



# **Royal College of Arts Science and Commerce (Autonomous)**

*Affiliated to University of Mumbai*

Program: B.Sc.

Course: Microbiology

Major

VSC / SEC

Syllabus for Semester: I and II

Syllabus for Undergraduate Programme as per  
National Education Policy (NEP-2020) with effect from  
Academic year **2024-2025**

## 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	
<b>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</b>													
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	
<b>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</b>													
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	
	<b>Total</b>	<b>48</b>	<b>8</b>	<b>20</b>	<b>12</b>	<b>10</b>	<b>6</b>	<b>8</b>	<b>2</b>	<b>4</b>	<b>14</b>	<b>132</b>	

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

Level	Sem	Major subject Course titles	Electives Course titles	Minor subject Course titles	OE 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	Introduction to Immunology	–	Applied Microbiology I	–	Microbiology of Water and Waste water	–	
		Molecular Biology	–	–	Microbes in Gut	–	–	
		Environmental Microbiology	–	–	–	–	–	
		Practical based on above	–	–	–	–	–	
	200 - 299	IV	Enzymology and Separation Techniques	–	Applied Microbiology II	–	–	Food and Dairy Microbiology
			Introduction to Genetics and Industrial Microbiology	–	–	Microbes in Kitchen	–	–
			Research Methodology and Bio-Statistics	–	–	–	–	–
			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 I

Course/ Paper Title	<b>Fundamentals of Microbiology</b>
Course offered as	<b>Discipline Specific Major Course I</b>
Course Code	RCUSMBMJ101
Semester	I
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

<b>Sr No.</b>	<b>Learning Objectives:</b>
	To enable the students
1	Recognize the major milestones in the history of microbiology
2	Comprehend evolution of microbial life
3	Understand prokaryotic and eukaryotic cell structure and function
4	Analyze and compare the structural features of prokaryotes, eukaryotes and Archaea

	<b>Course Outcome</b>
	On completing the course, the student will be able to:
CO1	Demonstrate the understanding of key events, and discoveries in the field of microbiology
CO2	Exhibit the knowledge of importance of microorganisms in evolution of life on earth
CO3	Identify and differentiate between prokaryotic and eukaryotic cells based on structural characteristics

## Detailed Syllabus

Module	Title with content <b>Fundamentals of Microbiology</b>	No. of lectures
<b>I</b>	<b>History of Microbiology and Prokaryotic cell structure and function</b>	15
	1.1 - History of Microbiology a) Discovery of microorganisms b) Controversy over spontaneous generation c) Golden age of Microbiology d) Development of industrial microbiology and microbial ecology e) The Modern Era of Microbiology	5
	1.2 - Prokaryotic cell structure and function a) Morphology and arrangement b) Cell wall and cell membrane c) Extramural layers -Glycocalyx, Slime, Capsule d) Components external to cell wall- Flagella, Pili, Fimbriae e) Cytoplasmic matrix and ribosomes (70S) f) Nucleoid and Plasmids g) Bacterial endospores and their formation	10
<b>II</b>	<b>Scope of Microbiology, Evolution and Eukaryotic cell structure and function</b>	15
	2.1 - Scope of Microbiology a. Fundamental Microbiology b. Applied Microbiology c. Future of Microbiology	2
	2.2 - Evolution of microbial life a) Evolution and extent of microbial life b) The first cells and the onset of biological evolution c) Comparison of Prokaryotes, Eukaryotes and Archaea	1
	2.3 - Eukaryotic cell structure and function a) External cell covering b) Plasma membrane and Cytoplasmic matrix c) Endoplasmic reticulum d) Golgi apparatus e) Ribosomes (80S) f) Mitochondria g) Chloroplasts h) Nucleus i) Cytoskeletal elements j) Cilia and Flagella	12

## 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.
7. Chess, B., & Talaro, K. (2021). *Talaro's Foundations in Microbiology* (11th ed.). McGraw-Hill.

Course/ Paper Title	<b>Growth and Control of Microorganisms</b>
Course offered as	<b>Discipline Specific Major Course II</b>
Course Code	RCUSMBMJ102
Semester	I
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

Sr No.	Learning Objectives:
	To enable the students
1	Describe nutrient requirements of microorganisms
2	Classify various types of culture media on the basis of their composition and function
3	Understand the concept of growth of bacteria and factors affecting growth
4	Understand the concept of death of bacteria
5	Appreciate the role of various physical and chemical agents in control of microorganisms

Course Outcome	
	On completing the course, the student will be able to:
CO1	Describe nutritional requirements
CO2	Choose different types of culture media depending on the need
CO3	Differentiate between different phases of growth
CO4	Explain death and factors affecting death of microorganisms
CO5	Choose appropriate physical and / or chemical agents based on their properties for control of microorganisms

## Detailed Syllabus

Module	Title with content	No. of lectures
	<b>Growth and Control of Microorganisms</b>	
<b>I</b>	<b>Microbial Growth and Nutrition</b>	15
	1.1 - Microbial Nutrition a) Elements of life b) Requirement for C, H, O and electrons c) Nutritional types of microorganisms d) Requirement for N, P and S e) Growth Factors	5
	1.2 - Culture media a) Types based on composition b) Common media ingredients c) Functional types of media	4
	1.3 - Microbial Growth a) Definition of growth b) Phases of bacterial growth c) Mathematical expression of growth d) Influence of environmental factors on growth	6
<b>II</b>	<b>Control of Microorganisms</b>	15
	2.1 - Common terminology - Sterilization, Commercial sterilization, Sterilant, Disinfection, Disinfectant, Sanitization, Antisepsis, Antiseptic, Degermation, Germicide, Microbiostasis, Asepsis	1
	2.2 - Pattern of microbial death Factors influencing effectiveness of antimicrobial agent	1
	2.3 - Use of physical methods in control a) Heat b) Filtration c) Radiation (mechanism of action, application, advantages and disadvantages)	7
	2.4 - Use of chemical agents in control a) Properties of ideal agent b) Phenolics c) Alcohols, d) Halogens, e) Heavy metals, f) Quaternary ammonium compounds g) Aldehydes h) Gaseous sterilants i) Chemotherapeutic agents (overview)	5
	2.5 - Evaluation of antimicrobial agent effectiveness	1

## 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.
7. Chess, B., & Talaro, K. (2021). *Talaro's Foundations in Microbiology* (11th ed.). McGraw-Hill.

Course/ Paper Title	<b>Practical based on RCUSMBMJ101 and RCUSMBMJ102</b>
Course offered as	<b>Discipline Specific Major Course</b>
Course Code	RCUSMBMJ1
Semester	I
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning Objectives:
	To enable the students
1	Prepare assignments using primary literature
2	Understand staining techniques and develop observational skills for identifying different types of bacteria and their organelles
3	Become familiar with different types of media used for cultivation of microorganisms
4	Explain various phases of growth of bacteria in batch culture
5	Use different methods for controlling microorganisms, both physical and chemical

	Course Outcome
	On completing the course, the student will be able to:
CO1	Prepare assignments on significant scientific discoveries in microbiology and describe the structural features of eukaryotic cells
CO2	Perform simple and differential staining techniques to differentiate bacteria and visualize cellular components
CO3	Prepare basic media and glassware for growth of microorganisms in laboratory
CO4	Plot a bacterial growth curve and identify various phases of growth in bacteria
CO5	Compare and choose the most effective physical and chemical antimicrobial agent

## Detailed Syllabus

Module	Title with content	No. of lectures
<b>I</b>	<b>Practical based on RCUSMBMJ101 (Fundamentals of Microbiology)</b>	30
	<ol style="list-style-type: none"> <li>1. Assignment: Contribution of Scientists in the field of Microbiology</li> <li>2. Ubiquity of microorganisms</li> <li>3. Basic staining technique to demonstrate morphology of bacteria: Monochrome staining</li> <li>4. Gram staining of bacteria</li> <li>5. Metachromatic granule staining</li> <li>6. Capsule staining</li> <li>7. Study of bacterial motility</li> <li>8. Wet mount of pond water</li> <li>9. Assignment on eukaryotic organelles</li> </ol>	
<b>II</b>	<b>Practical based on RCUSMBMJ102 (Basics of Microbiology)</b>	30
	<ol style="list-style-type: none"> <li>1. Preparation of culture media</li> <li>2. Growth in liquid and solid media</li> <li>3. Study of Incubator</li> <li>4. Growth under shaker and static condition</li> <li>5. Differential media and Selective media (Salt Mannitol Agar, MacConkey's Agar, Superimposed Blood Agar)</li> <li>6. Effect of temperature on microbial growth</li> <li>7. Effect of pH on microbial growth</li> <li>8. Bacterial Growth curve</li> <li>9. Demonstration of working of autoclave, hot air oven, bacteriological filters</li> <li>10. Effect of UV on bacteria</li> <li>11. Effect of antimicrobial agents</li> </ol>	

### References:

1. Benson, Microbiological Application – Laboratory Manual, 8E
2. Wiley, Sherwood, Woolverton, Prescott, Harley and Klein's Microbiology, 7E
3. Harley, Prescott, Laboratory Exercises in Microbiology, 5E
4. Cappuccino, Welsh, Microbiology A Laboratory Manual, 11E

Course/ Paper Title	<b>Basic Tools and Techniques in Microbiology</b>
Course offered as	<b>Vocational Skill Course</b>
Course Code	RCUSMBVSC101
Semester	I
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning Objectives:
	To enable the students
1	Understand the principles, construction, working and application of various types of microscopes
2	Know the principles of magnification and resolution in microscopy
3	Use different staining techniques to visualize microorganisms and their cellular structures
4	Recognize safety protocols and aseptic techniques
5	Acknowledge various methods of sterilization, culture inoculation, culture preservation and pure culture techniques

Course Outcome	
	On completing the course, the student will be able to:
CO1	Effectively use various types of microscopes
CO2	Explain how magnification and resolution affect clarity and detail of microscopic images
CO3	Apply special staining techniques to demonstrate various cellular components
CO4	Follow safety protocols and apply aseptic techniques effectively to ensure safe laboratory environment and avoid contamination
CO5	Prepare and sterilize labware & execute various inoculation and pure culture techniques
CO6	Preserve pure cultures

## Detailed Syllabus

Module	Title with content	No. of lectures
	<b>Basic Tools and Techniques in Microbiology</b>	
<b>I</b>	<b>Microscopy and Staining techniques</b>	30
	<ol style="list-style-type: none"> <li>1. Study of Microscopy</li> <li>2. Concept of magnification and resolution</li> <li>3. Study of bright field microscope</li> <li>4. Study of dark field microscope and</li> <li>5. Phase contrast microscope</li> <li>6. Differential staining - Gram's staining</li> <li>7. Negative staining</li> <li>8. Special staining               <ol style="list-style-type: none"> <li>a) Cell wall staining</li> <li>b) Lipid staining</li> <li>c) Endospore staining</li> </ol> </li> </ol>	
<b>II</b>	<b>Pure Culture Techniques and Preservation</b>	30
	<ol style="list-style-type: none"> <li>1. Safety in microbiology laboratory</li> <li>2. Concept of asepsis</li> <li>3. Aseptic transfer</li> <li>4. Preparation and sterilization of labware</li> <li>5. Methods of inoculation</li> <li>6. Isolation of pure culture and colony characteristics</li> <li>7. Preservation of pure culture - serial subculture, soil stock, low temperature freezing, lyophilization</li> </ol>	

### References:

1. Benson, Microbiological Application – Laboratory Manual, 8E
2. Wiley, Sherwood, Woolverton, Prescott, Harley and Klein's Microbiology, 7E
3. Harley, Prescott, Laboratory Exercises in Microbiology, 5E
4. Cappuccino, Welsh, Microbiology A Laboratory Manual, 11E
5. Jorgensen, Pfaller et al, Manual of Clinical Microbiology 11E

# Semester II

Course/ Paper Title	<b>Major Groups of Microorganisms</b>
Course offered as	<b>Discipline Specific Major Course I</b>
Course Code	RCUSMBMJ201
Semester	II
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

<b>Sr No.</b>	<b>Learning Objectives:</b>
1	To learn about the structure, life cycle, and significance of different Microbes.
2	To understand the distribution & the industrial & economic significance of different microbes.
3	To acknowledge the medical significance of different microbes.
4	To learn about methods to cultivate & identify different microbes.

	<b>Course Outcome</b>
	On completing the course, the student will be able to:
CO1	Identify various types of microorganisms on the basis of general & cultural characteristics
CO2	Classify different groups of microorganisms based on their characteristics.
CO3	Demonstrate the industrial, economical and medical significance of microorganisms
CO4	Decide on methods & media to cultivate various types of organisms

## Detailed Syllabus

Module	Title with content <b>Major groups of Microorganisms</b>	No. of lectures
<b>I</b>	<b>Study of Acellular, Prokaryotic &amp; Archaeal microorganisms :</b>	15
	1.1 Viruses: Historical highlights, General properties of viruses, prions, viroids Structure of viruses-capsids, envelopes, genomes Cultivation of viruses- overview Replication of Bacteriophages: Lytic cycle. Lysogeny, Structure and Life cycle of T4 phage.	06
	1.2 Rickettsia & Coxiella: General features, Differences, Cultivation, Life cycle, Diseases & symptoms, Major groups of Rickettsia – an overview, Epidemic typhus in detail.	03
	1.3 Chlamydia: General features, Cultivation, Life cycle & diseases caused.	01
	1.4 Mycoplasma: General features, Cultivation & diseases caused.	02
	1.5 Actinomycetes: General features of Nocardia and Streptomyces, Cultivation & Importance -ecological, commercial and medical	02
	1.6 Archaea: General features & distribution, Major Archaeal physiological groups, Archaeal cell wall, lipids and membranes, Ecological importance	01
<b>II</b>	<b>Study of Eukaryotic microorganisms :</b>	15
	2.1 Protozoa: Major Categories of Protozoa based on motility, reproduction. Medically important Protozoa, Life cycle of Entamoeba	04
	2.2 Algae: General characteristics, morphology, pigments, reproduction, cultivation of algae. Major groups of Algae –an overview. Biological, medical and economic importance of Algae. Differences between Algae and Cyanobacteria	05
	2.3 Fungi- Yeast and Moulds: General characteristics, structure, reproduction, cultivation. Major fungal divisions- overview. Life cycle of yeast, Biological and economic importance	05
	2.4 Slime molds and Myxomycetes: General characteristics	01

**References:**

1. Wiley, Sherwood, Woolverton, *Prescott's Principles of Microbiology*, 8th edition. McGraw-Hill Higher Education, 2009
2. Willey J. , Sandman K , Wood D. *Prescott's Microbiology (ISE)*(2019) 11th edition– McGraw-Hill Education
3. Pelczar Jr, M. J.; Chan, E.C.S. & Krieg, N. R. (1986). *Microbiology* 5th edition. New York: Tata McGraw-Hill Education Pvt. Ltd.
4. Madigan, M. T.; Bender K. , Buckley D. (2021). *Brock Biology of Microorganisms*. 16th Global edition- San Francisco: Pearson International edition
5. Tortora G.J., Funke, B.R., Case, C.L., 2020 *Microbiology: An introduction*. 13th Global edition. Pearson
6. P.C. Trivedi Sonali Pandey Seema Bhadauria, *Textbook of Microbiology*, Aavishkar Publishers, Distributors Jaipur 302 003 (Raj.) India
7. A.J.Salle, *Fundamental Principles of Bacteriology*, McGraw Hill Book Company Inc. 1984

Course/ Paper Title	<b>Biomolecules and Host Microbe Interactions</b>
Course offered as	<b>Discipline Specific Major Course II</b>
Course Code	RCUSMBMJ202
Semester	II
No. of Credits	2 (30 hours)
No. of lecture Hours/week	2

Sr No.	Learning Objectives:
1	To recognize the different types of chemical bonds in biomolecules.
2	To understand physical properties of water
3	To learn about the structure of nucleic acids and proteins.
4	To learn about the structure of carbohydrates and Lipids
5	To understand the types of Microbial Interactions

Course Outcome	
	On completing the course, the student will be able to:
CO1	Explain different types of interactions with water
CO2	Apply the knowledge of Nucleic acids, proteins, carbohydrates and lipids in cell formation.
CO3	Appreciate the structural differences between biomolecules.
CO4	Identify the types of interactions between microbes, humans and plants.
CO5	Appreciate the significance of microbial interactions

## Detailed Syllabus

Module	Title with content	No. of lectures
	<b>Biomolecules and Host Microbe Interactions</b>	
<b>I</b>	<b>Biomolecules</b>	15
	1.1 Chemical foundations: Types of bonds and their importance: a. Electrovalence, covalent, ionic and Hydrogen b. Ester, phosphodiester, thioester, peptide, glycosidic.	2
	1.2 Water- Structure, properties in brief.	1
	1.3 Carbohydrates: Definition, Classification, Biological role. Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharide (starch, glycogen, peptidoglycan, cellulose)	3
	1.4 Lipids: Fatty acids as basic components of lipids and their classification (Lehninger), nomenclature, storage lipids and structural lipids. Types of lipids with general structure of each and mention examples.	2
	1.5 Peptides and proteins: Definition and general features and examples with biological role. Primary, secondary, tertiary, quaternary structures of proteins- Brief outline.	4
	1.6 Nucleic acids: Nitrogenous bases- Purines , Pyrimidines Pentoses-Ribose, Deoxyribose, Nomenclature of Nucleosides and nucleotides, N-β-glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds). Basic structure of RNA and DNA.	3
<b>II</b>	<b>Microbial Interactions:</b>	15
	2.1 Types of Microbial Interactions: Mutualism, Cooperation, Commensalisms, Predation Parasitism, Amensalism, Competition. (One example each)	4
	2.2 Human Microbe Interactions. a) Normal flora of the human body: Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine, Genitourinary tract. b) Relationship between microbiota & the host. c) Gnotobiotic animals	5
	2.3 Microbial associations with vascular plants a) Phyllosphere b) Rhizosphere & Rhizoplane c) Mycorrhizae d) Nitrogen fixation : Rhizobia, Actinorhizae, Stem Nodulating Rhizobia e) Fungal & Bacterial endophytes f) Agrobacterium & other plant pathogens	6

**References:**

1. J. I. Jain, S. Jain and N. Jain, 2009, Fundamentals of Biochemistry, S. Chand & Company Ltd..
2. Nelson D. and M. Cox, 2005. Lehninger. Principles of Biochemistry. 4th Edition. W.H. Freeman and Company. New York
3. Satyanarayana U and U Chakrapani, 2010. Biochemistry, 3rd Edition. Books & Allied (P) Ltd.
4. Prescott, Harley. Klein, 2006. Microbiology, 7th edition, International edition, McGraw Hill.

Course/ Paper Title	<b>Practical based on RCUSMBMJ201 &amp; RCUSMBMJ202</b>
Course offered as	<b>Discipline Specific Major Course</b>
Course Code	RCUSMBMJ2
Semester	II
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning Objectives:
1	To study the morphological and cultural characteristics of yeast & molds & Actinomycetes
2	To learn to isolate extremophiles by using selective media.
3	To understand the difference between protozoa & algae on the basis of morphological characteristics
4	To learn to enrich & isolate Algae.
5	To demonstrate bacteriophages qualitatively and quantitatively

Course Outcome	
	On completing the course, the student will be able to:
CO1	Differentiate & identify yeast, molds & actinomycetes by their morphology & cultural growth pattern.
CO2	Isolate extremophiles & Algae by using selective media.
CO3	Identify protozoan & algae on the basis of cell shape, size, arrangement & motility.
CO4	Demonstrate the presence of bacteriophages by enrichment & isolation method.

## Detailed Syllabus

Module	Title with content	No. of lectures
<b>I</b>	<b>Practical based on RCUSMBMJ201 (Major Groups of Microorganisms)</b>	30
	<ol style="list-style-type: none"> <li>1. Study of Protozoa-Permanent slides and wet mount of Hay infusion</li> <li>2. Enrichment &amp; isolation of Coliphage</li> <li>3. Enrichment and isolation of halophiles</li> <li>4. Isolation of thermophiles</li> <li>5. Slide culture technique for Actinomycetes/Molds</li> <li>6. Isolation of Actinomycetes</li> <li>7. Study of fungi-Permanent slides and wet mount</li> <li>8. Isolation of Molds &amp; Yeast</li> <li>9. Enrichment &amp; Isolation of Algae</li> </ol>	
<b>II</b>	<b>Practical based on RCUSMBMJ202 (Biomolecules &amp; Host Microbe Interactions)</b>	30
	<ol style="list-style-type: none"> <li>1. Qualitative detection of Carbohydrates- Benedicts, Molisch's test.</li> <li>2. Qualitative detection of Proteins and amino acids- Biuret, Ninhydrin.</li> <li>3. Qualitative detection of DNA by DPA</li> <li>4. Qualitative detection of RNA by Orcinol.</li> <li>5. Normal flora of the Skin</li> <li>6. Normal flora of the Saliva</li> <li>7. Effectiveness of hand washing.</li> <li>8. Bacteroid Staining &amp; Isolation of Rhizobium</li> </ol>	

### References:

1. Cappuccino, Welsh, Microbiology A Laboratory Manual, 11E
2. Benson, Microbiological Application – Laboratory Manual, 8E
3. Soil Microbiology, Ecology and Biochemistry, Third Edition, Eldor A. Paul published by Elsevier Science and Technology.
4. Agricultural Microbiology an eCourse Developed by TNAU (ICAR)
5. David T Plummer, An Introduction to Practical Biochemistry, Third Edition Tata McGraw-Hill Publishing Company Limited

Course/ Paper Title	<b>Measurement Techniques in Microbiology</b>
Course offered as	<b>Skill Enhancement Course</b>
Course Code	RCUSMBSEC201
Semester	II
No. of Credits	2 (60 hours)
No. of lecture Hours/week	4

Sr No.	Learning Objectives:
1	To learn different methods of enumeration
2	To master skills required for enumeration
3	To understand working of instruments
4	To study methods to check efficiency of Autoclave & Hot Air Oven

Course Outcome	
	On completing the course, the student will be able to:
CO1	Enumerate microorganisms by different methods
CO2	Select appropriate methods of enumeration
CO3	Handle basic instruments independently
CO4	Prepare buffers of different pH
CO5	Validate efficiency of Autoclave & Hot Air Oven

## Detailed Syllabus

Module	Title with content	No. of lectures
<b>I</b>	<b>Measurement Techniques in Microbiology</b>	
<b>I</b>	<b>Measurement of Growth</b>	30
	<ol style="list-style-type: none"> <li>1. Overview of Growth &amp; its measurement</li> <li>2. Wet weight &amp; Dry Weight</li> <li>3. Breed's count</li> <li>4. Hemocytometer</li> <li>5. McFarland/Browns Opacity tube method</li> <li>6. Viable count - Surface spread,</li> <li>7. Viable count - Pour plate</li> <li>8. Micrometry</li> </ol>	
<b>II</b>	<b>Basic Instrumentation</b>	30
	<ol style="list-style-type: none"> <li>1. Terminology: Accuracy, Precision, Specificity, Sensitivity, Calibration</li> <li>2. Weighing Balance</li> <li>3. Pipettes &amp; pipetting techniques</li> <li>4. Colorimeter - Principle, construction and working</li> <li>5. Determination of <math>\lambda</math> max</li> <li>6. Verification of Beer - Lambert's Law</li> <li>7. Concept of pH &amp; buffer</li> <li>8. pH Meter - Principle, construction and working</li> <li>9. Preparation of Buffers and Measurement of pH</li> <li>10. Laminar Air Flow system</li> <li>11. Efficiency of Autoclave and Hot Air Oven</li> <li>12. Visit to Instrumentation facility</li> </ol>	

### References:

1. Cappuccino, Welsh, Microbiology A Laboratory Manual, 11E
2. Benson, Microbiological Application – Laboratory Manual, 8E
3. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edition.

# Royal College of Arts, Science and Commerce (Autonomous)

## Examination Pattern

(Major/ Minor and VSC/SEC/ Open Elective)

### Theory Examination Pattern

<b>I</b>	<b>Internal Assessment</b>	<b>20 Marks</b>
<b>a</b>	One class test (Short answers/Objectives/ Multiple Choice)	10 Marks
<b>b</b>	Assignment/ Project/ Presentation/Book or research paper Review	05 Marks
<b>c</b>	Active Participation, Overall performance	05 Marks
<b>II</b>	<b>Semester End Examination</b>	<b>30 Marks</b>
	<b>Duration</b>	<b>1 Hours</b>
	Q 1. Answer any two of four (subjective based on module I)	10 Marks
	Q 2. Answer any two of four (subjective based on module II)	10 Marks
	Q 3. Do as directed (ten objective based on module I and II)	10 Marks

### Practical examination Pattern

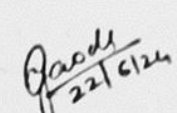
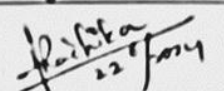
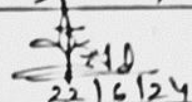
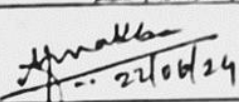
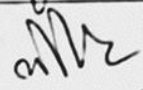
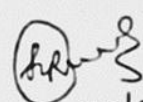
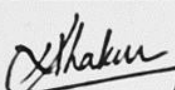
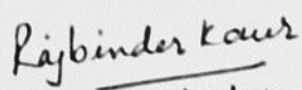
	<b>External Assessment for Practical</b>	<b>50 Marks</b>
	Experiment –I*	20
	Experiment –II*	20
	Viva / Quiz / Visit	5
	Journal	5

\*( one experiment of 20 marks or two experiments of 10 marks each)

## 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

## Board of studies in Microbiology

	Category	Name and Designation	Signature
1	Chairperson (Head of Department)	Ms. Vilasini Gaode Associate Professor	 22/6/24
2	Full time teachers of the Department	Ms. Radhika D'souza Associate Professor	 22/6/24
		Ms. Zamanat Syed Associate Professor	 22/6/24
		Mr. Farhaan Makba Associate Professor	 22/06/24
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	 22.06.2024.
		Dr. Vivek Tanawade Associate Professor Associate Dean of Undergraduate Studies School of Arts and Science Ahmedabad University	Attended Online
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,	 22/06/2024
5	One representative from industry / corporate sector/ allied area relating to placement.	Dr. Nirmla Devi Thakur Senior Manager Excel Innovation Centre, Excel Industries Ltd.	 22/6/24
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	Attended Online
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	 22/6/24



Principal  
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