Royal College of Arts Science and Commerce (Autonomous)

Affiliated to University of Mumbai

Program: B.Sc.

Course: Microbiology

Minor

Syllabus for Semester: III and IV

Syllabus for Undergraduate Programme as per National Education Policy (NEP-2020) with effect from Academic year **2025-2026**

NEP Credit Structure for Science

Level	Sem	Major		Minor	OE	VSC	SEC	AEC	IKS	VEC	OJT/FP /RP/CC /CEP	Cumulative Credits	
		DSC	DSE										
4.5	I	6 (2*2T+2P)		6 (2*2T+2P)	2	2		2	2	2		22	**UG Certificate Cumulative Credit:44**
	II	6 (2*2T+2P)		6 (2*2T+2P)	2		2	2		2	2	22	
Exit Option: Award of UG Certificate in Major with 40-44 Credits and an Additional 4 Credits Core NSQF Course / Internship OR Continue with Major and Minor													
5	III	8 (3*2T+2P)		4 (2T+2P)	2+2		2	2			2	22	**UG Diploma Cumulative Credit:88**
	IV	8 (3*2T+2P)		4 (2T+2P)	2+2		2	2			2	22	
Exit Option: Award of UG Diploma in Major and Minor with 80-88 Credits and an Additional 4 Credits Core NSQF Course / Internship OR Continue with Major and Minor													
5.5	V	10 (4*2T+2P)	4 (2T+2P)			4					4	22	**UG Degree Cumulative Credit:132**
	VI	10 (4*2T+2P)	4 (2T+2P)			4					4	22	
	Total	**48**	**8**	**20**	**12**	**10**	**6**	**8**	**2**	**4**	**14**	**132**	

List of All Courses offered from Semesters I – VI in MICROBIOLOGY

Level	Sem	Major subject Course titles	Electives Course titles	Minor subject Course titles	VSC Course title/s	SEC Course title/s
4.5	I	Fundamentals of Microbiology	–	–	Basic Tools and Techniques in Microbiology	–
		Growth and Control of Microorganisms	–	–	–	–
		Practical based on above	–	–	–	–
100 - 199	II	Major Groups of Microorganisms	–	–	–	Measurement Techniques in Microbiology
		Biomolecules and Host Microbe Interaction	–	–	–	–
		Practical based on above	–	–	–	–
5	III	Molecular Biology	–	Applied Microbiology I	Microbiology of Water and Waste water	–
		Introduction to Immunology	–	–	–	–
		Environmental Microbiology	–	–	–	–
		Practical based on above	–	–	–	–
200 - 299	IV	Introduction to Genetics and Metabolism	–	Applied Microbiology II	–	Food and Dairy Microbiology
		Infection, Epidemiology and Industrial Microbiology	–	–	–	–
		Enzymology and Separation Techniques	–	–	–	–
		Practical based on above	–	–	–	–
5.5	V	Genetic and Virology	Nutrition and Health	–	Clinical Microbiology	–
		Ancient Indian System of Medicine	Or	–	Food Safety and Management System	–
		Microbial Biochemistry I	Food Production	–	–	–
		Bioprocess Technology I	–	–	–	–
		Practical based on above	–	–	–	–
300 - 399	VI	Recombinant DNA Technology	Fermented Food	–	Techniques in Molecular Biology	–
		Medical Microbiology and Immunology	Or	–	Entrepreneurship in Microbiology	–
		Microbial Biochemistry II	Food Processing	–	–	–
		Bioprocess Technology II	–	–	–	–
		Practical based on above	–	–	–	–

Programme Outcomes (POs) for B.Sc.

Sr. No.	On completing B.Sc. Microbiology, the student will have:
PO1	Acquired the basic knowledge related to the subject offered.
PO2	Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in day-to-day life.
PO3	Acquired the skills in handling scientific instruments.
PO4	Acquired the skills of planning and performing laboratory experiments, recording observations and drawing logical inferences from the scientific experiments.
PO5	Developed scientific outlook not only with respect to science subjects but also in all aspects related to life.

Programme Specific Outcomes (PSOs) for MICROBIOLOGY

Sr. No.	On completing B.Sc. Microbiology, the student will be able to:
PSO1	Demonstrate an understanding of the concepts in basic and applied microbiology
PSO2	Acknowledge the role of microorganisms in medicine, health, food, industry, waste management, environment monitoring, agriculture and genetic manipulation
PSO3	Apply theoretical knowledge to conceptualize experiments in laboratory setting
PSO4	Use relevant tools, equipment and instruments in laboratory
PSO5	Develop observational and analytical skills necessary for interpretation of experiments and projects
PSO6	Exhibit critical thinking, problem solving skills and interdisciplinary approach in addressing microbiological problems
PSO7	Effectively communicate scientific information with clarity and precision
PSO8	Demonstrate ethical awareness and professional responsibility
PSO9	Demonstrate the ability to engage in self-directed learning and collaborative team work

Semester III

Course/ Paper Title	**Applied Microbiology I**
Course offered as	**Discipline Specific Minor Course**
Course Code	RCUSMBMN301
Semester	III
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

Sr No.	Learning Objectives:
	To enable the students
1	Recognize major fields in environmental microbiology.
2	Understand the importance of microorganisms in air, water and soil.
3	Evaluate methods of studying microorganisms.
4	Appreciate the role of microorganisms in environment

	Course Outcome
	On completing the course, the student will be able to:
CO1	Analyze microorganisms present in air, water and soil.
CO2	Determine the quality of air and drinking water.
CO3	Appreciate the role of different types of microorganisms in the environment.

Detailed Syllabus

Module	Title with content **Applied Microbiology I**	No. of lectures
I	**Microbiology of Air**	**10**
	1.1 Aeromicrobiology: a. Important airborne pathogens and toxins, b. Aerosols, nature of bioaerosols c. Aeromicrobiological pathway d. Extramural aeromicrobiology and intramural aeromicrobiology	6
	1.2 Sampling Devices for the Collection of Air Samples	3
	1.3 Detection of microorganisms on fomites	1
II	**Microbiology of Water**	**10**
	2.1 Sources of fresh water	1
	2.2 Microscopic organisms present in water	1
	2.3 Bacteriological Quality of Drinking Water	2
	2.4 Routine analysis of water: a. Standard Plate Count b. Coliform Count c. Detection of Coliforms in water: Presumptive Test d. Membrane filter technique	6
II	**Microbiology of Soil**	**10**
	3.1 Soil- Definition, Composition, function, Textural triangle	2
	3.2 Types of soil microorganisms and their activities	3
	3.3 Biogeochemical Cycles: Carbon cycle and Nitrogen cycle	3
	3.4 Soil Bioremediation	2

References:

1. Willey, J., Sandman, K., & Wood, D. (2019). *Prescott's Microbiology* (ISE) (11th ed.). McGraw-Hill Education.
2. Madigan, M. T., Bender, K., & Buckley, D. (2021). *Brock Biology of Microorganisms* (16th Global ed.). San Francisco: Pearson International.
3. Pelczar Jr., M. J., Chan, E. C. S., & Krieg, N. R. (1986). *Microbiology* (5th ed.). New York: Tata McGraw-Hill Education Pvt. Ltd.

Course/ Paper Title	**Applied Microbiology Practical I**
Course offered as	**Discipline Specific Minor Course**
Course Code	RUSMBMNP1
Semester	III
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning Objectives:
	To enable the students
1	Recognize major fields in environmental microbiology.
2	Appreciate the role of microorganisms in the environment.
3	Evaluate methods of studying microorganisms.
4	Apply the knowledge of routine analysis to evaluate the quality of water and wastewater

	Course Outcome
	On completing the course, the student will be able to:
CO1	Exhibit the knowledge of the importance of microorganisms in air, water and soil.
CO2	Differentiate between the methods available for the study of microorganisms.
CO3	Perform tests to analyze quality of water

Detailed Syllabus

Module	Title with content	No. of lectures
I		60
	1. Study of microorganisms in air	
	2. Determination of sedimentation rate	
	3. Detection of microorganisms on fomites	
	4. Enrichment and isolation of special types of soil bacteria - nitrosifiers, nitrifiers	
	5. Winogradsky's column	
	6. Routine analysis of water - SPC, coliform count	
	7. Membrane filter technique	
	8. Presumptive test	
	9. Study of bacteria, actinomycetes, fungi in soil	
	10. Composting	

References:

1. Willey, J., Sherwood, L., & Woolverton, C. (2011). *Prescott's Microbiology* (ISE) (8th ed.). McGraw-Hill Education.
2. Willey, J., Sandman, K., & Wood, D. (2019). *Prescott's Microbiology* (ISE) (11th ed.). McGraw-Hill Education.
3. Madigan, M. T., Martinko, J. M., Stahl, D., & Clark, D. P. (2012). *Brock Biology of Microorganisms* (13th Global ed.). San Francisco: Pearson International.
4. Madigan, M. T., Bender, K., & Buckley, D. (2021). *Brock Biology of Microorganisms* (16th Global ed.). San Francisco: Pearson International.
5. Pelczar Jr., M. J., Chan, E. C. S., & Krieg, N. R. (1986). *Microbiology* (5th ed.). New York: Tata McGraw-Hill Education Pvt. Ltd.
6. Tortora, G. J., Funke, B. R., & Case, C. L. (2020). *Microbiology: An Introduction* (13th Global ed.). Pearson.

Semester IV

Course/ Paper Title	**Applied Microbiology II**
Course offered as	**Discipline Specific Minor Course**
Course Code	RUSMBMN401
Semester	IV
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

Sr No.	Learning Objectives:
	To enable the students
1	Understand the factors influencing microbial growth in food and their role in food spoilage as well as preservation
2	Explore the microbiology of fermented foods, probiotics, and use of microbes as food
3	Understand the classification, sources and transmission of microbial infections & the factors affecting microbial virulence
4	Explore and mechanisms of innate and adaptive immunity.
5	Acknowledge the importance of fermentation & microorganisms in industries
6.	Learn the different aspects of industrial fermentation

	Course Outcome
	On completing the course, the student will be able to:
CO1	Demonstrate an understanding of the concepts in food spoilage, foodborne infection and intoxication.
CO2	Apply the knowledge of microbiology to food preservation and production.
CO3	Explain the types and sources of microbial infections and their modes of transmission and factors affecting microbial virulence.
CO4	Differentiate between innate and adaptive immunity.
CO5	Isolate production strains, design fermentation medium and basic fermentor & run a fermentation.
CO6	Decide on an appropriate type of fermentation for a particular production strain & on the basis of the fermentation product.

Detailed Syllabus

Module	Title with content **Applied Microbiology II**	No. of lectures
I	**Introduction to Food Microbiology**	**10**
	1.1-Factors affecting microbial growth in Food ● Intrinsic factors ● Extrinsic factors	2
	1.2-Microbial spoilage of different types of food based on chemical composition	2
	1.3- Major approaches used in food preservation	2
	1.4- Foodborne infections and foodborne intoxication (Tabulation)	1
	1.5-Microbiology of fermented food ● Tabulate fermented milk products and beverages ● Production of Cheese ● Probiotics ● Microbes as food	3
II	**Medical Microbiology**	**10**
	2.1. Microbial Infection ● Classification of infection ● Sources of infection ● Transmission of infection	3
	2.2 Factors affecting microbial virulence	2
	2.3 Types of infections	1
	2.4 innate or native immunity ● Factors affecting innate immunity ● Mechanisms of innate immunity	3
	2.5 Acquired or adaptive immunity –an overview ● Active immunity ● Passive immunity	1
III	**Industrial Microbiology**	**10**
	3.1 Definition & Scope List of range of fermentation products with two example	1
	3.2 Fermentation medium: Features, Raw material – carbon and nitrogen sources, Precursors, Buffers, Antifoams, OR reducing agents.	1
	3.3 Inoculum development.-Basic principle & schematic representation.	1
	3.4 Types of fermentations – Aerobic, Anaerobic, Surface, Submerged, Batch, Continuous, Fed batch & SSF (Brief description with at least one example each)	1
	3.5 Bioreactors: Features, Construction materials, Basic Design with parts (Diagram),	2
	3.6 Production strains: Characteristics of production strains	2

	Screening – Definition Primary and secondary screening for antibiotic producers	
	3.7 Production of ethanol	2

References:

1. Wiley, J. M., Sherwood, L. M., & Woolverton, C. J. (2022). *Prescott, Harley, and Klein's Microbiology* (12th ed.). McGraw Hill.
2. Frazier, W. C., & Westhoff, D. C. (2013). *Food Microbiology* (5th ed.). McGraw Hill Education (India) Private Limited.
3. Adams, M. R., Moss, M. O., & McClure, P. (2016). *Food Microbiology* (4th ed.). Royal Society of Chemistry
4. Ananthanarayan, R., & Paniker, C. K. J. (2017). *Textbook of Microbiology* (10th ed.). University Press.
5. Sivakumar, Joe & Sukesh, (2010). *An Introduction to Industrial Microbiology,* S. Chand & Company Ltd.
6. Patel, A. H. (2016). *Industrial Microbiology* (2nd ed.). New Delhi.
7. L.E. Casida, (2004). *Industrial Microbiology,* Published by New age International (P) ltd.
8. Stanbury & Whittaker, *Principles of fermentation Technology*, Second edition, MPG Books Ltd, Bodmin, Cornwall

Course/ Paper Title	**Applied Microbiology Practical I**
Course offered as	**Discipline Specific Minor Course**
Course Code	RUSMBMNP2
Semester	IV
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning objectives:
	To enable the students
1	Develop skills in isolating and identifying spoilage and probiotic microorganisms from food samples and evaluating microbiological quality of cheese
2	Understand the effects of preservatives on microbial growth
3	Learn the technique of blood staining and demonstrating phagocytosis
4	Select suitable media and techniques for isolation of pathogens and demonstration of virulence factors
5	Screen & isolate industrially important organisms
6	Evaluate different methods of fermentation

	Course Outcome
	On completing the course, the student will be able to:
CO1	Demonstrate proficiency in microbial isolation techniques especially from food.
CO2	Analyze the microbiological quality of cheese and evaluate the thermal resistance and MIC of food preservatives using standard laboratory methods.
CO3	Carry out blood staining to demonstrate blood cells involved in host defense
CO4	Isolate pathogens using suitable media and demonstrate microbial virulence factors
CO5	Formulate appropriate screening methods to isolate & study industrially important organism
CO6	Set up different modes of fermentation.

Detailed Syllabus

Module	Title with content	No. of lectures
I	**Food microbiology**	60
	Isolation of spoilage organisms from foods (Amylolytic, Proteolytic & Lipolytic)	
	TDT & TDP	
	MIC of Sodium Benzoate, Metabisulphite	
	MIC of Salt and sugar	
	Microbiological quality of Cheese- SPC, Proteolytic count, Yeast & Molds count, Coliform count	
	Isolation of probiotic organisms.	
II	**Medical Microbiology**	
	Blood staining	
	Phagocytosis	
	Isolation of pathogenic *Staphylococcus aureus* & *Pseudomonas aeruginosa*	
	Virulence factors - coagulase, hemolysin & lecithinase	
III	**Industrial Microbiology**	
	Crowded plate method	
	Wilkins Overlay method	
	Amylase production by Surface, Submerged & SSF method	
	Agar strip method	
	Central streak/ giant colony plate method	

References:

1. Frazier, W. C., & Westhoff, D. C. (2013). *Food Microbiology* (5th ed.). McGraw Hill Education (India) Private Limited.
2. Adams, M. R., Moss, M. O., & McClure, P. (2016). *Food Microbiology* (4th ed.). Royal Society of Chemistry
3. Ananthanarayan, R., & Paniker, C. K. J. (2017). *Textbook of Microbiology* (10th ed.). University Press.
4. Procop, G. W., Church, D. L., Hall, G. S., Janda, W. M., Koneman, E. W., Schreckenberger, P., & Woods, G. L. (2017). *Koneman's Color Atlas and Textbook of Diagnostic Microbiology* (7th ed.). Wolters Kluwer Health.
5. Patel, A. H. (2016). *Industrial Microbiology* (2nd ed.). New Delhi.
6. Casida L.E., (2004). *Industrial Microbiology*, Published by New age International (P) ltd.

Board of studies in Microbiology

	Category	Name and Designation	Affiliation
1	Chairperson (Head of Department)	Ms. Vilasini Gaode Associate Professor	Royal College of Arts, Science and Commerce
2	Full time teachers of the Department	Ms. Radhika D'souza Associate Professor	
		Ms. Zamanat Syed Associate Professor	
		Mr. Farhaan Makba Associate Professor	
3	Two subject experts from outside the Parent University nominated by the Academic Council.	Dr. Ulhas Patil Professor	Institute of Science, Dr. Homi Bhabha State University
		Dr. Vivek Tanawade Associate Professor Associate Dean of Undergraduate Studies	School of Arts and Science Ahmedabad University
4	One expert nominated by the Vice-Chancellor from a panel of six recommended by the College Principal.	Dr. S. V. Raut Professor and Head,	Dept. of Microbiology, Bhavan's College,
5	One representative from industry / corporate sector/ allied area relating to placement.	Dr. Nirmla Devi Thakur Senior Manager	Excel Innovation Centre, Excel Industries Ltd.
6	One postgraduate meritorious alumnus nominated by the Principal. (Please give three to four names of your alumnus)	Ms. Mukta Kuyare Manager, CSSD and Paramedical Services	Central Sterile Supplies Department, Bhakti Vedanta Hospital
7	One expert from outside the parent college nominated by the College Principal	Dr. Rajbinder Kaur Dehiya Associate Professor	Dept. of Microbiology, Sophia College for Women