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S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for F.Y.B.Sc

Program: BSc (Microbiology)

Program Code: RUSMIC

(Credit Based Semester and Grading System for the academic year 2019–2020)

RAMNARAIN RUIA AUTONOMOUS COLLEGE

SEMESTER I

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSMIC 101		FUNDAMENTALS OF MICROBIOLOGY	2	03
	I	Evolution of Microbes, History and Future of Microbiology		
	II	Prokaryotic and Eukaryotic Cell Structure		
	III	Chemical basis of life		
RUSMIC 102		MICROORGANISMS – IN THE LAB AND IN NATURE	2	03
	I	Cultivating and Visualizing Bacteria		
	II	Pure Culture Techniques, Characterization and preservation of Bacteria		
	III	Microbes in Natural Environments		
RUSMIC P101	Practicals based on above two courses		02	04

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SEMESTER-II

COURSE CODE	UNIT	TITLE	Credits	Lec / Week
RUSMIC 201		MICROBIAL WORLD: TYPES AND INTER-RELATIONS	2	03
	I	Microbial, world (Viruses Rickettsia, Actinomycetes and Archaea)		
	II	Microbial World (Algae, Fungi, Yeasts, Slime molds, Protozoa)		
	III	Microbe- Human interactions		
RUSMIC 202		TECHNIQUES IN MICROBIOLOGY	2	03
	I	Microbial growth		
	II	Control of Microorganisms		
	III	Modern Techniques in Microbiology		
RUSMIC P201		Practicals based on above two courses	02	04

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Course Code:RUSMIC 101

Course Title:Fundamentals of Microbiology

Academic year 2019-20

Learning Objectives:

This course will introduce F.Y.B.Sc. students to basics of microbiology. Theory of evolution is the unifying theory in biology, which answers most of the questions associated with different phenomena in biological systems. Microbial evolution is an important aspect which is relatively shadowed by evolution of higher eukaryotes. It is important to know the history ofthe field under study as it helps to understand the development of subject and provides orientation to students towards subject. Sub cellular structure of prokaryotic and eukaryotic cells is necessary to study as later in the course it will help to understand functioning of these cells.

To understand the biochemistry of cell, it is important to understand the structure and properties of biomolecules. As compared with 10+2 course, here biomolecules is studied in more detailed manner and has a biological context to it.

Learning Outcomes: Students should be able to-

- Understand evolution of microbes starting from origin of earth with respect to primitive environmental conditions on the planet.
- Know the history and thus development of microbiology as a field with contributions of important scientists.
- Realize scope of microbiology and know about its importance in other fields.
- Understand the subcellular structures of prokaryotic and eukaryotic cell.
- Understand structure and properties of biomolecules with reference to four important macromolecules viz. carbohydrates, proteins, lipids and nucleicacids.

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Detail Syllabus

Course Code	Title	Credits
RUSMIC101	**FUNDAMENTALS OF MICROBIOLOGY**	**2 Credits(45 lectures)**
Unit I	**Evolution of Microbes, History and Future of Microbiology**	**15 lectures**
	1.1: The Evolution of Microorganisms: a) Formation and Early History of Earth – Origin 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) 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 extraterrestrial life d) Bio-based economies	**10** **03** **02**
Unit II	**Prokaryotic and Eukaryotic Cell Structure**	**15 lectures**
	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,	**08**

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	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) Mitosis & meiosis i) Comparison of Prokaryotic and Eukaryotic Cells	**07**
Unit III	**Chemical basis of life**	**15 lectures**
	3.1: Chemical foundations: a) Biomolecules as compounds of carbon with a variety of functional groups. b) Universal set of small molecules. c) Macromolecules as the major constituents of cells. d) Configuration and Conformation with definitions and suitable examples only. e) Types of Stereoisomers and importance of stereoisomerism in biology. f) Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic. **3.2: Water- Structure, properties in brief.** **3.3:Carbohydrates and glycobiology:** a) Definition, Classification, Biological role. b) Monosaccharides,(Chair and boat conformation) oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharide (starch, glycogen, peptidoglycan, cellulose), glycoproteins(glycosaminoglycans and proteoglycans), glycome.	**02** **01** **04**

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	3.4 : Lipids: a) Fatty acids as basic component of lipids b) Classification, nomenclature, storage lipids and structural lipids. c) Types of lipids with general structure of each and mention examples. **3.5 : Amino acids & proteins:** a) General structure and features of amino acids (emphasis on amphoteric nature) b) Classification by R-group, Uncommon amino acidsand their functions Peptides and proteins- Definition and general features and examples with biologicalrole. c) Primary, secondary, tertiary, quaternary structures of proteins- Brief outline. **3.6 : Nucleic acids:** a) Nitrogenous bases- Purines, Pyrimidines b) Pentoses-Ribose, Deoxyribose, c) Nomenclature of Nucleosides and nucleotides, d) N-β-glycosidic bond, e) polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds). f) Basic structure of RNA and DNA.	**03** **03** **02**

References:

1. Prescott,Harley.Klein-Microbiology, Willey, Sherwood and Woolverton, 9th edition, 2013, International edition, McGraw Hill.
2. Michael T.Madigan&J.M.Martin,Brock,Biology of Microorganisms 13th Ed. International edition 2012, Pearson Prentice Hall.
3. Tortora, Funke, Case, Microbiology, An Introduction, 10th edition, 2010 Pearson Education, Inc., publishing as Pearson Benjamin Cummings
4. Conn, E.E., P. K.Stumpf, G.Bruening and R. Y.Doi. 1987. Outlines of Biochemistry,5 th edition, 1987. John Wiley &Sons. New York.
5. Lehninger, Nelson & Cox, Principles of Biochemistry, 4th edition, 2005, W.H.Freeman and company.

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Course Code:RUSMIC 102

Course Title:Microorganisms – in the lab and in nature

Academic year 2019-20

Learning Objectives:

To study the structure of cell and subcellular organelles, microscopic techniques are important. Cultivation of microorganisms in laboratory is important to study them. Thus nutritional requirements and cultivation methods are important to study. Certain bacteria cannot be cultivated in artificial nutrient media (VBNC) and some require diluted nutrients (oligotrophs) while some needs absence of oxygen (anaerobes), those are also studied.

To study microbes individually, pure culture techniques are important. For visualization of cells under microscope, staining techniques are used. Techniques for preservation of cultures are used in industries and research laboratories. Microorganisms play important rolein regulating the turnover of elements on this planet (biogeochemical cycles). Microbes growing in extreme conditions of environment have always been mater of curiosity and the products from these extremophiles also find various applications in research and industry.

Learning Outcomes: Students should be able to-

- Understand principle and construction of various microscopes.
- Understand growth requirements and cultivation methods for microorganisms.
- Understand pure culture techniques, principle and types of stains.
- Understand techniques for preservation of cultures and to emphasize the importance of culture collection centers.
- Understand different phenomena exhibited by microorganisms which affect the nature.

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Detail Syllabus

RUSMIC102	MICROORGANISMS – IN THE LAB AND IN NATURE	2 Credits (45 lectures)
Unit I	**Cultivating and Visualizing Bacteria**	**15 lectures**
	1.1: Microscopy: a) History of microscopy, Optical spectrum, Lenses and mirrors b) Simple and compound light microscope c) Dark field Microscopy d) Phase contrast Microscopy e) Electron Microscopy **1.2: Nutrition and Cultivation of Microorganisms:** a) Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. b) Nutritional classification on the basis of 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	**10** **5**
Unit II	**Pure Culture Techniques, Characterization and preservation of Bacteria**	**15 lectures**
	2.1 : Pure Culture Techniques a) Streak plate method b) Pour plate method **2.2 : Characterization of Bacteria:** a) Cultural Characteristics b) Morphological characteristics c) Staining procedures i. Dyes and stains: Types,	**01** **12**

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	Physicochemical basis Fixatives, Mordants, Decolorizers ii. Simple and differential staining with examples iii. Special staining (Cell wall, Capsule, Lipid granules, Spores, Metachromatic granules & Flagella) d) Physicochemical characterization: Influence of environmental factors on growth- oxygen, pH, temperature, osmotic pressure. **2.3 : Preservation of microorganisms:** a) Methods for maintenance and Preservation of Bacteria b) Culture Collection Centers	**02**
Unit III	**Microbes in Natural Environments**	**15 lectures**
	3.1: Microorganisms in Nature a) Microenvironments b) Introduction to microbial biofilms c) Mixed populations and microbial consortia d) Introduction to Quorum Sensing **3.2: Role of microbes in Biogeochemical cycles:** a) C- cycle, N- cycle, S- cycle, Iron cycle b) Interaction between elemental cycles **3.3: Microbial competition and cooperation** a) Types of Microbial Interactions:Mutualism, Cooperation, Commensalism, Predation Parasitism, Amensalism, Competition with examples b) Functions of symbiosis c) Establishment of symbiosis **3.4: Introduction to extremophiles and their importance**	**3** **6** **4** **02**

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References:

1. A.J.Salle,Fundamental Principles of Bacteriology, 1984, McGraw Hill publications
2. Michael J.Pelczar Jr., E.C.S. Chan ,Noel R , Microbiology TMH 5th Edition
3. Stanier.Ingraham et al ,General Microbiology, 5th Ed. 1987, Macmillan Education Ltd.
4. Tortora, Funke and Case. Adisson Wesley Longman Inc, Microbiology: An Introduction, 6th Edition.1998, Pearson.
6. Brock & Madigan, Biology of microorganisms. 13th edition, 2009. Pearson
7. Prescott, Microbiology, 7th edition 2011, McGraw Hill Publications

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	PRACTICALS	
RUSMICP101	**SECTION-1** **FUNDAMENTALS OF MICROBIOLOGY.**	**1 Credit**
Unit-I	1. Assignment: Contribution of Scientists in the field of Microbiology/scope 2. Spontaneous generation 3. Demonstration of microbes in air, cough, on table surface, finger tips etc.	
Unit-II	4. Study of prokaryotic subcellular structures by special staining: Cell wall, capsule, endospore, flagella, lipid, metachromatic granules. 5. Study of Motility (Hanging Drop Preparation) 6. Wet mount of Hay infusion 7. Permanent slides of eukaryotic microorganisms	
Unit-III	8. Qualitative detection a. Carbohydrates- Benedicts, Molisch's test. b. Proteins, amino acids- Biuret, Ninhydrin. c. Nucleic acid detection by DPA and Orcinol	
RUSMICP102	**SECTION-2** **MICROORGANISMS – IN THE LAB AND IN NATURE**	**1 Credit**
Unit-I	1. Parts of a microscope 2. Micrometry 3. Dark field and Phase Contrast Microscopy: Demonstration 4. Monochrome staining 5. Gram staining 6. Negative Staining 7. Nutritional requirements- Designing media using food material 8. Preparation of standard laboratory Culture Media: a. Liquid medium(Nutrient Broth) b. Solid Media(Nutrient agar, Sabouraud's agar) c. Preparation of slant,butts& plates 9. Inoculation techniques and Study of Growth: a. Inoculation of Liquid Medium	

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	b. Inoculation of Solid Media(Slants, Butts and Plates)	
Unit-II	10. Pure culture techniques- Streak plate method 11. Study of Colony Characteristics of bacteria. 12. Use of Differential & Selective Media : (MacConkey& Salt Mannitol Agar), Enriched (Blood Agar) & enrichment (Ashby's Mannitol broth) 13. Effect of environment on growth a. Temperature b. pH c. Osmotic pressure 14. Demonstration of anaerobic jar 15. Methods of Preservation of culture- Soil stock, oil overlay and preparation of glycerol stocks,lyophilization (demo)	
Unit-III	16. Dip slide technique to demonstrate microbial biofilms 17. Crowded plate technique for demonstration of antibiosis *18.* Demonstration of bacteroid forms of *Rhizobia*	

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Course Code:RUSMIC 201

Course Title: Microbial World: Types and Inter-relations

Academic year 2019-20

Learning Objectives:

Microbial world is diverse. Different types of microorganisms are known viz. Bacteria, Fungi, Archaebacteria, Rickettsia etc. This course discusses structural features and characteristics of these microorganisms. These microbes are a part of our day to day life, right from microbial products (antibiotics) to causing infection by pathogenic strains. Some of themhave ecological and economic significance. Microbes are associated with different parts of human body influencing resistance to pathogens and immune system of human body.Introduction to human immune system is mentioned. In spite of these defense mechanisms, pathogens are able to establish infection, mechanism of infection is discussed.

Learning Outcomes: Students should be able to-

- Understand structure and characteristics of Viruses Rickettsia, Actinomycetes Archaea, algae, fungi, yeasts, slime molds, protozoa.
- Understand the life cycle of representative organism from each of these groups.
- Knowing different normal flora organisms with respect to different parts in human body.
- Understanding mechanism of infection in human body.
- Understanding factors and components of host defense.

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Detail Syllabus

RUSMIC201	**MICROBIAL WORLD: TYPES AND INTER-RELATIONS**	**2 Credits (45 lectures)**
Unit I	**Microbial, world (Viruses Rickettsia, Actinomycetes and Archea**)	**15 lectures**
	1.1 : 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	**05**
	1.2 :Rickettsia, Chlamydia,Mycoplasma: General features and medical significance	**03**
	1.3 : Actinomycetes: a) General features b) Examples- Nocardia and Streptomyces c) Importance: ecological, commercial and medical	**02**
	1.4 Archaea: a) Introduction- Major Archaeal physiological groups, b) Archaeal cell wall, lipids and membranes c) Ecological importance	**03**
	1.5 Cyanobacteria & Myxobacteria a) General Properties. b) Ecological significance	**02**
Unit II	**Microbial World (algae, fungi, yeasts, slime molds, protozoa)**	**15 lectures**

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	2.1: Protozoa: a) General characteristics b) Major categories of Protozoa based on motility, reproduction c) Medically important Protozoa d) Life cycle of Entamoeba **2.2: Algae:** a) Characteristics of algae: morphology, Pigments, reproduction b) Cultivation of algae c) Major groups of Algae –an overview d) Biological,Medical and economic importance of Algae e) Medical,ecological& Commercial application **2.3: Fungi and Yeast:** a) Characteristics: structure, Reproduction b) Cultivation of fungi and yeasts c) Major fungal divisions- overview d) Life cycle of yeast e) Biological and economical importance **2.4: Slime molds**	**04** **05** **05** **01**
Unit III	**Microbe- Human interactions:**	**15 lectures**
	3.1:Normal flora of the human body: a) Initial colonization of the new-born b) Indigenous flora of specific regions-Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine and Genitourinary tract c) Gnotobiotic animals d) Introduction to the concept of microbiome **3.2: Development of infection:** a) Portal of entry and infectious dose b) Attaching to host c) Surviving defenses d) Virulence factors e) Establishment of disease:	**04** **06**

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	i. Classical stages of an infection ii. Patterns of an infection- localized, systemic, focal, mixed, primary, secondary, acute and chronic infections iii. Signs and symptoms of disease iv. Persistence of microbes and diseased state f) Portal of exit **3.3 :Host defense against infection: Overview** a) Factors affecting host defense: Species resistance, racial resistance and Individual resistance b) Introduction to innate and adaptive defenses c) Barriers at portal of entry: Physical barriers, Chemical defenses, genetic resistance.	**05**

References:

1. Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg, Microbiology, 5th Edition 1998, Tata McGraw-Hill Publishing Company
2. Prescott's Microbiology, 9th Edition; Joanne M. Willey, Linda M. Sherwood, Christopher J.Woolverton,2013, McGraw Hill International Edition
3. Michael T.Madigan&J.M.Martin,Brock,Biology of Microorganisms 13th Ed. International edition,2012, Pearson Prentice Hall.
4. Tortora, Funke, Case, Microbiology, An Introduction, 10th edition, 2010 Pearson Education, Inc., publishing as Pearson Benjamin Cummings
5. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002,| McGraw Hill.
6. Jacquelyn Black, Laura Black, Microbiology, Principles and Explorations, 9th ed, 2015, John Wiley & Sons Inc

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Course Code: RUSMIC 202

Course Title: Techniques in Microbiology

Academic year 2019-20

Learning Objectives:

Growth of microorganisms is to be estimated in different fields like industrial microbiology, environmental microbiology, clinical samples, food microbiology etc. For this, different methods of enumeration of bacteria are to be studied. Also growth pattern of microorganism is characteristic of it and thus needed to be studied. Direct and indirect methods of microbial growth are discussed. Control of growth of microorganisms is important with respect to maintenance of aseptic conditions in industries, hospitals, research laboratories, etc. So, different methods of controlling growth are studied. Mechanisms underlying these methods are emphasized. Topic of biosafety is introduced at this very appropriate level, where students will start handling microorganisms in laboratory. Nowadays, study of microorganisms is shifting from cultural method based to molecular methods based. So, it is important to teach students principle and methods associated with these techniques which find applications not only in research but also in diagnostics, food microbiology etc.

Learning Outcomes: Students should be able to-

- Understand growth pattern of microorganisms, mainly for bacteria.
- Understand different methods of measurement of growth of microorganisms.
- Understand mechanisms of various physical and chemical antimicrobial agents.
- Understand the concept of biosafety and biosafety levels.
- Understand molecular methods of detection of bacteria and other culture independent methods of the same.

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Detail Syllabus

RUSMIC202	TECHNIQUES IN MICROBIOLOGY	2 Credits (45 lectures)
Unit I	**Microbial growth**	**15 lectures**
	1.1: Growth curve and Mathematical Expression of growth a) Definition of growth, Growth phases b) Determining growth constant and growth rate. **1.2: Measurement of growth** a) Direct microscopic count – Breed'scount,Petroff – Hausser counting chamber- Haemocytometer. b) Viable count – Spread plate and Pour plate technique c) Measurements of cell constituents. d) Turbidity measurements– Brown's opacity tubes and spectrophotometer techniques e) Factors affecting growth pattern	**05** **10**
Unit II	**Control of Microorganisms**	**15 lectures**
	2.1 Definitions of terms **2.2 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-bacteriological filters	**01** **05**

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	2.3 : Chemical agents for control of microorganisms Mode of action, advantages, disadvantages and applications of all major groups of antimicrobial agents **2.4 : Evaluation of chemical disinfectants** **2.5 : Chemotherapeutic antimicrobial agents** – Types and examples (Tabular form) **2.6 : Biosafety in Microbiology** a) Biosafety general principles and terminology with equipment b) Biological containment and laboratory safety levels	**03** **01** **01** **04**
Unit III	**Modern techniques in Microbiology**	**15 lectures**
	3.1 : Modern microscopy: a) Fluorescence microscopy b) Confocal Microscopy **3.2 : Molecular methods of microbe detection** a) Identification and quantification using nucleic acid probes and labeled antibodies b) Microbial activity measurements using radioisotopes and microelectrodes c) PCR, Electrophoretic techniques, Hybridization techniques, Blotting techniques **3.3 : Introduction to Metagenomics, community DNA analysis**	**03** **10** **02**

References:

1. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg
2. A.J.Salle, Fundamental Principles of Bacteriology,1984,McGraw Hill Book Company Inc.
3. Prescott,Hurley.Klein-Microbiology, 5th edition, International edition 2002, McGraw Hill.

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4. Prescott's Microbiology, 7th Edition; Joanne M. Willey, Linda M. Sherwood, Christopher J.Woolverton,2011, McGraw Hill International
5. Michael T.Madigan&J.M.Martin,Brock,Biology of Microorganisms 11th Ed. International edition,2006, Pearson Prentice Hall.
6. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, 7th edition, 2010, Cambridge University Press.

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	PRACTICALS	2 Credits
RUSMICP201	**SECTION-1** **MICROBIAL WORLD: TYPES AND INTER-RELATIONS**	**1 Credit**
Unit-I	1. Demonstration of Bacteriophages in sewage 2. Isolation of Actinomycetes from soil and Slide Culture technique for Actinomycetes 3. Biogas production using methanogens	
Unit-II	4. Isolation of yeast, and other fungi *5.* Fungal Wet mounts & Study of Morphological Characteristics *Mucor, Rhizopus, Aspergillus, Penicillium* 6. Slide culture of fungi 7. Cultivation of fungi- static and shaker conditions 8. Permanent slides of Algae, Protozoa 9. Demonstration of protozoa in hay infusion	
Unit-III	10. Normal flora of the skin, oral cavity and intestine. 11. Role of fomites 12. Cough plate technique	
RUSMICP202	**SECTION-2** **TECHNIQUES IN MICROBIOLOGY**	**1 Credit**
Unit-I	13. Study of growth curve of bacteria 14. Enumeration of microorganisms using Haemocytometer& Breed's Count 15. Enumeration of microorganisms Brown's opacity tubes 16. Viable count: Spread plate and pour plate	
Unit-II	17. Demonstration of efficiency of autoclave 18. Effect of UV Light on bacteria 19. Effect of surface tension on bacterial growth 20. Study of Oligodynamic action 21. Effect of dyes, phenolic compounds and chemotherapeutic agents on bacteria- disc diffusion method	
Unit-III	22. Introduction to laboratory equipment for electrophoresis, PCR 23. Assignment on any modern method used in microbial detection	

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Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment - 40% 40 marks.

Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries(case studies/ seminars/presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B) External examination - 60 %

Semester End Theory Assessment - 60% 60 marks

i. Duration - These examinations shall be of **two hours** duration.

ii. Theory question paper pattern :-

1. There shall be **four** questions each of **15** marks. On each unit there will be one question & fourth one will be based on all the three units.
2. All questions shall be compulsory with internal choice within the questions. Each question will be of **30** marks with options.

Paper Pattern:

Questions	Options	Marks	Questions on
Q.1)A)	Any 2 out of 4	10	Unit I
Q.1)B)	Any 5 out of 8	5	
Q.2)A)	Any 2 out of 4	10	Unit II
Q.2)B)	Any 5 out of 8	5	
Q.3)A)	Any 2 out of 4	10	Unit III
Q.3)B)	Any 5 out of 8	5	
Q.4)	Any 3 out of 5	15	All three units

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Practical Examination Pattern:

(A) Internal Examination:-

	Paper I	Paper II
Journal	05	05
Test	10	10
Participation	05	05
Total	20	20

(B) External (Semester end practical examination) :- 50 Marks Per Section

Sr.No.	Particulars	Marks		Total
1.	Laboratory work (Section-I + Section-II)	25 + 25	=	50
2.	Spots	05 + 05	=	10

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department ; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks DistributionPattern

Semester I

Course	101			102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Semester II

Course	201			202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

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