours: 30

Credits 02

Course objectives	• To know the concept in medical microbiology • To study about Bacterial and fungal diseases • To learn about viral and protozoal diseases • To make aware about control, prevention and treatment of diseases
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Course outcomes	After successful completion of this course, students are expected to: • Understand the fundamentals of medical microbiology • Know diseases with respect to the few bacterial and fungal causative agent • Learn diseases with respect to the few viral and protozoal causative agents . • Deduce the control, prevention and treatment of diseases	
Unit	Topic particular	Hours
Unit I	Concept in medical microbiology ○ Disease-causing agent ○ Types of diseases – Acquired (infections, noninfectious), congenital, ○ Infection: types, source and transmission ○ Signs, symptoms and syndromes ○ Microbial pathogenicity ○ Diagnosis ○ Prevention and treatment	7
Unit II	Bacterial and fungal disease Diseases with respect to the causative agent, pathogenicity, lab diagnosis, prevention and treatment ○ Enteric fever ○ Pneumonia ○ Dermatitis ○ Candidiasis	7
Unit III	Viral and protozoal disease Diseases with respect to the causative agent, pathogenicity, lab diagnosis, prevention and treatment ○ COVID-19 ○ Rabies ○ Malaria ○ Ameboic dysentery	8
Unit IV	Control, prevention and treatment ○ Vaccination – example and schedule ○ Examples of chemotherapeutic agents – drugs, toxoids, interferons ○ Antimicrobial agents examples – antibacterial, antifungal, antiprotozoal ○ Concept of Multiple drug resistance	8
References • Anantnarayan, P., Paniker, C. K. J., (2009). Textbook of Microbiology 8thEd, Universities Press, Hyderabad. • Atlas, R. M. (1995). Microorganisms in our world, Mosby Year Book Inc. • Chakraborty, P. (2013). A text book of Microbiology, New Central Book, Agency, Delhi. • Dey, N. C. & Dey, T. K., (1999). Medical Bacteriology and Microbiology, 16th Ed, Allied Agency, Calcutta. • 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. • Dubey, R. C., & Maheshwari, D. K. (2005). Text Book of Microbiology, S Chand and Co, New Delhi.		

FYBSc (Microbiology)
Semester II
MIB-SEC-121: Methods in Microbial Testing

Total Hours: 30

Credits 02

Course objectives	- To know the microbial test used in the food and dairy industry - To learn about microbial testing of air and soil - To learn about microbial water analysis - To make aware of quality testing in pharmaceutical industries	
Course outcomes	After successful completion of this course, students are expected to: - Inculcate the skills used in the food and dairy industry - Acquaint the skills related to the microbial analysis of air and soil. - Comprehend microbial water analysis and its permissible limits. - Deduce the quality and regulatory aspects of pharma products	
Unit	Topic particular	Hours
Unit I	Microbial testing of food and dairy - Sampling of food/ dairy products - Serial dilution and agar plate technique - Breed count - Resazurin, MBRT, phosphatase test - Mycotoxin detection	7
Unit II	Microbial testing of air and soil - Air sampling - Impingement of air in medium - Active (use of air sampler) and passive monitoring (settling velocity) - Sampling technique for Soil - Total viable count - NPK analysis	7
Unit III	Microbial testing of water - Multiple tube test: Preseptive, confirmed, completed test - Standard plate count - DO, BOD, and COD testing - TDS, TSS, TS testing - Membrane filtration	8
Unit IV	Microbial testing of Pharma product - Good Manufacturing Practices (GMP) - Good Laboratory Practices (GLP) - Sampling of pharma product - Regulatory aspects of quality control - Quality assurance - Sampling and specification of raw materials and finished Products	8
References - 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., & Dagainawala, 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.
- Patil Ulhas, Kulkarni, J. S., Chaudhari, A. B. & Chincholkar, S. B. (2016). Foundations in Microbiology, 9th edition, Nirali Prakashan, Pune.
- Modi, H. A. (2014). Elementary Microbiology, Vol.1 and 2, Akshar Prakashan, Ahmedabad.

FYBSc (Microbiology)

Semester II

MIB-SEC-122: Practical course on Microbial testing

Total Hours: 30

Credits 01

Course objectives	• 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: • Inculcate the skills used in the food and dairy industry • Acquaint the skills related to the microbial analysis of air, soil and water with its permissible limits	
Sr. No.	Topic Particular	Hours
1	Enumeration of bacteria from food /milk samples using standard plate count	4
2	To check the efficacy of milk pasteurization using the Phosphatase test	4
3	To analyze the laboratory air using an air sampler	4
4	Determination of TS and TDS of wastewater	4
5	To determine the Dissolved Oxygen (DO) of sewage water	4
6	Bacterial detection using differential coliform test	4
7	Demonstration of LAF and biosafety cabinet	4
8	Documentation and report writing in the microbiological industry (anyone)	4

References

- Aneja, K. R. (1996). Experiments in Microbiology, 3rd edition, Wishwa Prakashan, 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. (2004). Practical Microbiology, 1st edition, S.Chand and Co., Delhi.
- Harley, J. P. & Prescott, L. M. (2002). Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York.
- Parija S. C. (2005). Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi.