

**KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY,  
BHUJ.**

**Year: 2023-2024**



**B.Sc (Honours) MICROBIOLOGY**  
(With Research /Without Research)

**Semesters : III and IV**  
(Exit option)

**FACULTY OF SCIENCE**

**SYLLABUS**

**Curriculum as per UGC Guideline**  
**Framed according to National Education Policy (NEP) - 2020**  
**With effect from June – 2023 (and thereafter)**



# **B.Sc. (Honours) MICROBIOLOGY Programme**

**(With Research/without Research)**

**NEP-2020**

**With effect from June – 2023 (and thereafter)**

**FACULTY OF SCIENCE**

**Subject: MICROBIOLOGY**

**B. Sc. Semesters: III & IV**



**NATURE AND EXTENT OF BACHELOR'S DEGREE PROGRAMME IN  
MICROBIOLOGY (HONOURS)**

A bachelor's degree in Microbiology with Research or without Research is a 4 year degree course which is divided into 8 semesters.

Sl.No.	Type of Award	Stage of Exit	Mandatory Credits to be secured for the Award
1	Certificate in the Discipline	After successful completion of 1st Year	
2	Diploma in the Discipline	After successful completion of 1st and 2nd Years	
3	B.Sc. in Microbiology	After successful completion of 1st, 2nd and 3rd Years	
4	B.Sc. (Honours with Research/without Research) in Microbiology	After successful completion of 1st, 2nd, 3rd and 4th Years	

A student pursuing 4 years undergraduate programme with research in a specific discipline shall be awarded an appropriate Degree in that discipline on completion of 8th Semester if he/she secures \_\_\_\_\_ Credits. Similarly, for certificate, diploma and degree, a student needs to fulfill the associated credits. An illustration of credits requirements in relation to the type of award is illustrated as above.

Bachelor's Degree (Honours) is a well-recognized, structured, and specialized graduate level qualification in tertiary, collegiate education. The contents of this degree are determined in terms of knowledge, understanding, qualification, skills, and values that a student intends to acquire to look for professional avenues or move to higher education at the postgraduate level.

Bachelor's Degree (Honours) programmes attract entrants from the secondary level or equivalent, often with subject knowledge that may or may not be directly relevant to the field of study/profession. Thus, B.Sc. (Honours) Course in Microbiology aims to equip students to qualify for joining a profession or to provide development opportunities in particular employment settings. Graduates are enabled to enter a variety of jobs or to continue academic study at a higher level.

**AIMS:**

1. To develop the curriculum for fostering discovery-learning.
2. To adopt recent pedagogical trends in education including e-learning, flipped class, hybrid learning and MOOCs
3. To mold responsible citizen for nation-building and transforming the country towards the future.
4. To provide an environment that ensures cognitive development of students in a holistic manner. A dialogue about Microorganisms and its significance is promoted in this framework, rather than didactic monologues on mere theoretical aspects.
5. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A Microbiology graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.



6. To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
7. To enable the graduate, prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

### **COURSE INTRODUCTION**

The new curriculum of B.Sc. in Science (MICROBIOLOGY) offers essential knowledge and technical skills to study Microorganisms and its interaction in Environment. Students would be trained in all areas of Microbiology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently being used in the study of microorganisms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of microorganisms and their relevance to the national economy.

B.Sc. Microbiology Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities and projects would also be organized for real-life experience and learning. Candidates who have curiosity in Microorganisms, ecosystem, love exploring exotic places and wish to work as researchers or professions like Botanist, Conservationist, Ecologist, etc. can choose B.Sc. Microbiology course.

### **Programme outcomes (POs):**

Transformed curriculum shall develop educated outcome-oriented candidature, to develop into responsible citizen for nation-building and transforming the country towards the future with their knowledge gained in the field of Microbiology.

### **Programme specific objectives (PSOs): B.Sc. I Year Certificate Course in Introduction To Microbial World**

- ✓ This certificate course will provide knowledge on various fields of Microbiology.
- ✓ The syllabus is prepared to enable students for competitive exams in frontier areas of Microbiology.
- ✓ Students will be able to know about various microorganisms.
- ✓ Student shall produce competent Microbiologist who can employ and implement their gained knowledge in basic and applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and environment to provide sustainable development.
- ✓ Certificate and diploma courses are framed to generate self- entrepreneurship and self-employability, if multi exit option is opted.
- ✓ Lifelong learning is achieved by drawing attention to the vast world of knowledge of microorganisms and their domestication.
- ✓ Students will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, enhance communication skill, social interaction, and increase awareness in use of microorganism's in various Fields.
- ✓ The training provided to the students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with graduate preparation for national



as well as international competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI, BSI, FRI etc., as well self-employment.

### **TEACHING LEARNING PROCESS**

Teaching and learning in this programme involve classroom lectures as well tutorials.

It allows-

- The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- Written assignments and projects submitted by students
- Project-based learning
- Group discussion
- Home assignments
- Quizzes and class tests
- PPT presentations, Seminars, interactive sessions
- Diversity survey
- Co-curricular activity etc.
- Study Tour or Field visit

### **EVALUATION METHODS:**

Academic performance in various courses *i.e.* DSC, IDC/MDC, AEC. VAC and SEC are to be considered as parameters for assessing the achievement of students in the Microbiology subject. A number of appropriate assessment methods of microbiology will be used to determine the extent to which students demonstrate desired learning outcomes.

1. A student shall be evaluated through Comprehensive Continuous Assessment (CCA)/ (*Internal Evaluation*) as well as the **End of Semester examination (External Evaluation)**. The weight-age of CCA shall be 50%, whereas the weight-age of the Semester end examination shall be 50%. CCA will include test/online-offline exam/ seminars/assignments/ submissions/ student attendance and active participations.
  2. The **End of Semester examination (External Evaluation)** shall have an assessment based upon following perspective with respect to all the courses:
    - a. Evaluation with respect to Knowledge,
    - b. Evaluation with respect to Understanding,
    - c. Evaluation with respect to Skill,
    - d. Evaluation with respect to Application and
    - e. Higher Order Thinking Skills.
- The End of Semester Examination will be conducted by the University. A certified journal of the respective practical course must be produced at the time of practical examination by the student.



- This is compulsory to record laboratory work in the Journal. Certified journal has to produce while appearing at the time of Practical examination

Year	Semester	Course Code	Paper Title	Credits	Marks		Total
					CA	UA	
First Year	III	MAJ MB 301 (Theory)	<b>MICROBIAL PHYSIOLOGY</b>	3	35	40	75
	III	MAJ MB 302-P (Practical)	As above (lab course)	1	15	10	25
	III	MAJ MB 303 (Theory)	<b>BIOMOLECULES AND METABOLISM</b>	3	35	40	75
	III	MAJ MB 304-P (Practical)	As above (lab course)	1	15	10	25
			<b>Total Credits</b>	<b>8</b>	<b>Total Marks</b>		<b>200</b>
	III	MAJ MB 305 (Theory)	<b>SOIL AND WATER MICROBIOLOGY</b>	3	35	40	75
	III	MAJ MB 306-P (Practical)	As above (lab course)	1	15	10	25
			<b>Total Credits</b>	<b>4</b>	<b>Total Marks</b>		<b>100</b>
	III	MDC307 (Theory)	<b>MICROBIAL PHYSIOLOGY</b>	3	35	40	75
	III	MDC 308-P (Practical)	As above (lab course)	1	15	10	25
			<b>TOTAL CREDITS</b>	<b>4</b>	<b>Total Marks</b>		<b>100</b>
	III	SEC309	<b>MUSHROOM CULTIVATION</b>	2	25	25	50
	IV	MAJ MB 401 (Theory)	<b>MICROBIAL BIODIVERSITY</b>	3	35	40	75
	IV	MAJ MB 402-P (Practical)	As above (lab course)	1	15	10	25
	IV	MAJ MB 403 (Theory)	<b>FOOD MICROBIOLOGY</b>	3	35	40	75
	IV	MAJ MB 404-P (Practical)	As above (lab course)	1	15	10	25
			<b>Total Credits</b>	<b>8</b>	<b>Total Marks</b>		<b>200</b>
	IV	MAJ MB 405 (Theory)	<b>DAIRY MICROBIOLOGY</b>	3	35	40	75
	IV	MAJ MB 406-P (Practical)	As above (lab course)	1	15	10	25
			<b>Total Credits</b>	<b>4</b>	<b>Total Marks</b>		<b>100</b>
IV	MIN MB 407 (Theory)	<b>MICROBIAL BIODIVERSITY</b>	3	35	40	75	
IV	MIN MB 408-P (Practical)	As above (lab course)	1	15	10	25	
		<b>Total Credits</b>	<b>4</b>	<b>Total Marks</b>		<b>100</b>	
IV	SEC409	<b>BIOFERTILIZER</b>	2	25	25	50	



## The Structure of the Question Paper for the University Theory Exam

MAJ/MIN/MDC MB-301/303/305/407/401/403/505/407

Total Marks : 40

Total No. of Questions : 04

Questions	Section	Marks
Question – 1 Unit – I	(Descriptive - Essay type – Short notes <i>with internal option</i> ) 2 out of 3	10 marks
Question – 2 Unit –II	–do–	10 marks
Question – 3 Unit – III	–do–	10 marks
Question – 4 (Unit I to III)	(10 out of 12) 1 Marks Each	10 Marks

- The examination pattern of the university is around 50% external and 50% internal.
- Types of questions for Question 4 may be varied like: definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice questions/ one word answer / match the pairs etc.
- Project work/ Visit/ Tour/ Charts/ Model/ Given by teacher or as a part of Syllabus) will be mandatory for all the students.



**DETAILED SYLLABUS OF B.Sc. 2 YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

**KSKV Kachchh University, Bhuj - Kachchh**  
(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:**

**COURSE TITLE: MICROBIAL PHYSIOLOGY**

(Course code: MAJ MB 301) Credit: 3

**DISCIPLINE SPECIFIC CORE COURSES (MAJOR)**

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	THEORY			
				Credits	Lectures	External	Internal
Certificate Course	B.Sc.III	MAJ MB-301	MICROBIAL PHYSIOLOGY	3	45	40 Marks	35 Marks

**Course Outcomes (COs):**

Upon successful completion of this paper students will learn about MICROBIAL PHYSIOLOGY concepts like Students will learn about the Classification of bacteria on the basis of growth supporting environmental factors, Modes of Nutritional Uptake, Enzymes, and Microbial Growth

UNIT-I	MICROBIAL NUTRITION	15 Hours
	1. Classification of bacteria on the basis of growth supporting environmental factors such as Oxygen, Temperature, pH, osmotic pressure, Salt and Hydrostatic pressure.  2. Modes of Nutritional Uptake  a. Entry of nutrition in the cell, Passive diffusion, Facilitated diffusion and active transport  b. Utilization of nutrients that cannot enter the cell.	
UNIT-II	ENZYMES	15 Hours
	1. General Introduction a. Physical and Chemical properties b. Structure of enzymes: Prosthetic group, Apo enzyme, Co-enzymes, co-factors. c. Nomenclature and classification of enzymes. IUB system of enzyme classification 2. Enzyme action. a. Active sites of enzymes. b. Factors affecting enzyme activity. c. Inhibition of enzyme activity: Competitive, noncompetitive and uncompetitive.	





UNIT-III	ENZYMES AND ENERGY	15 Hours
	1. Enzyme kinetics A. Michaelis-Menten equation, 2. Metabolic regulation A. Types of regulatory mechanisms: Feedback inhibition, energy linked control, precursor activation, zymogen activation, covalent modification and allosteric regulation. 3. Energy: its generation & conservation A. Energy rich compounds and their role	

**REFERENCE BOOKS:**

1. Microbiology, Pelczar, M.J.chan, E.C.S., Krig, N.R., McGraw – Hill Book Co.
2. Microbiology by J.G. Black, 2002
3. Introduction to Microbiology by J.L.Ingraham and C.A.Ingraham, 2000.
4. Text book of Environmental studies for Undergraduate courses. Erach Bharucha. UGC, Universities Press, Orient Longman Pvt.Ltd.
5. Microbial Ecology, R Campbell. Johan Wiley and Sons.
6. Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93- 5070-1010)
7. Pommerville J.C. (2014) Alcamo’s Fundamental of Microbiology, 10th Edition, Jones &BarlettPvt. Ltd., (ISBN: 978-0-07-462320-6)
9. Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)
10. Microbiology by Prescott, Parley, Klein. 7th edition, 2008



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**SEMESTER 3:**

**Course Title: MICROBIAL PHYSIOLOGY**

**Practical/ Lab course (Course code: MAJ MB 302-P) Credit: 2**

<b>DISCIPLINE SPECIFIC CORE COURSE (MAJOR)</b>						
<i>COURSE</i>	<i>SEMESTER</i>	<i>COURSE CODE</i>	<i>COURSE TITLE</i>	<i>PRACTICAL</i>		
				<i>Credits</i>	<i>PRACTICAL</i>	<i>INTERNAL/External</i>
<i>Certificate Course</i>	<i>B.Sc. III</i>	<i>MAJ MB-302-P</i>	<i>MICROBIAL PHYSIOLOGY</i>	1	30	25(15+10) <i>Marks</i>
<i>TOPIC (30hr)</i>						

1. Study of different types of media
  - a. Selective media: Rose Bengal agar medium
  - b. Differential media: Mac Conkey's medium, EMB agar medium, Triple Sugar iron agar medium
  - c. Enrichment media: Selenite broth
  - d. Enriched media: Blood agar medium, Glucose Yeast Extract agar medium
  - e. Natural media: Soil extract agar, Potato dextrose agar medium
2. Determination of absorption maxima of a colored solution and bacterial suspension
3. To study biochemical reaction of bacteria based on carbon source and carbohydrate utilization
  - i. Oxidative and fermentative breakdown of glucose
  - ii. Fermentation of sugars and sugar alcohol—glucose, xylose, mannitol, lactose, maltose and sucrose
  - iii. Glucose breakdown product--Methyl red test, Voges-Proskauer's test.
  - iv. Citrate utilization test
  - v. Starch utilization test
4. To study biochemical reaction of bacteria based on nitrogen source, amino acids and proteins
  - i. Indole production test
  - ii. H<sub>2</sub>S production test
  - iii. Urea utilization test
  - iv. Casein hydrolysis test
  - v. Gelatin hydrolysis test
  - vi. Deamination test
  - vii. Decarboxylation test
5. To study of biochemical reaction of bacteria based on other tests
  - i. Catalase test
  - ii. Dehydrogenase test
6. Screening of protease producing bacteria
7. Screening of amylase producing bacteria

**References:**

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
4. Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302)



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**SEMESTER 3:**

**COURSE TITLE: MICROBIAL PHYSIOLOGY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJ MB-302P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 15**

Ex 1. A. Study biochemical reaction of bacteria	05Marks
B. Screening of proteose producing bacteria	
C. Screening of amylase producing bacteria	
Ex 2 Spotting	05Marks
Ex 3 Viva voce	02 Marks
Ex 4 Journal	03 Marks

**KSKV Kachchh University, Bhuj - Kachchh**  
(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:**

**COURSE TITLE: MICROBIAL PHYSIOLOGY**

**B. Sc. : MICROBIOLOGY UNIVERSITY PRACTICAL MAJ MB-302-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 10**

Ex 1. A. Study biochemical reaction of bacteria	05Marks
B. Screening of proteose producing bacteria	
C. Screening of amylase producing bacteria	
Ex 3 Spotting	03Marks
Ex 4 Viva voce	01 Marks
Ex 5 Journal	01 Marks



**DETAILED SYLLABUS OF B.Sc. II YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY****KSKV Kachchh University, Bhuj - Kachchh**

(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:****COURSE TITLE: BIOMOLECULES AND METABOLISM****(Course code: MAJ MB 303) Credit: 3**

<b>DISCIPLINE SPECIFIC CORE COURSES (MAJOR)</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>THEORY</b>			
				<b>Credits</b>	<b>Lectures</b>	<b>External</b>	<b>Internal</b>
<b>Certificate Course</b>	<b>B.Sc.III</b>	<b>MAJ MB-303</b>	<b>BIOMOLECULES AND METABOLISM</b>	<b>3</b>	<b>45</b>	<b>40 Marks</b>	<b>35 Marks</b>

**Course Outcomes (COs):**

Upon successful completion of this paper students will learn about Fundamentals of microscopy concept like Students will learn to understand the BIOMOLECULES AND METABOLISM To learn Chemical structure, properties, classification and biological significance of biomolecules.

<b>UNIT-I</b>	<b>Biomolecules-I</b>	<b>15 Hours</b>
	Chemical structure, properties, classification and biological significance of biomolecules A. Carbohydrates B. Proteins	
<b>UNIT-II</b>	<b>Biomolecules-II</b>	<b>15 Hours</b>
	Chemical structure, properties, classification and biological significance of biomolecules A. Lipids B. Nucleic acids	
<b>UNIT-III</b>	<b>Introduction to Metabolism</b>	<b>15 Hours</b>
	a. Anabolism, Catabolism, Primary and Secondary metabolism. b. Role of reducing power, precursor metabolites and energy rich compounds in cell metabolism.	

**REFERENCE BOOKS:**

1. Microbiology, Pelczar, M.J.chan, E.C.S., Krig, N.R., McGraw – Hill Book Co.



2. Microbiology by J.G. Black, 2002
3. Introduction to Microbiology by J.L.Ingraham and C.A.Ingraham, 2000.
4. Text book of Environmental studies for Undergraduate courses. Erach Bharucha. UGC, Universities Press, Orient Longman Pvt.Ltd.
5. Microbial Ecology, R Campbell. Johan Wiley and Sons.
6. Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93- 5070-1010)
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10. Microbiology by Prescott, Parley, Klein. 7th edition, 2008

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(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:**

**COURSE TITLE: BIOMOLECULES AND METABOLISM**  
**Practical/ Lab course (Course code: MAJ MB 304-P) Credit: 2**

<b>DISCIPLINE SPECIFIC CORE COURSE (MAJOR)</b>						
<i>COURSE</i>	<i>SEMESTER</i>	<i>COURSE CODE</i>	<i>COURSE TITLE</i>	<i>PRACTICAL</i>		
				<i>Credits</i>	<i>HRS</i>	<i>Internal/External</i>
<i>Certificate Course</i>	B.Sc. I	<b>MAJ MB-304-P</b>	<b>BIOMOLECULES AND METABOLISM</b>	1	30	<b>25( 15+10) Marks</b>
<b>TOPIC (30hr)</b>						

1. Qualitative analysis of bio molecules:

- a. Carbohydrate: Solubility test, Iodine test, Molisch's test, Benedict's test, Barfoed test, Bial's test, and Saliwanoff's test.
- b. Proteins: Biurate test, Ehrlich's test, Glyoxilic acid test, Xanthoproteic test.
- c. Lipid: Solubility test, Saponification test, Acrolein test, Hubl's iodine test
- d. Estimation of Nucleic acid based on spectrophotometer

References:

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
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**SEMESTER 3:**

**COURSE TITLE: BIOMOLECULES AND METABOLISM**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJ MB-304P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 15**

Ex.1 .Qualitative analysis of bio molecules:	05 Marks
Ex 2 Viva voce	02 Marks
Ex 3 Journal	03 Marks
Ex 4 Spotting	05 Marks

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**SEMESTER 3:**

**COURSE TITLE: BIOMOLECULES AND METABOLISM**

**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MAJ MB-304-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 10**

Ex.1 .A. Qualitative analysis of bio molecules:	05 Marks
Ex. 2 Spotting	1.5 Marks
Ex. 3 Viva voce	02 Marks
Ex. 4 Journal	1.5 Marks



**DETAILED SYLLABUS OF B.Sc. 2 YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

KSKV Kachchh University, Bhuj - Kachchh

(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:****COURSE TITLE: SOIL AND WATER MICROBIOLOGY****(Course code: MAJ MB 305) Credit: 3****DISCIPLINE SPECIFIC CORE COURSES (MINOR)**

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	THEORY			
				Credits	Lectures	External	Internal
Certificate Course	B.Sc. III	MAJMB-305	SOIL AND WATER MICROBIOLOGY	3	45	40 Marks	35 Marks

**Course Outcomes (COs):**

Upon successful completion of these papers students will learn about SOIL AND WATER MICROBIOLOGY concept like Students will learn about the microbiology of soil **microorganisms** as **biogeochemical agents**,

UNIT-I	MICROBIOLOGY OF SOIL	15 Hours
	<ol style="list-style-type: none"> <li>1. Soil as a culture medium - Physicochemical characteristics of soil</li> <li>2. Soil micro flora: Diversity in soil micro flora</li> <li>3. Methods of studying soil micro flora:               <ol style="list-style-type: none"> <li>a. Direct microscopic method, Agar plate technique, Enrichment culture technique and Buried slide method.</li> <li>b. Use of Winogradsky column in studying microbial diversity in soil</li> </ol> </li> <li>4. Microbial interactions in soil:               <ol style="list-style-type: none"> <li>a. Neutral, Positive &amp; Negative associations</li> <li>b. Interaction between plant roots and microorganisms:                   <ol style="list-style-type: none"> <li>i. Rhizosphere and its significance,</li> <li>ii. Mycorrhiza and root nodule formation</li> </ol> </li> </ol> </li> </ol>	
UNIT-II	MICROORGANISMS AS BIOGEOCHEMICAL AGENTS	15 Hours
	<ol style="list-style-type: none"> <li>1. Introduction to biogeochemical transformations in soil – mineralization and immobilization of elements</li> <li>2. Rotation of elements in nature               <ol style="list-style-type: none"> <li>a. Nitrogen cycle – Proteolysis, ammonification, nitrification, denitrification and nitrogen fixation</li> <li>b. Sulfur cycle - Sulfur oxidation and reduction</li> <li>c. Carbon cycle – Degradation of complex organic compounds, carbon dioxide fixation, Humus and its significance</li> <li>d. Iron cycle – Iron oxidation and reduction</li> <li>e. Phosphorus cycle – Mineralization, immobilization and solubilization of Phosphorus</li> </ol> </li> </ol>	



UNIT-III	MICROBIOLOGY OF DRINKING WATER	15 Hours
	<ol style="list-style-type: none"> <li>1. Natural waters – sources of contamination</li> <li>2. Microbial indicators of fecal pollution- coliforms and other than coliforms.</li> <li>3. Nuisance organisms in water: Slime forming bacteria, Iron &amp; Sulfur bacteria and Algae</li> <li>4. Bacteriological examination of drinking water- qualitative and quantitative</li> <li>5. Purification of drinking water: Sedimentation, Filtration and Disinfection</li> <li>6. Types of wastewaters, Chemical and Microbiological characteristics of waste water. BOD, COD &amp; TOD as indicators of strength of wastewater.</li> <li>7. Waste water treatment: Primary, secondary, tertiary</li> </ol>	

**REFERENCE BOOKS:**

1. Microbiology, Pelczar, M.J.chan, E.C.S., Krig, N.R., McGrow – Hill Book Co.
2. Microbiology by J.G. Black, 2002
3. Introduction to Microbiology by J.L.Ingraham and C.A.Ingraham, 2000.
4. Text book of Environmental studies for Undergraduate courses. Erach Bharucha. UGC, Universities Press, Orient Longman Pvt.Ltd.
5. Microbial Ecology, R Campbell. Johan Wiley and Sons.
6. Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93- 5070-1010)
7. Pommerville J.C. (2014) Alcamo's Fundamental of Microbiology, 10th Edition, Jones &BarlettPvt. Ltd., (ISBN: 978-0-07-462320-6)
9. Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)
10. Introduction to Microbial World: Ritesh Tandel, Komal Chawda & Kalpesh Sorthia.





KSKV Kachchh University, Bhuj - Kachchh

(Effective from June 2023-24 UNDER NEP-2020)

SEMESTER 3:

COURSE TITLE: SOIL AND WATER MICROBIOLOGY

Practical/ Lab course (Course code: MAJMB 306-P) Credit: 2

<b>DISCIPLINE SPECIFIC CORE COURSE (MINOR)</b>						
COURSE	SEMESTER	COURSE CODE	COURSE TITLE	PRACTICAL		
				Credits	PRACTICAL	INTERNAL/External
Certificate Course	B.Sc. III	MIN MB-306-P	SOIL AND WATER MICROBIOLOGY	1	30	25(15+10) Marks
				TOPIC (30hr)		

1. Microbiological analysis of soil
  - a. Standard plate count of Rhizosphere and non rhizosphere soil
  - b. Isolation of symbiotic and non-symbiotic nitrogen fixing bacteria and actinomycetes from soil
2. Microbiological analysis of drinking water
  - a. Standard plate count of drinking water
  - b. Detection of fecal pollution of water by performing presumptive test, confirmed test and completed test.
  - c. Determination of MPN of coli forms in water.

References :

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
4. Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302)



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(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:**

**Course Title: SOIL AND WATER MICROBIOLOGY**  
**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJMB-306P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 15**

- EX-1 Microbiological analysis of Soil / water (Any one) 05 Marks
1. Standard plate count of water / soil sample
  2. Determination of MPN for coli forms in water sample
  3. Presumptive and confirmed test for water
  4. Confirmed and completed test for water
  5. Isolation of symbiotic and non-symbiotic nitrogen fixing bacteria and actinomycetes from soil
- Ex 2 Spotting 05Marks
- Ex 3 Viva voce 02 Marks
- Ex 4 Journal 03 Marks

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**SEMESTER 3:**

**Course Title: SOIL AND WATER MICROBIOLOGY**  
**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MAJMB-306-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 10**

- EX-1 Microbiological analysis of Soil / water (Any one) 05 Marks
1. Standard plate count of water / soil sample
  2. Determination of MPN for coli forms in water sample
  3. Presumptive and confirmed test for water
  4. Confirmed and completed test for water
  5. Isolation of symbiotic and non-symbiotic nitrogen fixing bacteria and actinomycetes from soil
- Ex.2. Spotting 1.5 Marks
- Ex 3. Viva voce 02Marks
- Ex 4 Journal & 1.5 Marks



**DETAILED SYLLABUS OF B.Sc. 2 YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

KSKV Kachchh University, Bhuj - Kachchh  
(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:**  
**COURSE TITLE: MICROBIAL PHYSIOLOGY**  
(Course code: MDC 307) Credit: 3

**DISCIPLINE SPECIFIC CORE COURSES (MDC)**

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	THEORY			
				Credits	Lectures	External	Internal
Certificate Course	B.Sc.II I	MDC-307	MICROBIAL PHYSIOLOGY	3	45	40 Marks	35 Marks

**Course Outcomes (COs):**

Upon successful completion of these papers students will learn about MICROBIAL PHYSIOLOGY concept like Students will learn about the Classification of bacteria on the basis of growth supporting environmental factors, Modes of Nutritional Uptake, Enzymes, and Microbial Growth

<b>UNIT-I</b>	<b>MICROBIAL NUTRITION</b>	<b>15 Hours</b>
	1. Classification of bacteria on the basis of growth supporting environmental factors such as Oxygen, Temperature, pH, osmotic pressure, Salt and Hydrostatic pressure.  2. Modes of Nutritional Uptake a. Entry of nutrition in the cell, Passive diffusion, Facilitated diffusion and active transport  b. Utilization of nutrients that cannot enter the cell.	
<b>UNIT-II</b>	<b>ENZYMES</b>	<b>15 Hours</b>
	1. General Introduction a. Physical and Chemical properties b. Structure of enzymes: Prosthetic group, Apo enzyme, Co-enzymes, co-factors. c. Nomenclature and classification of enzymes. IUB system of enzyme classification 2. Enzyme action. a. Active sites of enzymes. b. Factors affecting enzyme activity. c. Inhibition of enzyme activity: Competitive, noncompetitive and uncompetitive.	



UNIT-III	ENZYMES AND ENERGY	15 Hours
	1. Enzyme kinetics A. Michaelis-Menten equation, 2. Metabolic regulation A. Types of regulatory mechanisms: Feedback inhibition, energy linked control, precursor activation, zymogen activation, covalent modification and allosterism 3. Energy: its generation & conservation A. Energy rich compounds and their role	

**REFERENCE BOOKS:**

1. Microbiology, Pelczar, M.J.chan, E.C.S., Krig, N.R., McGrow – Hill Book Co.
2. Microbiology by J.G. Black, 2002
3. Introduction to Microbiology by J.L.Ingraham and C.A.Ingraham, 2000.
4. Text book of Environmental studies for Undergraduate courses. Erach Bharucha. UGC, Universities Press, Orient Longman Pvt.Ltd.
5. Microbial Ecology, R Campbell. Johan Wiley and Sons.
6. Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93- 5070-1010)
7. Pommerville J.C. (2014) Alcamo's Fundamental of Microbiology, 10th Edition, Jones &BarlettPvt. Ltd., (ISBN: 978-0-07-462320-6)
9. Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)



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**SEMESTER 3:**

**Course Title: MICROBIAL PHYSIOLOGY**

**Practical/ Lab course (Course code: MDC 308-P) Credit: 2**

<b>DISCIPLINE SPECIFIC CORE COURSE (MDC)</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>PRACTICAL</b>	<b>INTERNAL/External</b>
<b>Certificate Course</b>	<b>B.Sc. III</b>	<b>MDC-308-P</b>	<b>MICROBIAL PHYSIOLOGY</b>	<b>1</b>	<b>30</b>	<b>25(15+10) Marks</b>
				<b>TOPIC (30hr)</b>		

1. Study of different types of media
  - a. Selective media: Rose Bengal agar medium
  - b. Differential media: Mac Conkey's medium, EMB agar medium, Triple Sugar iron agar medium
  - c. Enrichment media: Selenite broth
  - d. Enriched media: Blood agar medium, Glucose Yeast Extract agar medium
  - e. Natural media: Soil extract agar, Potato dextrose agar medium
2. Determination of absorption maxima of a colored solution and bacterial suspension
3. To study biochemical reaction of bacteria based on carbon source and carbohydrate utilization
  - i. Oxidative and fermentative breakdown of glucose
  - ii. Fermentation of sugars and sugar alcohol—glucose, xylose, mannitol, lactose, maltose and sucrose
  - iii. Glucose breakdown product--Methyl red test, Voges-Proskauer's test.
  - iv. Citrate utilization test
  - v. Starch utilization test
4. To study biochemical reaction of bacteria based on nitrogen source, amino acids and proteins
  - i. Indole production test
  - ii. H<sub>2</sub>S production test
  - iii. Urea utilization test
  - iv. Casein hydrolysis test
  - v. Gelatin hydrolysis test
  - vi. Deamination test
  - vii. Decarboxylation test
5. To study of biochemical reaction of bacteria based on other tests
  - i. Catalase test
  - ii. Dehydrogenase test
6. Screening of protease producing bacteria
7. Screening of amylase producing bacteria

**References:**

5. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya
6. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya
7. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
8. Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302)

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**SEMESTER 3:**

**COURSE TITLE: MICROBIAL PHYSIOLOGY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MDC-308P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time: \_\_\_Hrs** **Total Marks: 15**

Ex 1. A. Study biochemical reaction of bacteria	05Marks
B. Screening of proteose producing bacteria	
C. Screening of amylase producing bacteria	
Ex 2 Spotting	05Marks
Ex 3 Viva voce	02 Marks
Ex 4 Journal	03 Marks

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**SEMESTER 3:**

**COURSE TITLE: MICROBIAL PHYSIOLOGY**

**B. Sc. : MICROBIOLOGY UNIVERSITY PRACTICAL MDC-308-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time: \_\_\_Hrs** **Total Marks: 10**

Ex 1. A. Study biochemical reaction of bacteria	05Marks
B. Screening of proteose producing bacteria	
C. Screening of amylase producing bacteria	
Ex 2 Spotting	03Marks
Ex 3 Viva voce	01 Marks
Ex 4 Journal	01 Marks



**DETAILED SYLLABUS OF B.Sc. 2 YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY****KSKV Kachchh University, Bhuj - Kachchh**

(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 3:****Course Title: Mushroom Cultivation****Practical/ Lab course (Course code: SEC 309 ) Credit: 2**

COURSE	SEMESTER	COURSE CODE	COURSE TITLE	PRACTICAL		
				Credits	Practical	Internal/External
Certificate Course	B.Sc. III	SEC-309	Mushroom Cultivation	2	60	50( 25+25) Marks
TOPIC (50hr)						

1. Training on sterilization techniques (Glass wares, Medium, and Laboratory).
2. Microscopical observation of Mushrooms.
3. Media preparation; Isolation and purification of mushroom fungus.
4. Spawn preparations.
5. Cultivation of mushroom – conditions for cultivation of mushroom
6. Spawn running for *Pleurotus* spp and *Calocybe* spp.
7. Harvesting and preservation.
8. Determination of nutritional value: Proteins, sugars, lipids, crude fiber and ash contents.
9. Composting of solid waste generated in mushroom cultivation.

**References:**

1. Nita Bahl, 2002. Hand Book on Mushroom Cultivation. 4th Edition, Vijay Primalni for Oxford & IBH Publishing Co., Press, New York, New Delhi.
2. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi.
3. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India



**DETAILED SYLLABUS OF B.Sc. II YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

**KSKV Kachchh University, Bhuj - Kachchh**  
 (Effective from June 2023-24 UNDER NEP-2020)  
**SEMESTER IV:**  
**COURSE TITLE: MICROBIAL BIODIVERSITY**  
 (Course code: MAJ MB-401) Credit: 3

<b>DISCIPLINE SPECIFIC CORE COURSE</b>							
<b>(MAJOR)</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>THEORY</b>			
				<b>Credits</b>	<b>Lectures</b>	<b>External</b>	<b>Internal</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>MAJ MB-401</b>	<b>MICROBIAL BIODIVERSITY</b>	<b>3</b>	<b>45</b>	<b>40 Marks</b>	<b>35 Marks</b>
<b>UNIT</b>	<b>TOPIC</b>						
	<b>(45hrs)</b>						

**Course Outcomes (COs):**

<b>UNIT-I</b>	<b>INTRODUCTION TO MICROBIAL BIODIVERSITY</b>	<b>15 Hours</b>
	1. What is biodiversity? 2. Species concept. 3. Evolutionary tree of microorganisms. 4. Value of biodiversity. 5. Microbial biodiversity as index of environmental change	
<b>UNIT-II</b>	<b>BIODIVERSITY PROKARYOTIC, EUKARYOTIC AND ACELLULAR MICROORGANISMS</b>	<b>15 Hours</b>
	1. Prokaryotes: a. Proteobacteria, b. Gram negative Non proteobacteria, c. Firmicutes, d. Actinobacteria, e. Archaea 2. Eucarya: a. Protozoans b. Fungi c. Algae 3. Acellular organisms: Viruses and prions	
<b>UNIT-III</b>	<b>METHODS OF ASSESSING BIODIVERSITY</b>	<b>15 Hours</b>
	1. Culturable diversity: Cultivation methods. Axenic culture, Biochemical, serological, phage typing	





	2. Un-Cultural methods: Molecular and genomic methods- Molecular context of microbial diversity. Importance of DNA and rRNA sequence comparison and determination of GC content, FAME, flowcytometry.	
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**REFERENCE BOOKS:**

1. Microbial ecology R Campbell John Wiley and Sons NY
2. Microbial diversity Forms and functions by Oladele Ogunstian Blackwell publishing
3. Microbiology: Pelczar M J, Chan E. C. S., Krig N R Mc Grow Hill
4. General Microbiology Stanier R Y, Ingram, Eheelies, M L Painter Mac Millan India
5. Introduction to microbiology J L Ingram and C A Ingram
6. Tortora, G.J., Funke, B.R. and Case, C.L. (2010) Microbiology: An Introduction. 10th Edition, Pearson Benjamin Cummings, San Francisco.

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**SEMESTER IV:**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**Practical/Lab course (Course code: MAJ MB-402-P) Credit: 1**

<b>DISCIPLINE SPECIFIC CORE COURSE (MAJOR)</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>PRACTICAL</b>	<b>Internal/External</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>MAJ MB-402-P</b>	<b>MICROBIAL BIODIVERSITY</b>	<b>1</b>	<b>30</b>	<b>25(15+10) Marks</b>
<b>UNIT</b>	<b>TOPIC (30hr)</b>					

1. Study of ecological diversity amongst bacteria:

- a. Cultivation of acidophilic and alkaliphilic bacteria
- b. Cultivation of halophilic and non halophilic bacteria.
- c. Cultivation of thermophilic and mesophilic bacteria.

(Soil sample, medium and cultivation conditions for proper cultivation and observe turbidity / colony characters and study morphology by Gram staining.)

2. Study of microbial diversity in soil by using Winogradsky Column (Demonstration only)

3. Study of morphological and cultural diversity of E. coli, Enterobacter aerogenes, S. aureus, Bacillus subtilis, Bacillus megaterium and Bacillus cereus.

- a. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
- b. Study of cultural / growth diversity using N. broth and N agar media

5. Study of diverse groups of eukaryotic micro-organisms

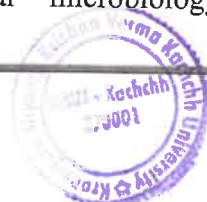
a. Fungi: Cultural and microscopic characters of Mucor, Rhizopus, Aspergillus, Penicillium and yeast

b. Algae: Study of algae present in pond water. Study of permanent slides of spirogyra and diatoms.

c. Protozoa: Study of presence of protozoa in pond water. Study of permanent slides of Amoeba, Euglena and Paramecium

**References:**

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya,



2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)

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**SEMESTER 4:**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJ MB-402-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_ **Hrs** **Total Marks: 15**

Ex. 1. Study of ecological diversity amongst bacteria:

- a. Cultivation of acidophilic and alkaliphilic bacteria
- b. Cultivation of halophilic and non-halophilic bacteria.
- c. Cultivation of thermophilic and mesophilic bacteria.
- d. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
- e. Study of cultural / growth diversity using N. broth and N agar media

Ex. 2 Viva voce

02 Marks

Ex. 3 Journal

03 Marks

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**SEMESTER 4 :**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MAJ MB402-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_ **Hrs** **Total Marks: 10**

Ex. 1. Study of ecological diversity amongst bacteria:

- a. Cultivation of acidophilic and alkaliphilic bacteria
- b. Cultivation of halophilic and non-halophilic bacteria.
- c. Cultivation of thermophilic and mesophilic bacteria.
- d. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
- e. Study of cultural / growth diversity using N. broth and N agar media

Ex. 2 Spotting

1.5 Marks

Ex. 3 Viva voce

02 Marks

Ex. 4 Journal

1.5 Marks



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**KSKV Kachchh University, Bhuj - Kachchh**  
(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER IV:**  
**COURSE TITLE: FOOD MICROBIOLOGY**  
(Course code: MAJMB-403) Credit: 3

<b>DISCIPLINE SPECIFIC CORE COURSE</b>							
<b>(MAJOR)</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>THEORY</b>			
				<b>Credits</b>	<b>Lectures</b>	<b>External</b>	<b>Internal</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>MAJMB-403</b>	<b>FOOD MICROBIOLOGY</b>	<b>3</b>	<b>45</b>	<b>40 Marks</b>	<b>35 Marks</b>
<b>UNIT</b>	<b>TOPIC (45hrs)</b>						

**Course Outcomes (COs):**

The main aspects of this paper are to describe the FOOD MICROBIOLOGY, basic structure of typical prokaryotes and archaea. It focuses on important differences in structure between bacteria and archaea. Understand diversified nutritional requirements of microorganisms and their cultivation using various different media. It also focuses on bacterial and archaeal reproduction, cell cycle, growth curve and effect of various environmental factors on growth of microorganisms.

<b>UNIT-I</b>	<b>FOOD AND RELATED MICROORGANISMS</b>	<b>15 Hours</b>
	1. Food as a substrate for microorganisms. a. Microbial flora of fresh foods. Fruits, vegetables, meat, fish, eggs. b. Factors affecting kinds and numbers of microorganisms. Intrinsic and extrinsic factors. 2. Food borne infections. a. Sources of contamination. b. Major food borne diseases. 3. Food Poisoning a. Role of <i>S. aureus</i> , <i>Cl. botulinum</i> , and <i>Salmonella spp.</i> b. Molds as poisoning agents.	
<b>UNIT-II</b>	<b>FOOD SPOILAGE AND PRESERVATION</b>	<b>15 Hours</b>
	1. Spoilage of food: a. Causes of spoilage, b. Biochemical changes caused by microbes c. Spoilage of fruits, vegetables, eggs, meat and canned foods. 2. Preservation of Food a. General principles b. Methods of preservation- i. Use of Aseptic handling ii. High temperature – Pasteurization, Sterilization, Canning	



	iii. Low temperature - Refrigeration and freezing iv. Dehydration v. Osmotic pressure vi. Preservatives. vii. Radiations- Ionizing and non-ionizing radiation	
<b>UNIT-III</b>	<b>FERMENTED FOODS, MICROBES AS FOOD AND FOOD SAFETY</b>	<b>15 Hours</b>
	1. Fermented food products: Pickles, idli, khaman and bread, Soy sauce, Kimchi, Sauerkraut 2. Microbes as food: Mushrooms, Spirulina and Yeasts 3. Microbiological criteria for food safety: Microbial standards of food FSSAI, FDA, AGMARK, FPO, BIS.	

### **REFERENCE BOOKS:**

1. Microbiology –An application based approach by M. J. Pelczar, Ecs Chan, Noel Krieg
2. Food microbiology by William C. Frazier, Dennis C. Westhoff Forth edition, Tata McGraw Hill Reprint 1995
3. Modern Food Microbiology 6<sup>th</sup> edition by James M. Jay, An Aspen publication Gaithersburg, Maryland 2000.
4. Microbiology by Prescott, Parley, Klein. 7<sup>th</sup> edition, 2008.
5. Microbiology by M. J. Pelczar, ECS Chan, Noel Krieg.

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#### **SEMESTER IV:**

#### **COURSE TITLE: FOOD MICROBIOLOGY**

**Practical/Lab course (Course code: MAJ MB-204-P) Credit: 1**

<b>DISCIPLINE SPECIFIC CORE COURSE MAJOR</b>						
<i>COURSE</i>	<i>SEMESTER</i>	<i>COURSE CODE</i>	<i>COURSE TITLE</i>	<i>PRACTICAL</i>		
				<i>Credits</i>	<i>Lectures</i>	<i>Internal/External</i>
<i>Certificate Course</i>	<b>B.Sc. IV</b>	<b>MAJ MB-404-P</b>	<b>FOOD MICROBIOLOGY</b>	<b>1</b>	<b>30</b>	<b>25(15+10) Marks</b>
<b>TOPIC (30hr)</b>						

1. Microbiological analysis.
  - a. Standard plate count of food sample
    - i. Fresh food and
    - ii. spoiled food
    - iii. fermented food
  - b. Determination of MPN of coli forms
  - d. Preparation of fermented food
  - e. Cultivation of yeast

#### **References:**

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I,



- 9th Edition. Aditya,
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
  3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)

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**SEMESTER 4 :**

**COURSE TITLE: FOOD MICROBIOLOGY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJ MB-404-P**

<i>Date:</i>	<i>Place:</i>	<i>Time: ___Hrs</i>	<i>Total Marks: 15</i>
Ex.1. a. Standard plate count of food sample			10 marks
b. Determination of MPN of coli forms			
d. Preparation of fermented food			
e. Cultivation of yeast.			
Ex 2 Viva voce			02 Marks
Ex 3 Journal			03 Marks

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**SEMESTER 4 :**

**COURSE TITLE: FOOD MICROBIOLOGY**

**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MAJ MB-404-P**

<i>Date:</i>	<i>Place:</i>	<i>Time: ___Hrs</i>	<i>Total Marks: 10</i>
Ex.1. a. Standard plate count of food sample			5Marks
b. Determination of MPN of coli forms			
d. Preparation of fermented food			
e. Cultivation of yeast			
Ex. 2. Spotting			
Ex. 3 Viva voce			1.5Marks
Ex. 4 Journal &			02 Marks



**DETAILED SYLLABUS OF B.Sc. II YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

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**SEMESTER IV:**

**COURSE TITLE: DAIRY MICROBIOLOGY**

(Course code: MAJ MB-405) Credit: 3

<b>DISCIPLINE SPECIFIC CORE COURSE</b>							
<b>(MINOR)</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>THEORY</b>			
				<b>Credits</b>	<b>Lectures</b>	<b>External</b>	<b>Internal</b>
<i>Certificate Course</i>	<i>B.Sc. IV</i>	<i>MAJ MB-405</i>	<b>DAIRY MICROBIOLOGY</b>	3	45	40 Marks	35 Marks
<b>UNIT</b>	<b>TOPIC (45hrs)</b>						

**Course Outcomes (COs):**

<b>UNIT-I</b>	<b>DAIRY PRODUCTS AND RELATED MICROORGANISMS</b>	<b>15 Hours</b>
	1. Characteristics of milk a. Physical and chemical properties of milk. b. Natural microflora of milk. 2. Milk borne infections. a. Sources of contamination. b. Milk borne diseases.	
<b>UNIT-II</b>	<b>MILK SPOILAGE AND PRESERVATION</b>	<b>15 Hours</b>
	1. Spoilage of milk: a. Causes of spoilage b. Biochemical changes caused by microbes 2. Preservation of milk: a. Use of Aseptic handling b. High temperature – Pasteurization, Sterilization, Canning c. Low temperature - Refrigeration and freezing d. Grading of milk- Resazurin test and MBRT e. Determination of efficiency of pasteurization- Phosphatase test	
<b>UNIT-III</b>	<b>FERMENTED MILK PRODUCTS</b>	<b>15 Hours</b>
	1. Starter culture 2. Cheese- types, curdling, processing, ripening 3. Other fermented dairy products- Yogurt, cultured buttermilk, acidophilus milk, bifidus milk and Kefir. 4. Introduction to Probiotics, Prebiotics and Synbiotics	



## REFERENCE BOOKS:

1. Microbiology –An application based approach by M. J. Pelczar, Ecs Chan, Noel Krieg
2. Food microbiology by William C. Frazier, Dennis C. Westhoff Forth edition, Tata McGraw Hill Reprint 1995
3. Modern Food Microbiology 6<sup>th</sup> edition by James M. Jay, An Aspen publication Gaithersburg, Maryland 2000.
4. Microbiology by Prescott, Parley, Klein. 7<sup>th</sup> edition, 2008.
5. Microbiology by M. J. Pelczar, ECS Chan, Noel Krieg.

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**SEMESTER IV:**

**COURSE TITLE: DAIRY MICROBIOLOGY**

**Practical/Lab course (Course code: MAJ MB-406-P) Credit: 1**

<b>DISCIPLINE SPECIFIC CORE COURSE (MINOR)</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>PRACTICAL</b>	<b>Internal/External</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>MAJ MB-406-P</b>	<b>DAIRY MICROBIOLOGY</b>	<b>1</b>	<b>30</b>	<b>25( 15+10) Marks</b>
<b>UNIT</b>	<b>TOPIC (30hr)</b>					

1. Microbiological analysis of Milk:
  - a. Standard plate count of milk sample
  - b. Determination of microbial load of milk by use of MBRT of raw milk, boiled milk and pasteurized milk
  - c. Detection of acid-fast organisms in milk sample

## **References:**

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9<sup>th</sup> Edition. Aditya,
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9<sup>th</sup> Edition. Aditya,
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11<sup>th</sup> Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)



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**SEMESTER 4 :**

**COURSE TITLE: DAIRY MICROBIOLOGY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MAJ MB 406-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time: \_\_\_Hrs** **Total Marks: 15**

Ex.1. Microbiological analysis of Milk	10 Marks
Ex. 2 Viva voce	02 Marks
Ex. 3 Journal	03 Marks

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**SEMESTER 4:**

**COURSE TITLE: DAIRY MICROBIOLOGY**

**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MAJMB-406-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time: \_\_\_Hrs** **Total Marks: 10**

Ex.1. Microbiological analysis of Milk	05 Marks
Ex. 2 Spotting	1.5Marks
Ex. 3 Viva voce	02 Marks
Ex. 4 Journal	1.5 Marks





**DETAILED SYLLABUS OF B.Sc. II YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

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(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER IV:**  
**COURSE TITLE: MICROBIAL BIODIVERSITY**  
(Course code: MIN MB-407) Credit: 3

<b>DISCIPLINE SPECIFIC CORE COURSE</b>							
<b>(MULTIDISCIPLINARY)</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>THEORY</b>			
				<b>Credits</b>	<b>Lectures</b>	<b>External</b>	<b>Internal</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>MIN MB-407</b>	<b>MICROBIAL BIODIVERSITY</b>	<b>3</b>	<b>45</b>	<b>40 Marks</b>	<b>35 Marks</b>
<b>UNIT</b>	<b>TOPIC (45hrs)</b>						

**Course Outcomes (COs):**

<b>UNIT-I</b>	<b>INTRODUCTION TO MICROBIAL BIODIVERSITY</b>	<b>15 Hours</b>
	1. What is biodiversity? 2. Species concept. 3. Evolutionary tree of microorganisms. 4. Value of biodiversity. 5. Microbial biodiversity as index of environmental change	
<b>UNIT-II</b>	<b>BIODIVERSITY PROKARYOTIC, EUKARYOTIC AND ACELLULAR MICROORGANISMS</b>	<b>15 Hours</b>
	2. Prokaryotes: f. Proteobacteria, g. Gram negative Non proteobacteria, h. Firmicutes, i. Actinobacteria, j. Archaea 2. Eucarya: a. Protozoans b. Fungi c. Algae 3. Acellular organisms: Viruses and prions	
<b>UNIT-III</b>	<b>METHODS OF ASSESSING BIODIVERSITY</b>	<b>15 Hours</b>
	1. Culturable diversity: Cultivation methods. Axenic culture, Biochemical, serological, phage typing  2. Un-Cultural methods: Molecular and genomic methods-	



	Molecular context of microbial diversity. Importance of DNA and rRNA sequence comparison and determination of GC content, FAME, flowcytometry.	
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### REFERENCE BOOKS:

1. Microbiology, Pelczar, M.J.chan, E.C.S., Krig, N.R., McGraw – Hill Book Co.
2. Microbiology by J.G. Black, 2002 3. Introduction to Microbiology by J.L.Ingraham and C.A.Ingraham, 2000 1.
3. Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 10th Edition, McGraw - Hill Education, (ISBN: 978-981-3151- 26-0)
4. Willey J.M., Sherwood L.M. and Woolverton C.J., (2008) Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw - Hill Education, (ISBN: 978- 007126727-4)
5. Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)
6. Basic Bacteriology: Ritesh Tandel

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**SEMESTER IV:**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**Practical/Lab course (Course code: MDC MB-408-P) Credit: 1**

<b>DISCIPLINE SPECIFIC CORE COURSE</b>						
<b>(MULTIDISCIPLINARY)</b>						
COURSE	SEMESTER	COURSE CODE	COURSE TITLE	PRACTICAL		
				Credits	PRACTICAL	Internal/External
Certificate Course	B.Sc. IV	MIN MB-408-P	MICROBIAL BIODIVERSITY	1	30	25( 15+10) Marks
				<b>TOPIC</b> (30hr)		

1. Study of ecological diversity amongst bacteria:
  - a. Cultivation of acidophilic and alkaliphilic bacteria
  - b. Cultivation of halophilic and non halophilic bacteria.
  - c. Cultivation of thermophilic and mesophilic bacteria.
 (Soil sample, medium and cultivation conditions for proper cultivation and observe turbidity / colony characters and study morphology by Gram staining.)
2. Study of microbial diversity in soil by using Winogradsky Column (Demonstration only)
3. Study of morphological and cultural diversity of E. coli, Enterobacter aerogenes, S. aureus, Bacillus subtilis, Bacillus megaterium and Bacillus cereus.
  - a. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
  - b. Study of cultural / growth diversity using N. broth and N agar media
5. Study of diverse groups of eukaryotic micro-organisms
  - a. Fungi: Cultural and microscopic characters of Mucor, Rhizopus, Aspergillus, Penicillium and yeast
  - b. Algae: Study of algae present in pond water. Study of permanent slides of spirogyra and diatoms.
  - c. Protozoa: Study of presence of protozoa in pond water. Study of permanent slides of Amoeba, Euglena and Paramecium



**References:**

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya,
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)

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**SEMESTER 4:**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**B. Sc.: MICROBIOLOGY INTERNAL PRACTICAL MIN MB-408-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 15**

Ex. 1. Study of ecological diversity amongst bacteria:

- a. Cultivation of acidophilic and alkaliphilic bacteria
- b. Cultivation of halophilic and non-halophilic bacteria.
- c. Cultivation of thermophilic and mesophilic bacteria.
- d. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
- e. Study of cultural / growth diversity using N. broth and N agar media

Ex. 2 Viva voce

02 Marks

Ex. 3 Journal

03 Marks

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**SEMESTER 4 :**

**COURSE TITLE: MICROBIAL BIODIVERSITY**

**B. Sc.: MICROBIOLOGY UNIVERSITY PRACTICAL MIN MB-408-P**

**Date:** \_\_\_\_\_ **Place:** \_\_\_\_\_ **Time:** \_\_\_\_Hrs **Total Marks: 10**

Ex. 1. Study of ecological diversity amongst bacteria:

- a. Cultivation of acidophilic and alkaliphilic bacteria
- b. Cultivation of halophilic and non-halophilic bacteria.
- c. Cultivation of thermophilic and mesophilic bacteria.
- d. Study of morphological diversity by performing Gram staining, capsule staining and spore staining
- e. Study of cultural / growth diversity using N. broth and N agar media

Ex. 2 Spotting

1.5Marks

Ex. 3 Viva voce

02 Marks

Ex. 4 Journal

1.5 Marks



**DETAILED SYLLABUS OF B.Sc. 2 YEAR FOR CERTIFICATE COURSE IN MICROBIOLOGY**

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(Effective from June 2023-24 UNDER NEP-2020)

**SEMESTER 4:****Course Title: BIOFERTILIZER****Practical/ Lab course (Course code: SEC 409) Credit: 2**

<b>DISCIPLINE SPECIFIC CORE COURSE (SEC)</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>Practical</b>	<b>Internal/External</b>
<b>Certificate Course</b>	<b>B.Sc. IV</b>	<b>SEC-409</b>	<b>BIOFERTILIZER</b>	<b>2</b>	<b>60</b>	<b>50( 25+25) Marks</b>
				<b>TOPIC (50hr)</b>		

## 1. Organic Farming Method

## A. Compost and Vermi compost

- i. Collection of different soil samples
- ii. Qualitative estimation of nitrogen, phosphorus and potassium in soil samples
- iii. Collection of fruit, vegetable and other domestic waste
- iv. Preparation of compost beds and introducing earthworms
- v. Collection of vermicastings
- vi. Sieving, drying and packing of vermicompost
- vii. Visit to animal shed and observing farm yard manure production
- viii. Preparation of media and isolation of biofertilizers

## B. Organic Fertilizer Jeevamrut, Amrutpani, and Bijamrut

- i. Preparation Method
- ii. Microbial Analysis

## References:

1. Principles of Organic Farming:: by E Somasundaram,DUdhayaNandhini,MMeyyappan;2021
2. Organic farming in India:: by Arpita Mukherjee;2017
3. Biofertilizer and biocontrol agents for agriculture;; by AM Pirttila .2021
4. Trends in Organic Farming in India;; by S. S. Purohit,2006
5. Biofertilizers for Sustainable Agriculture and Environment;; by BhoopanderGiri Ram Prasad, Qiang-Sheng Wu, AjitVarma;2019

Chairmen

BOS

Microbiology

