AC/II(23-24).2.RUS9

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for

Program: F.Y.B.Sc. (Microbiology)

Program Code: (RUSMIC)

(As per the guidelines of National Education Policy 2020-
Academic year 2023-24)

(Choice based Credit System)

Graduate Attributes

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

GA	Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges; work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in Science program in the subject of Statistics will be able to:**
PO 1	Recall, explain and summarize basic concepts related to cytology, biochemistry, physiology, genetics and reproduction of prokaryotes and compare it with eukaryotes.
PO 2	Appreciate and exemplify the diversity in the microbial world and evaluate their ecological role as well as state their significance to humankind.
PO 3	Understand the basic concepts associated with growth and control of microorganisms and apply it in pure culture and preservation techniques.
PO 4	Differentiate, classify and characterize microorganisms based on their morphological, cultural, biochemical, and molecular properties.
PO 5	Explore, compare and evaluate the role of microorganisms in different natural environments as well as plants, animals and humans, and evaluate and exemplify their interrelationships.
PO 6	Apply the understanding of microbial processes to diverse science areas such as medical, industrial, agricultural and food and evaluate their potential for human well-being, for tackling environmental issues and exploring sustainable solutions
PO 7	Recall and explain the nature of biomolecules and metabolic processes; the role and kinetics of enzymes as well as the thermodynamic laws that drive these reactions.
PO 8	Recall the basic working principles of various bioanalytical techniques and tools and apply them to detect, estimate and structurally evaluate biomolecules present in the microbial cells.
PO 9	Understand and explain the nature of genetic material and elaborate the molecular mechanisms underlying various genetic processes like replication, transcription, translation, gene transfer and recombination in bacteria; and explain basic concepts in virology.

PO 10	Apply the basics of genetics and molecular biology to understand and evaluate techniques in genetic engineering and also for the use of bioinformatic tools for presentation and processing of data.
PO 11	Recognize and explain the role of microorganisms in different diseases, attribute pathogenesis mechanisms to their properties and extrapolate it to disease diagnosis, treatment and prevention. Outline and recall concepts in epidemiology of diseases. Classify and evaluate different chemotherapeutic agents.
PO 12	Recall, classify and summarize mechanisms of defense in humans, detail out the functioning of our immune system, correlate it to disease and its prevention and outline its association to health. Apply immunological principles for diagnosis of diseases.
PO 13	Understand and outline different biochemical mechanisms and their regulation; retrieve and construct biochemical pathways in microbial metabolism of major macromolecules and, recall and integrate the bioenergetics of metabolic reactions.
PO 14	Evaluate, exemplify and outline the role of microorganisms in different industrial fermentations, summarize technological aspects of bioprocesses, recall knowledge about patents, copyright and regulatory practices and QA.
PO 15	Demonstrate key practical skills/competencies in working with microbes for their study and use in the laboratory as well as outside, including the use of good microbiological practices. Analyze problems involving microbes, articulate them and devise innovative and creative solutions.
PO 16	Hypothesize, design experiments, construct experimental plans, execute them and analyze data with a basic understanding of statistics. Demonstrate an ability to be unbiased and critical in interpretation of scientific data
PO 17	Communicate effectively to express scientific ideas and/or their experimental data in an effective, precise and concise manner.

Credit Structure for FYBA/BSc/BVoc/BACM

Semester	Subject 1		Subject 2	GE/ OE course	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEP CC, RP	Total Credits
	DSC	DSE						
1	4		4	4	VSC-2 Sub 1+ SEC -2	AEC- 2 (CSK) + VEC- 2 (Understanding India) + IKS-2		22
2	4		4	4	VSC-2 Sub 2+ SEC -2	AEC-2 (CSK)+ VEC-2 (Env Sc)	CC-2	22
Total	8		8	8	8	10	2	44
Exit option: award of UG certificate in Major with 44 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								

Course Code-Department Specific Course: RUSMIC.O101

Course Title: Fundamentals of Microbiology-I

Academic year 2025-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand and explain the process of formation of earth and evolution of microorganisms on earth.
CO 2	Summarize the key events in the history of Microbiology
CO 3	Recognize the scope and relevance of Microbiology
CO 4	Compare and contrast between structural features of prokaryotic and eukaryotic cell
CO 5	Classify the microorganisms based on their growth requirements
CO 6	Design or identify culture media and conditions for their cultivation.
CO 7	Carry out culturing techniques and test microbial activities using aseptic techniques

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC.O101		**Fundamentals Of Microbiology-I**	**3/45**
	Unit I	**Evolution of Microbes, History and Future of Microbiology**	**1/15**
		1.1 The Evolution of Microorganisms a) Formation and Early History of Earth b) Origin of Cellular life. c) RNA world hypothesis and protein synthesis d) Microbial Diversification e) Endosymbiotic origin of prokaryotes f) Microbial Evolution – Process **1.2 History, Branches and Scope of Microbiology** a) Discovery of microorganisms b) Conflict over spontaneous generation c) Golden Age of Microbiology-Koch Postulate, Medical Microbiology, Immunology d) Development of industrial microbiology and microbial ecology e) Branches, Scope and relevance of microbiology **1.3 Future of Microbiology and unification with other sciences** a) Molecular and genomic methods to study microorganisms b) Emerging diseases c) Search for extra-terrestrial life d) Bio-based economies	
	Unit II	**Prokaryotic and Eukaryotic Cell Structure**	**1/15**
		2.1 Prokaryotic Cell Structure and functions a) Overview of prokaryotic cell structure b) Cell wall c) Cell membrane d) Components external to cell wall-Capsule, Slime layer, Flagella, Pili, Fimbriae e) Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles f) Nucleoid, Plasmids g) Bacterial endospores and their formation **2.2 Eukaryotic Cell Structure** a) Overview of Eukaryotic cell structure b) Cytoplasmic matrix, microfilaments, intermediate filaments, and microtubules, Cilia and Flagella	

		c) Organelles of the Biosynthetic-secretory and endocytic pathways –Endoplasmic reticulum & Golgi apparatus. Lysosome, Autophagy, Proteasome d) Eukaryotic ribosomes e) Mitochondria f) Chloroplasts g) Nucleus –Nuclear Structure h) Comparison of Prokaryotic and Eukaryotic Cells i) Mitosis & meiosis	
	Unit III	**Cultivation and preservation of Microorganisms**	
		1.1 Nutrition and culture media a) Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. b) Nutritional classification based on source of energy, electron and carbon c) Modes of nutrition: Endocytosis, Phagocytosis, movement of solutes across membranes d) Media Design and composition e) Types of Culture media with examples f) VBNC & oligotrophs g) Anaerobic cultivation **1.2 Pure Culture Techniques** a) Streak plate method b) Pour plate method c) Colony characteristics **1.3 Preservation of microorganisms** a) Methods for maintenance and Preservation of Bacteria b) Culture Collection Centers	**15**

Practical: RUSMICP.O101

Course code	Practical	1 Credit
RUSMICP.O101	**Fundamentals of Microbiology-I**	
	1. Demonstration of Pasteur's experiment to refute Spontaneous Generation theory. 2. Demonstration of microbes in air, cough, on table surface, finger tips etc. 3. Nutritional requirements- Designing media using food material 4. Preparation of standard laboratory Culture Media: i. Liquid medium (Nutrient Broth) ii. Solid Media (Nutrient agar, Sabouraud's agar) iii. Preparation of slant, butts & plates 5. Inoculation techniques and Study of Growth: i. Inoculation of Liquid Medium ii. Inoculation of Solid Media (Slants, Butts and Plates) 6. Pure culture techniques- Streak plate method 7. Study of Colony Characteristics of bacteria. 8. Use of Differential & Selective Media: (MacConkey's agar & Salt Mannitol Agar), Enriched (Blood Agar) 9. Cultivation in defined and crude media- Demonstration	

References:

a) Willey, Sherwood and Woolverton, Prescott's Microbiology, 9th edition, 2013, International edition, McGraw Hill.

b) Michael T. Madigan & J.M. Martin, Brock's Biology of Microorganisms 13th Ed. International edition 2012, Pearson Prentice Hall.

c) https://www.hort.purdue.edu/newcrop/ncnu02/v5-011.html

d) https://www.weforum.org/agenda/2018/04/can-a-nature-based-economy-help-us-drive-green-growth

a) Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology 5th Edition, 1986, Tata McGraw Hill Publishing Company Tortora, Funke and Case, Microbiology: An Introduction, 10th Edition, 2010, Pearson.

Modality of Assessment: Department Specific Course (3 Credit Theory Course for BSc)

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	20
2	Class Test/ Project / Assignment / Presentation	10
	TOTAL	**30**

B) External Examination (Semester End)- 60%- 45 Marks

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **One hour thirty Minutes**.
2. Theory question paper pattern:

Paper Pattern:

Question		Options	Marks	Questions Based on
1	A	Any two out of three questions	10	Unit 1
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
2	A	Any two out of three questions	10	Unit 2
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
3	A	Any two out of three questions	10	Unit 3
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
		TOTAL	**45**	

Practicals- 1 Credit: Total Marks 25

Experimental tasks, quiz, viva	20 Marks
Journal	05 Marks

Course Code-Department Specific Course: RUSMIC.E111

Course Title: Fundamentals of Microbiology-II
Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand and compare features of different domains of microbes
CO 2	Explain ecological, environmental, industrial and medical significance of different microbes
CO 3	Summarize the types and the role of normal flora on human body and infer its significance
CO 4	Define different terms used to describe infectious diseases and explain the role of microbes in disease process
CO 5	Explain the concepts and terminologies used in epidemiology and correlate disease transmission to disease control
CO 6	Recall the mechanisms of physical & chemical antimicrobial agents.
CO 7	Execute & perform the techniques used to demonstrate the microbicidal action of physical & chemical agents.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC.E111		**Fundamentals Of Microbiology-II**	**3/45**
	Unit I	**Microbial diversity**	**1/15**
		1.1 Domain Bacteria- Proteobacteria, Firmicutes, Gram positive bacteria, Cyanobacteria, High G+C content bacteria and other important phyla of bacteria **1.2 Domain Archaea** Major Archaeal physiological groups, Archaeal cell wall, lipids and membranes **1.3 Microbial Eukarya** a) Protozoa- Major categories, ecological and medical significance b) Fungi- Major categories, ecological, industrial and medical significance c) Algae- Major categories, ecological and environmental significance **1.4 Viruses** a) Historical highlights, General properties of viruses, prions, viroids b) Structure of viruses-capsids, envelopes, genomes– TMV, Influenza, and T4 as representatives c) Cultivation of viruses- overview	
	Unit II	**Microbe- Human interactions**	**1/15**
		2.1 Normal flora of the human body a) Skin, Respiratory tract, Oral cavity, Gastrointestinal tract and Genitourinary tract b) Gnotobiotic animals c) Introduction to the concept of microbiome **2.2 Development of infection** a) Portal of entry and infectious dose b) Attaching to host c) Virulence factors d) Process of infection e) Stages of a disease, Signs and symptoms of disease f) Portal of exit g) Patterns of an infection- localized, systemic, focal, mixed, primary, secondary, acute and chronic infections	

		2.3 Introduction to epidemiological concepts a) Reservoirs of infection b) Modes of disease transmission c) Nosocomial infections d) Epidemiological terminology: epidemic, endemic, pandemic, sporadic, incidence rate, prevalence rate, mortality, morbidity e) Controlling epidemics: Controlling reservoirs, controlling transmission- Immunization strategies- passive and active, Surveillance	
	Unit III	**Control of Microorganisms**	**1/15**
		3.1 Introduction to terms in control of microorganisms **3.2 Introduction to physical agents for control of microorganisms** (mode of action, advantages, disadvantages and applications) a) High temperature-moist heat and dry heat b) Low temperatures c) Radiation d) Osmotic pressure e) Desiccation f) Physical removal of microorganisms using bacteriological filters **3.3 Introduction to Chemical agents for control of microorganisms** (mode of action, advantages, disadvantages and applications of all major groups of antimicrobial agents) **3.4 Evaluation of Chemical disinfectants** **3.5 Chemotherapeutic & antimicrobial agents- types & examples (tabular form)**	

Practicals:

Course code	PRACTICALS	1 Credit
RUSMIC. P.E111	**Fundamentals of Microbiology-II**	
	1. Demonstration of Bacteriophages in sewage 2. Staining of Actinomycetes 3. Staining of yeast, and wet mount of fungi 4. Normal flora of the skin, oral cavity and intestine. 5. Role of fomites 6. Demonstration of efficiency of autoclave & hot air oven 7. Effect of UV Light on bacteria 8. Study of detergents as antimicrobial agents 9. Study of Oligodynamic action 10. Effect of dyes, phenolic compounds and chemotherapeutic agents on bacteria- disc diffusion method	

References:

a) Willey, Sherwood and Woolverton, Prescott's Microbiology, 9th edition, 2013, International edition, McGraw Hill.
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c) Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology 5th Edition, 1986, Tata McGraw Hill Publishing Company
d) Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology International edition 2002, McGraw Hill.
e) Jacquelyn Black, Laura Black, Microbiology, Principles and Explorations, 9th Ed, 2015, Wiley

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	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
3	A	Any two out of three questions	10	Unit 3
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
		TOTAL	**45**	

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Journal	05 Marks
