



**M. G. Science Institute (Autonomous)  
Ahmedabad 380 009, Gujarat, India.**

**Proposed Syllabus  
B.Sc. MICROBIOLOGY SYLLABUS  
Effective From June 2024**

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**Bachelor of Science – Microbiology – Syllabus 2024**  
**4 Year, 8 Semester Full-Time Programme**  
**Choice-Based Credit System (CBCS) & Grading System**  
**Outcome-Based Education Pattern**

**1.0 Preamble:** A comprehensive BSc program in Microbiology prepares students with a deep and insightful understanding of microbial life and its applications. Through a blend of theoretical knowledge and hands-on experiments, this program nurtures skills in research, analysis, and critical thinking. Students explore the vast realms of microbiology, including virology, bacteriology, and mycology, preparing them for diverse careers in healthcare, research, and industry.

**2.0 Definitions**

**2.1 Bachelor Degree:** The Bachelor Degree means the degree conferred to the student after successfully earning 132 credits spread over the first 6 semesters of the programme.

**2.2 Bachelor Degree (Hons.):** The Bachelor Degree (Hons.) means the degree conferred to the student after successfully earning 176 credits spread over the 8 semesters of the programme.

**2.3 Choice Based Credit System:**

**2.4 Credit:** In terms of credits, for a period of 1 semester of 15 weeks:

- a. every ONE-hour session per week of Lecture amounts to 1 credit per semester,
  - b. a minimum of TWO hours per week of Tutorials amount to 1 credit per semester,
  - c. a minimum of TWO hours per week of Practical amount to 1 credit per semester,
- Each credit is a combination of 3 components viz. Lecture (L) + Tutorial (T) + Practice (P) (Practical/ Project Work), i.e., LTP Pattern.

**2.5 Course:** A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

**2.6 Course Announcement:** The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of the Choice Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

**2.7 Course Registration:** It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission, shall be assigned to a Faculty Advisor who shall advise her/him about the academic programs and counsel on the choice of courses considering the student's profile, career goals, and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within the first week of Semester I and immediately after the conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII, and VIII.

**2.8 Course Outcomes:** The course outcomes are the specific and measurable attributes defining the knowledge, skills, and attitude of the learners who are expected to demonstrate by the completion of the course.

**2.9 Grading System:** The Grading System is the 10-point standard scale system defined by the UGC comprising the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

**2.10 Graduate Attributes:** The Graduate Attributes are the generic abilities, attitudes, and approaches expected to be demonstrated by the learner in the world around him/ her in a longer period of the lifetime.

**2.11 Outcome Based Education (OBE):** OBE is the approach focusing on the performance outcome comprising of the following:

- a. The performer – the student (learner), not only the teacher
- b. The performable (thus demonstrable or assessable) to perform

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- c. The performance outcome, not the activity or task to be performed
- 2.12 **Outcome Based Assessment:** An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What evidence of student learning is most relevant for each learning outcome and what standard or criteria will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and is used to determine whether or not a qualification has been achieved.
- 2.13 **Programme Educational Objectives:** Programme Educational Objectives are a set of broad future-focused student performance outcomes that explicitly identify what students will be able to do with what they have learned, and what they will be like after they leave school and are living full and productive lives. Thus, PEOs are what the programme is preparing graduates for in their career and professional life (to attain within a few years after graduation).
- 2.14 **Programme Outcomes:** Programme Outcomes are a set of narrow statements that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.
- 2.15 **Programme Specific Outcomes (PSOs):** The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.
- 2.16 **Semester:** The Semester means the one-half of the academic year comprising the teaching days and examination & evaluation days as per the UGC/ University norms.
- 2.17 **Teaching and Learning Activities:** The set of pedagogical tools and techniques or teaching and learning activities that aim to help students attain the intended learning outcomes and engage them in these learning activities through the teaching process.

### 3.0 B.Sc. Programme Focus:

#### 3.1 Programme Educational Objectives (PEOs):

PEO: 1: Graduates of B.Sc. will develop a set of knowledge and skills through analytical and critical thinking abilities so as to develop careers in their respective industry or further study

PEO: 2 Graduates of B.Sc will be able to understand the moral and ethical implications of their professions and personal decisions, through their efforts they will strive to make a sustainable ecosystem.

PEO: 3 Graduates of B.Sc will learn to be good leaders and develop the ability to work in a team, constantly inspiring their team members

PEO: 4 Graduates of B.Sc will develop empathy recognizing the diverse perspectives prevailing in society

PEO: 5 Graduates of B.Sc will be able to learn, unlearn, and relearn adapting to ever-changing technology to be a global citizen.

#### 3.2 Programme Outcomes (POs): At the end of the B.Sc. - Microbiology Programme the learner will possess:

PO: 1 - Students will be able to understand the basic principles of microbiology, microbial taxonomy, microbial morphology and physiology, Biomolecules

PO: 2 Students will be able to understand and apply the basic and advanced concepts of molecular genetics, microbial metabolism, immunology, and bioprocess technology

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PO: 3 Students will also learn the fundamentals of environmental microbiology, medical microbiology, agriculture and soil microbiology, water and wastewater microbiology, and biotechnology

PO: 4 Students will develop proficiency in handling microbial cultures and working under aseptic conditions

PO: 5 Students will develop skills in various microbiological practicals, the study of microorganisms in their natural environments, staining techniques, identification techniques, microbiological analysis of soil, water, and food, blood analysis, serological testing, urine analysis, fermentation product analysis, sterility of pharmaceutical products

PO: 6 Students will develop the ability to identify the prevailing problems in society and try to alleviate them using their knowledge and concepts

PO: 7 Students will be able to collect data, and statistically analyze it after designing an experiment for existing or emerging issues.

PO: 8 Students will develop scientific writing skills and will be able to interpret and present concepts meaningfully both verbally and in writing.

PO: 9 Students will have basic knowledge of ethical, moral, and legal issues pertaining to the use of microorganisms and their products.

PO: 10 Students will gain knowledge of allied subjects such as zoology, biochemistry, and biostatistics.

#### 4.0 B.Sc. - Microbiology Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	8	Compulsory	50	50	100
2	Minor Course	4	Compulsory (Chemistry/Zoology)	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System	2	Elective	25	25	50
7	Value Added Courses	2	Elective	25	25	50

#### Course Types Definitions:

- 1. Major Course:** Major courses are the compulsory courses prescribed in various semesters of the programme. The learner shall have to acquire **68** credits (including 4 credits assigned to the Internship) in the Major courses in the Degree Programme and **92** credits (including 4 credits assigned to the Internship) in the Major courses in the Degree Programme with Hons.
- 2. Minor Course:** Minor courses are the compulsory courses prescribed in various semesters of the programme. The learner shall have to acquire **24** credits in the Minor courses in the Degree Programme and **32** credits in the Minor courses in the Degree Programme with Hons.
- 3. Multidisciplinary Course:** Multidisciplinary courses are elective courses from other disciplines/ faculties and are relevant to the academic programme under pursuit. The learner shall have to acquire **12** credits in the Multidisciplinary courses during the first 3 semesters of the programme.
- 4. Skill Enhancement Course:** Skill Enhancement courses are elective courses purely aiming at developing various life skills and professional skills to be practiced by the learner. The learner

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shall have to acquire **10** credits in the SECs in the Degree Programme and **10** credits in the SECs in the Degree Programme with Hons.

5. **Ability Enhancement Course:** Ability Enhancement courses are elective courses aiming at proficiency in English and Communication skills
6. **Indian Knowledge System (IKS):** IKS courses are elective courses aiming at acquainting the learners with Indian values, ethos, culture, arts, and spirituality. The learner shall acquire **4** credits in the IKS as a part of the degree programme.
7. **Value Added Courses (VAC):** Value Added courses are elective courses aiming at empowering the learners with skills and knowledge, enabling them to apply what they have learned to their professional and everyday lives. The learner shall acquire **4** credits in the VAC as a part of the degree programme.

### 5.0 The Programme Structure:

FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR		
SEM I		SEM II	SEM III	SEM IV	SEM V	SEM VI	SEM VII	SEM VIII
Course	Course Classification	Course Classification	Course Classification	Course Classification	Course Classification	Course Classification	Course Classification	Course Classification
Major Course-1	Major 1 (4C)	Major 3 (4C)	Major 5 (4C)	Major 8 (4C)	Major 11 (4C)	Major 14 (4C)	Major 17 (4C)	Major 20 (4C)
Major Course-2	Major 2 (4C)	Major 4 (4C)	Major 6 (4C)	Major 9 (4C)	Major 12 (4C)	Major 15 (4C)	Major 18 (4C)	Major 21 (4C)
Minor Course-1	Minor 1 (4C)	Minor 2 (4C)	Major 7 (4C)	Major 10 (4C)	Major 13 (4C)	Major 16 (4C)	Major 19 (4C)	Major 22 (4C)
MDC - 1	MDC 1 (4C)	MDC 2 (4C)	MDC 3 (4C)	Minor 3 (4C)	Minor 4 (4C)	Minor 6 (4C)	Minor 7 (4C)	Minor 8 (4C)
AEC - 1	AEC 1 (2C)	AEC 2 (2C)	AEC 3 (2C)	AEC 4 (2C)	Minor 5 (4C)	AEC 5 (2C)	Research Project/On the Job Training (6C)	Research Project/ On the Job Training (6C)
SEC - 1	SEC 1 (2C)	SEC 2 (2C)	SEC 3 (2C)	SEC 4 (2C)	SEC 5 (2C)	Internship (4C)		
IKS - 1	IKS 1 (2C)	VAC 1 (2C)	IKS 2 (2C)	VAC 2 (2C)				
<b>TOTAL CREDITS</b>	22	22	22	22	22	22	22	22

**Total Credits for the Bachelor's Degree programme: 132**

**Total Credits for the Bachelor Degree (Hons.) programme: 176**

### 6.00 Multiple Entry-Exit Option:

The B.Com. Banking and Financial Services programme is fully compliant with the *Curriculum and Credit Framework for Undergraduate Programmes* issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with UG Certificate awarded, at the end of the second year with UG Diploma awarded, at the end of the third year with UG Degree awarded and at the end of the fourth year with UG Honors Degree awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years

from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the *Curriculum and Credit Framework for Undergraduate Programmes* issued by the UGC in December 2022.

### **7.00 Internship Project:**

Every learner must undergo and complete the internships/ apprenticeships in a firm/ industry/ organization or training in labs with faculty or researchers in their own or other colleges/institutes/ research institutions during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as *Practice*, every learner will have to produce the work for 120 hours during the internship.

#### **Evaluation of the Internship Project:**

4.1 It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

- a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
- b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness, and overall professionalism. The learning outcomes of the Internship Project and the utility of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.
- c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
- d. The college-level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
- e. Copies of the SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

### **8.00 Comprehensive Concurrent Evaluation (CCE)/ Concurrent Internal Evaluation (CIE):**

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before the commencement of the term. The scheme of Comprehensive Concurrent Evaluation shall explicitly state the linkages of each CCE with the Course Outcomes and define the targeted attainment levels for each CO.
2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of a minimum of 25 marks.
5. For a 4 Credit Course, there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formula.
6. For 2 Credit Courses, there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of the course and shall be conceptualized, executed, assessed, and documented by the course teacher along with student-wise and

- class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
  9. A copy of the duly signed CCE *outcome* shall be displayed on the notice boards/ ERP, within a week of the assessment, and course teachers shall guide the students on a need basis.
  10. The college may conduct additional makeup / remedial CCE items at its discretion.
  11. At the end of the term, aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
  12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. **Current Academic Year (CAY) + 4 years.**

### 9.00 End-Semester Evaluation:

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/ Committee of the college headed by a full-time regular faculty member nominated by the Principal as Controller of the Examination.
2. The ESE for each course shall have the weightage as follows:
  - For a 4 Credit Course: 50 marks
  - For a 2 Credit Course: 25 marks
3. The ESE for each course shall have 5 questions each of 10 marks. In the case of 2 Credit courses, the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.
5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVE ABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answer any 5 out of 8 (2 marks each)
Q.2	UNDERSTANDING	Answer any 2 out of 3 (5 marks each)
Q.3	APPLYING	Answer 3 (a) or 3 (b) (10 marks)
Q.4	ANALYSING	Answer 4 (a) or 4 (b) (10 marks)
Q.5	EVALUATING	Answer 5 (a) or 5 (b) (10 marks)
	CREATING	

### 10.00 Passing Standard

- A learner shall be said to have earned the credits for a course if he/she earns a minimum of 35% marks.
- Formative Evaluation and Summative Evaluation shall be separate heads of passing.

**10.1 Grading System:** The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

- (a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester
- (b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

**10.2 Degree Requirements:** The degree requirements for the B.Sc. The microbiology

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programme is the completion of a minimum of 136 credits and 180 credits in the case of an Honours degree.

**10.3 Maximum Duration for Completion of the Programme:** The maximum duration for completion of the programme is 7 years.

**11.00 Attendance:**

The student must meet the requirement of **75% attendance per semester per course** for the grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

**12.00 Medium of Instruction:** The medium of Instruction & Evaluation shall be English.

**13.00 Detailed Course List (Annexure 1)**

**14.00 Detailed Syllabus for each course (Annexure 2)**



**Annexure 1**  
**Detailed Course List**  
**Major Courses**  
**(Compulsory Course – 4 Credits Each)**

Course No.	Course Code	Course Title	Semester
111	MIM 111	Introduction to the Microbial world	1
112	MIM 112	Microbiology Practicals	1
121	MIM 121	Basic Bacteriology	2
122	MIM 122	Microbiology Practicals	2
231	MIM 231	Microbial Physiology	3
232	MIM 232	Microbial Metabolism	3
233	MIM 233	Microbiology Practicals	3
241	MIM 241	Soil & Agriculture Microbiology	4
242	MIM 242	Water & Waste-water Microbiology	4
243	MIM 243	Microbiology Practicals	4
351	MIM 351	Molecular biology of prokaryotes	5
352	MIM 352	Immunology	5
353	MIM 353	Microbiology Practicals	5
361	MIM 361	Medical Microbiology	6
362	MIM 362	Virology & Mycology	6
363	MIM 363	Microbiology Practicals	6
471	MIM 471		7
472	MIM 472		7
473	MIM 473		7
481	MIM 481		8
482	MIM 482		8
483	MIM 483		8

**Minor Courses**  
**(Compulsory Course – 4 Credits Each)**

Course No.	Course Code	Course Title	Semester
354	MIE 354	Bioprocess Technology	5
355	MIE 355	Environmental Microbiology	5
364	MIE 364	Biotechnology	6

**Skill Enhancement Courses**  
**(Elective Course – 2 Credits Each)**

Course No.	Course Code	Course Title	Semester
116A	SE - 01	Microbiology in daily life	1
116B	SE - 02	Introduction to Biomolecules	1
126A	SE - 03	Disinfection and Sterilization	2
126B	SE - 04	Introduction to Hematology	2
236	SE - 02	Preparations of Reagents & Media in Laboratory	2
246	SE - 03	Food Microbiology	3
216B	SE - 04	Dairy Microbiology	4
356	SE - 05	Blood Banking	5

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**Annexure 2**  
**Detailed Syllabus for Each Course**

<b>Semester: I</b>	<b>Course No.: 111</b>	<b>Course Code: -- MIM-111 (T)</b> <b>Course Title: Introduction to Microbial world</b>
<b>Credits: 4</b>		<b>Course Category: -Major</b>

**Course Outcomes: On successful completion of the course the learner will be able to**

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO111.1	REMEMBERING	Learn about the origin of life and the evolution of the microbiology field. Contributions of scientists pertaining to microbiology and different areas of microbiology.
CO111.2	UNDERSTANDING	Learn about the morphological and differential characteristics of different groups of microorganisms.
CO111.3	APPLYING	Define and understand various terms and techniques involved in fundamental principles of microscopy.
CO111.4	ANALYSING	Understand stains and dye chemistry, know about fixatives and mordants Learn different staining procedures and apply them in the laboratory.
CO111.5	EVALUATING	--

Unit No.	Unit Contents	Sessions Allotted
<b>1</b>	<p><b>Origin and History of the Microbial World:</b> Origin and history of the microbial world</p> <p>A. Origin of Microbial Life</p> <ol style="list-style-type: none"> <li>i. Biogenesis Vs Abiogenesis (Hypothesis and experiments)</li> <li>ii. Miller's experiments, Ubiquitous nature of microbial life.</li> <li>iii. Development from simple to complex life forms.</li> </ol> <p>B. History of Microbiology Significance of Scientific contributions in the development in Microbiology as a discipline:</p> <ol style="list-style-type: none"> <li>i. Early contributions: Robert Hook, Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall.</li> <li>ii. Scientific contribution leading to diversification of Microbiology: Recent milestone discoveries in the field of microbiology.</li> </ol> <p>C. Medical Microbiology and Immunology: Edward Jenner, Paul Ehrlich, Ellie Metchnikoff, Joseph Lister</p> <p>D. Food Microbiology and Fermentation: Alexander Fleming, Louis Pasteur, Selman Waksman</p> <p>E. Soil Microbiology: Sergei Winogradsky, Martinus Beijerinck</p> <p>F. Microbial Genetics: Watson and Crick, Hargobind Khurana, Griffith, Avery, McCarty, and Macloed</p> <p>G. Avenues of Microbiology</p>	<b>15</b>
<b>2</b>	<p><b>Introduction to the Microbial world:</b></p> <p>A. Distribution in nature. Different habitat:</p> <ol style="list-style-type: none"> <li>i. Terrestrial- soil and other animals, plants</li> <li>ii. Aquatic – Fresh and Marine water</li> <li>iii. Atmosphere- Air</li> <li>iv. Extremophiles – Temperature, Salt, Anaerobiosis, Pressure</li> </ol>	<b>15</b>

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	<p>B. Major groups of microorganisms.</p> <ol style="list-style-type: none"> <li>i. Bacteria and Actinomycetes</li> <li>ii. Yeast and Fungi</li> <li>iii. Algae</li> <li>iv. Viruses</li> <li>v. Viroids and prions</li> <li>vi. Protozoa</li> </ol>	
<b>3</b>	<p><b>Microscopy:</b></p> <p><b>A.</b> Introduction</p> <ol style="list-style-type: none"> <li>i. History of microscopy</li> <li>ii. Terms in microscopy – Magnification, Refractive index, Numerical aperture, Resolving power</li> <li>iii. Aberrations in lenses</li> </ol> <p><b>B.</b> Principle, working, and applications of</p> <ol style="list-style-type: none"> <li>i. Bright field microscopy.</li> <li>ii. Darkfield microscopy</li> <li>iii. Phase contrast microscopy</li> <li>iv. Fluorescence microscopy</li> <li>v. Introduction to Electron microscopy – SEM, TEM</li> </ol>	<b>15</b>
<b>4</b>	<p><b>Stains and Staining:</b></p> <p>4.1- Dye/ Stain chemistry.</p> <p>4.2- Importance of Staining.</p> <p>4.3- Physical and Chemical principles of staining.</p> <p>4.4- Staining procedures – Wet mount and dry smear preparations.</p> <p>4.5- Role of Fixatives, Mordents and Intensifiers.</p> <p>4.6- Simple, Differential and Structural staining.</p>	<b>15</b>

**MIM-112(P): MICROBIOLOGY PRACTICALS****Paper Name: Microbiology Practicals****Credits: 04 (08 hrs/week Total: 120 hrs)**

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO112.1	REMEMBERING	Describe the good lab practices and biosafety measures to be adopted while working in a microbiology lab. Explain the principle and applications of various instruments used in microbiology laboratory
CO112.2	UNDERSTANDING	Preparation, sterilization, and disposal of basic bacteriological media used for the cultivation of bacteria Handling and use of glassware used in microbiology laboratory
CO112.3	APPLYING	Apply staining techniques to prepare slides for microscopic examination of various types of microorganisms. Understand the techniques for isolation and apply the technique to isolate a microorganism from different environmental samples Able to identify different prokaryotic, eukaryotic, and acellular microorganisms

1. Introduction to microbiological laboratories: Dos and Don'ts
2. Study of principle, component parts, and operation of the compound light microscope
3. Study of principles and working of laboratory instruments: Autoclave, Hot air oven, Incubator, Water bath, Bacteriological Filters, Centrifuge, Rotary shaker, pH meter, Colorimeter
4. Introduction to size, shape, labeling (if required), and uses of laboratory glass wares/plastic wares: Test tube, Pipette, Conical flask, Petri dish, Measuring cylinder, Coplin Jar, Burette, Beaker, Glass spreader
5. Cleaning and preparation of glassware for sterilization
6. Disposal of laboratory waste and cultures
7. pH adjustment of solution by use of pH strip and pH meter
8. Preparation of bacteriological media: Nutrient broth and Nutrient agar
9. Study of curd sample by wet mount (temporary mount)
10. Study of hay infusion by hanging drop method
11. Simple staining of bacteria: Monochrome staining & Negative staining
12. Differential staining of bacteria: Gram stain method
13. Isolation of bacteria from Soil, Water, and food
14. Study of permanent slides/photomicrographs of different groups of microorganisms
  - a. Permanent slides of prokaryotic microbes (bacteria): *Staphylococci*, *Bacilli*, *Spirochetes*, *Actinomycetes*
  - b. Permanent slides of eukaryotic microbes:
    - i. Fungi: Yeast, *Mucor*, *Penicillium*
    - ii. Algae: *Diatoms*, *Spirogyra*, *Chlamydomonas*

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iii. Protozoa: *Amoeba*, *Paramecium*, *Euglena*

- c. Photomicrographs of acellular microbes (viruses): HIV, TMV, Bacteriophage T2

**Suggested Text Books:**

1. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata McGraw Hill Press.
2. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 7th Edition. McGraw Hill Companies Inc.

**Suggested Reference Books:**

1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
2. Fundamentals of Microbiology – 6th edition, I. E. Alcamo, Jones, and Bartlett Publishers
3. H A Modi Elementary Microbiology Volume I Akta Prakashan, Nadiad
4. Black J G, (2002) Microbiology: Principles and Explorations, 5<sup>th</sup> edn, John Wiley and Sons, Inc.

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<b>Semester: I</b>	<b>Course No.: 116A</b>	<b>Course Code: MI-SEC-116A</b> <b>Course Title: Microbiology in daily life</b>
<b>Credits: 02</b>		<b>Course Category: -SEC</b>

		Bloom's cognitive level
<b>CO1</b>	Cite examples of various types of useful and harmful microorganisms and their ubiquitous nature.	<b>1</b>
<b>CO2</b>	Discuss the applications of microorganisms in various fields	<b>2</b>
<b>CO3</b>	Outline the relatedness of the different upcoming areas of biological sciences to the field of Microbiology.	<b>3</b>
<b>CO4</b>	Classify the microorganisms into different types and compare their characteristic features	<b>3</b>
<b>CO5</b>	Review the role of a microbiologist in solving a range of problems affecting humans and nature.	<b>4</b>
<b>CO6</b>	Specify the use of microorganisms in day-to-day life.	<b>3</b>

Unit No	Title of Unit and Contents	No of Lectures
<b>I</b>	i. Introduction, Definition of Microbiology, Useful microorganisms, Microorganisms are everywhere (ubiquitous nature of microorganisms), Applications in various fields. ii. Introduction to Pathogens and harmful microorganisms iii. Role of Microbiologists- to solve a range of problems affecting our health, environment, food, agriculture, and defense. iv. Microbes used in day-to-day life, Use of sanitizers and disinfectants, Role of antimicrobials in toothpaste and cosmetics, antimicrobial activity of kitchen spices, Role of microorganisms in making fermented food like curd, idli, and dosa. Role of microorganisms in spoilage of food.	<b>15</b>
<b>II</b>	i. Demonstration of microorganisms in natural samples like food, milk, and water by wet mount ii. Study of Skin flora iii. Antimicrobial activity of Spices iv. Preparation of curd	<b>30</b>

**References:**

1. Dubey R. C. and D. K. Maheshwari. (2012). A textbook of Microbiology. S Chand
2. Ananthanarayan and Paniker's Textbook of Microbiology. 10th edition. Universities Press, Hyderabad, India
3. Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.
4. Subba Rao N. S. (2016). Advances in Agricultural Microbiology. Netherlands: Elsevier Science.

<b>Semester: I</b>	<b>Course No.: 116B</b>	<b>Course Code: MI-SEC-116B</b>
		<b>Course Title: Introduction to Biomolecules</b>
<b>Credits: 02</b>		<b>Course Category: -SEC</b>

		Bloom's cognitive level
<b>CO1</b>	Learn about the basic biomolecules of life	<b>1</b>
<b>CO2</b>	Understand the structural, and physicochemical properties of carbohydrates, lipids, amino acids, proteins, and nucleic acids	<b>2</b>
<b>CO3</b>	It also provides hands-on practical training for the qualitative analysis of different biomolecules	<b>3</b>

Unit No	Title of Unit and Contents	No of Lectures
<b>I</b>	Structure and significance of: i. Carbohydrates ii. Protein iii. Lipid iv. Nucleic acids	<b>15</b>
<b>II</b>	i. Qualitative Analysis of Carbohydrates a. Monosaccharides: hexoses (glucose and fructose) b. Disaccharides: reducing (maltose/lactose and non-reducing (sucrose) c. Polysaccharides: Starch, Glycogen ii. Qualitative analysis of amino acids & proteins iii. Qualitative analysis of lipids a. Solubility test b. Saponification test	<b>30</b>

**References:**

1. Jain and Jain (2009) Fundamentals of Biochemistry, S Chand Publication
2. D.T. Plummer (2017). Introduction to Practical Biochemistry, McGraw Hill Publication

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<b>Semester: II</b>	<b>Course No.: 121</b>	<b>Course Code: MIM-121(T)</b>
		<b>Course Title: Basic Bacteriology</b>
<b>Credits: 4</b>		<b>Course Category: -Major</b>

**Course Outcomes: On successful completion of the course the learner will be able to**

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO121.1	REMEMBERING	Have knowledge regarding the fine structure of bacterial cell Learn about the functions of bacterial organelles Learn the details of different surface organelles of bacteria
CO121.2	UNDERSTANDING	Define different terms involved in the nutrition of bacteria. Describe various media and their use for the cultivation of bacteria. Methods for cultivation of anaerobic bacteria
CO121.3	APPLYING	Understand the difference between pure and mixed culture Understand the techniques of isolation and pure culture Apply the technique to isolate a pure culture from different samples Learn preservation techniques
CO121.4	ANALYSING	Learn the taxonomic criteria for classification and nomenclature of bacteria Classify different species according to Bergey's Manual of Systematic Classification
CO121.5	EVALUATING	--

Unit No.	Unit Contents	Sessions Allotted
1	<b>Structural Organization of a Bacterial Cell</b> <b>A.</b> Surface appendages (a) Flagella (b) Pili and Fimbriae (c) Prosthecae and Stalks <b>B.</b> Surface layers (a) Capsule and Slime layer (b) Cell wall, <b>C.</b> Differential staining – Gram staining and Acid-fast staining (c) Cytoplasmic membrane and Mesosomes <b>D.</b> Cytoplasm and cell organelles (a) Cytoplasm (b) Ribosomes (c) Nuclear material and Plasmid (d) Cellular reserve food material (e) Bacterial Endospore – structure, sporulation and germination	15
2	<b>Nutrition and Cultivation of Bacteria</b> <b>A.</b> Nutritional and chemical requirements of bacteria: i. Carbon, ii. Oxygen, iii. Nitrogen, iv. Sulfur, v. Phosphorus, vi. Trace elements, vii. Vitamins,	15

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	<ul style="list-style-type: none"> <li>viii. Growth factors</li> <li>ix. Water</li> </ul> <p>B. Nutritional diversities in bacteria</p> <ul style="list-style-type: none"> <li>i. Based on the source of energy: Phototrophs, Chemotrophs</li> <li>ii. Based on the source of electron donor: Lithotrophs, Organotrophs</li> <li>iii. Based on the source of carbon: Autotrophs, Heterotrophs, Mixotrophs, Obligate parasites</li> </ul> <p>C. Culture media :</p> <ul style="list-style-type: none"> <li>i. Media ingredients,</li> <li>ii. Preparation of media,</li> <li>iii. Types of media <ul style="list-style-type: none"> <li>a. Based on the state of media: Solid, Broth, Semi-solid</li> <li>b. Based on ingredients: Natural, Synthetic, and complex</li> <li>c. Based on functions: General purpose, selective, Differential, Enriched and Enrichment media Biochemical media, Assay media and Enumeration Media</li> </ul> </li> </ul> <p>D. Cultivation of anaerobic bacteria</p>	
3	<p><b>Pures cultures techniques :</b></p> <p>A. Pure culture, mixed culture, Selective methods to obtain pure cultures</p> <ul style="list-style-type: none"> <li>i. Chemical,</li> <li>ii. Physical, and</li> <li>iii. Biological Methods</li> </ul> <p>B. Isolation methods of pure culture :</p> <ul style="list-style-type: none"> <li>i. Aseptic technique</li> <li>ii. Streak plate,</li> <li>iii. Spread plate and</li> <li>iv. Pour plate techniques</li> </ul> <p>C. Cultural characteristics: Colony characters, Characteristics of broth cultures</p> <p>D. Maintenance and preservation of pure culture</p> <p>E. Culture collection centers</p>	15
4	<p><b>Bacterial Taxonomy</b></p> <p><b>Taxonomy:</b></p> <p>A. Introduction of different systems of bacterial classification</p> <p>B. Principles of binominal system of nomenclature</p> <p>C. Criteria for classification and identification</p> <ul style="list-style-type: none"> <li>i. Morphological characteristics,</li> <li>ii. Cultural characteristics,</li> <li>iii. Antigenic characteristics,</li> <li>iv. Physiological characteristics,</li> <li>v. Ecological characteristics,</li> <li>vi. Chemical composition and characteristics,</li> <li>vii. Genetic characteristics</li> </ul> <p>D. Introduction to Bergey's Manual of Systematic Bacteriology</p>	15

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**Paper Code: MIM-122(P) (Practicals)**  
**Paper Name: Microbiology Practicals**  
**Credits: 04 (08 hrs/week Total: 120 hrs)**

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO122.1	REMEMBERING	Students will learn the growth & morphological characteristics of different bacteria
CO122.2	UNDERSTANDING	Students will understand the principle behind different staining techniques & The growth conditions of bacteria
CO122.3	APPLYING	Students will be able to perform bacterial staining & identify different structures of bacteria such as spores, capsules, cell walls, and granules
CO122.4	APPLYING	Students will be able to design experiments to decipher the optimum condition for bacterial growth

1. Cultivation and isolation of bacteria:
  - a. Broth culture method
  - b. Agar plate methods
    - i. Spread plate method
    - ii. Pour plate method
    - iii. Streak plate method [Method: Gram stain of mixed bacterial culture, Isolation of bacteria, Colony (Cultural) characteristics, Morphological characteristics (Gram stain)]
  - c. Agar slant (slope) method for pure culture
2. Preservation of microbial cultures:
  - a. Periodic subculturing and storage at refrigeration temperature
  - b. Preservation of bacteria in soil (Nitrogen fixers)
3. Structural and special staining techniques:
  - a. Endospore staining by Dorner's method
  - b. Cell wall staining by Dyar's method
  - c. Capsule staining by Hiss's method
  - d. Metachromatic granule staining by Albert's method
  - e. Spirochaetes staining by Fontana's method
4. Effect of Physical parameters on growth of *E. coli*, *S. aureus*, *Bacillus*
  - a. pH
  - b. Temperature
  - c. Osmotic pressure- Salt
5. Study of pigmented bacteria:
  - a. *Staphylococcus aureus*
  - b. *Micrococcus luteus*
  - c. *Serratia marcescens*
  - d. *Pseudomonas aeruginosa*
6. Cultivation of anaerobic bacteria by use of ...
  - a. Robertson's cooked meat medium
  - b. Thioglycolate broth
  - c. Anaerobic jar (Demonstration)

**Suggested Text Books:**

1. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata McGraw Hill Press.
2. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 7th Edition. McGraw Hill Companies Inc.

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**Suggested Reference Books:**

1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
2. Fundamentals of Microbiology – 6th edition, I. E. Alcamo, Jones, and Bartlett Publishers
3. H A Modi Elementary Microbiology Volume I Akta Prakashan, Nadiad
4. H A Modi Elementary Microbiology Volume II Akta Prakashan, Nadiad
5. Black J G, (2002) Microbiology: Principles and Explorations, 5<sup>th</sup> edn, John Wiley and Sons, Inc.

<b>Semester: II</b>	<b>Course No.: 126A</b>	<b>Course Code: MI-SEC-126A</b>
		<b>Course Title: Disinfection and Sterilization</b>
<b>Credits: 02</b>		<b>Course Category: -SEC</b>

		Bloom's cognitive level
<b>CO1</b>	Provides basic knowledge of the control of microorganisms.	<b>1</b>
<b>CO2</b>	Provides basic skills of disinfection and sterilization.	<b>3</b>
<b>CO3</b>	Helpful to those who work or want to work in the field of general microbiology, medical & paramedical sciences, pharmaceuticals, agriculture, tissue culture, biotechnology, fermentation, etc.	<b>3</b>

Unit No	Title of Unit and Contents	No of Lectures
<b>I</b>	i. Understanding of terms: Sterilization, Disinfection, Sanitization, Antisepsis, Antimicrobial agent (Germicide, Bactericide, Bacteriostatic) ii. Conditions/Factors influencing the effectiveness of antimicrobial agents iii. Control of microorganisms by chemical agents: Phenolics, Alcohols, Aldehydes, Halogens, Quaternary ammonium compounds, Sterilizing gases (Ethylene oxide, Beta-propiolactone, Vaporized hydrogen peroxide) iv. Control of microorganisms by physical agents: Moist Heat, Dry Heat, UV Radiation, Gamma Radiation	<b>15</b>
<b>II</b>	i. Disinfection of hands by washing with soap and water ii. Aseptic technique a. Disinfection of tabletop/floor of the room by using Phenol/Lysol b. Sterilization of inoculating wire loop, straight wire, forceps, glass spreader, the mouth of test tube & flask, etc. by direct heating in burner's flame. iii. Demonstration of aseptic transfer of bacterial culture iv. Disinfection of skin of fingertips by using alcohol/tincture of iodine v. Principle, working knowledge, and operation of hot air oven and autoclave vi. Sterilization of glassware in a hot air oven vii. Sterilization of media in an autoclave	<b>30</b>

**References:**

1. Prescott, Harley and Klein's Microbiology, JM Willey, LM Sherwood, CJ Woolverton, 9th Edition (2014), McGraw Hill Higher Education-USA
2. 2 Microbiology, Pelczar JR., Chan ECS, Krieg NR, 5th Edition (1993), McGraw-Hill Book Company, NY.
3. Principles of Microbiology, R. M. Atlas, 2nd Edition (Indian Edition) (2015) McGraw Hill Education (India) Private Limited, New Delhi, India
4. Medical Microbiology – A Guide to The Laboratory Diagnosis and Control of Infection, Edited by Robert Cruickshank, 11th Edition (1972), The English Language Book Society Great Britain

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<b>Semester: II</b>	<b>Course No.: 126B</b>	<b>Course Code: MI-SEC-126B</b>
<b>Credits: 02</b>		<b>Course Title: Introduction to Hematology</b>
		<b>Course Category: -SEC</b>

		Bloom's cognitive level
<b>CO1</b>	Provides basic knowledge of blood and functions of blood.	<b>1</b>
<b>CO2</b>	Provides basic skills in hematological testing.	<b>3</b>
<b>CO3</b>	Helpful to those who work or want to work in the field of pathology laboratory, hematology, etc.	<b>3</b>

Unit No	Title of Unit and Contents	No of Lectures
<b>I</b>	i. Concepts of Hematology ii. Composition of blood: Understanding of cellular and acellular components of blood, types of blood cells, plasma, and serum iii. Functions of blood and blood components, functions of blood cells, functions of plasma and serum, functions of hemoglobin. iv. Introduction to thalassemia and anemia	<b>15</b>
<b>II</b>	i. Determination of blood group (ABO, Rh) ii. Cross-matching of Blood iii. Study of blood cells in permanent slide: Eosinophils, Basophils, Monocytes, Lymphocytes and Neutrophils iv. Demonstration of Hemoglobin estimation by Sahli's method.	<b>30</b>

**References:**

1. Baker and Silverton's Introduction to Medical Laboratory Technology, Baker F J, Silverton R E, Pallister C J, 7th edition (1998), Butterworths-Heinemann, Oxford, UK
2. Textbook of Medical Laboratory Technology, Godkar Praful. B., second edition (2003), Bhalani Publishing House.
3. Medical Laboratory Technology, Mukherjee 4th edition (2022), McGraw-Hill Education.

  
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