

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
(An Autonomous College - Affiliated to Shivaji University, Kolhapur)

Accredited By NAAC with A⁺ Grade (CGPA 3.63)

National Education Policy (NEP-2020)

Syllabus for

B.Sc. Part -I

Microbiology (Major)

Syllabus to be implemented from July 2023 onward

B.Sc. I SEMESTER I

Major Microbiology

Level	Major DSC	Practical	Minor DSE	Practical Minor	OE/GE		IKS	AEC	Total credits
4.5	MJ-BMiT23-101 Microbiology Paper I	MJ-BMiP23-103 Microbiology Practical-I	Course I	Practical course- I	Course I	Practical course- I	Introductio n of Vedic Microbio logy	English	22
	MJ-BMiT23-102 Microbiology Paper II		Course II		Course II				
Credits	2+2= 4	2	2+2= 4	2	4	2	2	2	

B.Sc. I SEMESTER II

Level	Major DSC	Practical	Minor	Practical Minor	OE/GE		SEC	AEC	Total credits
4.5	MJ-BMiT23-201 Microbiology Paper III	MJ-BMiP23-203 Microbiology Practical-II	Course III	Practical course-II	Course III	Practical course-II	SEC-I	English	22
	MJ-BMiT23-202 Microbiology Paper IV		Course IV		Cours IV				
Credits	4	2	4	2	4	2	2	2	
Semester I + Semester II									44

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
Department of Microbiology
B. Sc. I: 2023-24

- The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.
- The units of the syllabus are well defined, taking into consideration the level and capacity of students.
- This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students.
- The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research.

Course Outcomes (COs)

- General knowledge of the development of Microbiology and particularly the progression from classical Microbiology to the modern Microbiology
- Laboratory skills and exposure to a variety of important experiments as isolation of microorganisms, staining, qualitative analysis of biomolecules, antimicrobial effect and instrumentation study.
- In communication skills written and oral skills develop for dissemination of scientific results in report, article, or oral presentation formats; standard citation methods; ethics in science and scholarship and its importance to scientific inquiry and professionalism.
- The new and updated syllabus is based on a basic and applied approach with vigor and depth.

GENERAL OBJECTIVES OF THE COURSE / PAPER :

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in Microbiology.
- 3) To expose the students to various emerging areas of Microbiology.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To develop their ability to apply the knowledge of Microbiology in day to day life.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To develop skills required in various industries, research labs and in the field of human health.

B.Sc. Part-I, Major Microbiology
Semester-I Paper - I
MJ-BMiT23-101 Introduction to Microbiology (Credits: 02)

Unit I - History and development of Microbiology **07**

- a) Theory of abiogenesis and biogenesis
- b) Contributions of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister, Paul Ehrlich, Edward Jenner.

Unit II - Branches of Microbiology **07**

- a) Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology.
- b) Introduction- types of microflora, beneficial & harmful activities of organisms

Unit III - Introduction to types of microorganisms **08**

- a) Difference between prokaryotic and eukaryotic microorganisms.
- b) General characteristics of different groups - Acellular microorganisms. (Viruses, Viroids, Prions) and cellular microorganisms. (Bacteria, Archaeobacteria, Rickettsia, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and economic importance.

Unit IV- Scope of Microbiology **08**

- a) The place of microorganisms in living world
 - i. Prokaryotic and eukaryotic protists
 - ii. Whittaker's five kingdom concept
- b) Applied areas of Microbiology
 - i. Microorganisms used as biopesticides, biofertilizers and used in biodegradation.
 - ii. Microorganisms used in food fermentations (dairy and nondairy based fermented food products) and probiotics.

Learning Outcomes:

Students should be able to

1. Learn the fundamental aspects of prokaryotic and eukaryotic cell structures and the differences between them.
2. Learn about different branches of Microbiology.
3. Comprehend the mega diversity among microorganisms.
4. Describe introduction of microbial world and scope of microbiology in various fields.
5. Understand the significance of different taxonomic classification systems especially the Bergey's Manual of Determinative Bacteriology in the field of Microbiology.
6. Study the contributions of eminent scientists in the overall development of modern Microbiology.
7. Examine and understand the importance of the theory of abiogenesis.

Books recommended :

1. Microbiology by Pelczar ,M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
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9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT I to IV)**
10. Microbiology by C. P. Baveja **(UNIT I to IV)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I to IV)**
13. Microbiology. Pelzar 5th edition (Unit IV)

Paper-II

MJ-BMiT23-102 Bacteriology

(Credits: 02)

Unit I - Bacterial Cell Organization

07

- a. Morphology – Size, shape, arrangement.
- b. Cytology-Structure, chemical composition and functions of –
 - i. Cell wall- Gram positive and Gram negative Bacteria
 - ii. Cell membrane, mesosomes.
 - iii. Capsule, slime layer.
 - iv. Surface appendages – flagella, pili.

Unit II – Microscopy

08

- a. Types of Microscopes – Light (phase contrast, dark field, interference, fluorescent microscope), Electron Microscope
- b. Light Microscope – Parts, image formation, magnification, numerical aperture (uses of oil immersion objective) resolving power and working distance. Ray diagram and applications.
- c. Electron Microscope –Parts, principle of image formation, Ray diagram and applications.
- d. Comparative study of compound and electron microscope.

Unit III – Stains and Staining Procedure

07

- a. Definition of dye and stain.
- b. Classification of stain – acidic, basic and neutral.
- c. Study of bacteria – unstained (wet) preparation and stained preparations.
- d. Common staining techniques- Principle, procedure, mechanism and application of simple staining, negative staining, differential staining- Gram and acid fast staining, impregnation method.
- e. Special staining methods- Cell wall (Chance's method), Capsule (Maneval's method) and Volutin granule (Albert's method)

Unit IV – Control of Microorganisms

08

- a. Definitions of sterilization, disinfection & sanitization.
- b. Physical agents of control of microorganisms- temperature (dry heat and moist heat). Filtration (asbestos and membrane filter)
- c. Chemical agents for control of microorganisms- mode of action, applications and advantages of –
 - i. Phenolic and phenolic compound.
 - ii. Alcohol (Ethyl alcohol)
 - iii. Halogen compounds (Chlorine and Iodine)
 - iv. Heavy metal (Cu and Hg)

Learning outcomes-

1. Study the morphological and cytological characters of the bacterial cell with emphasis on their functionality.
2. Imbibe the basics of stains and staining techniques for comprehensive study of bacteria and other microbes.
3. Understand the importance of Gram's staining in the bacterial taxonomical classification systems.
4. Comprehend the biological concepts of sterilization and disinfection.
5. Learn the mode of action of different chemicals and substances employed as disinfectants for the control of micro organisms.
6. Study the basic principles of autoclave and hot air oven.

Books recommended for Theory

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12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**

1. Preparations **and standardization** of-
 - a) stains (0.5% basic fuchsin, 0.5% crystal violet),
 - b) Reagents (phosphate buffer of pH 7, 1 N and 1M solutions of HCL and NaOH),
 - c) physiological saline.
2. Preparation of a) cotton plugs for test tubes and flasks.
b) Wrapping of plates and pipettes.
3. Use, care and study of compound microscope.
4. Demonstration of laboratory equipment: - Incubator, Autoclave, Hot air oven, Seitz filter, Distilled water plant, anaerobic jar.
5. Microscopic Examination of Bacteria by Monochrome staining method
6. Microscopic Examination of Bacteria by Negative staining method.
7. Microscopic Examination of Bacteria by Gram's staining method
8. Microscopic Examination of motility of Bacteria by Hanging drop technique.
9. To study microbicidal effect of alcohol
10. To study efficacy hand sanitizer.

B.Sc. Part-I, Major Microbiology

Semester-II Paper-III

MJ-BMiT23-201

Biochemistry

(Credits: 02)

Unit I- Carbohydrates

- a) Families of monosaccharide's - aldoses, Ketoses, Triose, Tetroses, Pentoses, Hexoses.
- b) Definitions, classifications and brief account of -
 - i. Monosaccharides- classification based on aldehyde & ketone, groups, structure of ribose, deoxyribose, glucose, galactose and Fructose.
 - ii. Disaccharides - Concept of reducing and non reducing sugar, Glycoside bonds, Structure of lactose and sucrose.
 - iii. Polysaccharides structure and biological role of starch, glycogen and cellulose.

Unit II - Proteins

- a) Amino acids the building blocks of proteins, General formula of amino acids and concept of zwitterion, Classification of amino acids.
- b) Primary structure of proteins
- c) Oligopeptides – Structure and function of naturally occurring glutathione, insulin and Synthetic aspartame.
- d) Secondary structure of proteins, peptide unit and its salient feature . The alpha helix, β pleated sheet and their occurrence in proteins.
- e) Tertiary and quaternary structure of proteins, Forces holding the polypeptide together.
- f) Functions of proteins.

Unit III - Enzymes

- a) Definitions.
- b) Structure – Concept of apoenzyme, Coenzyme, Cofactor prosthetic group and active site.
- c) Types – extracellular, intracellular, constitutive and inducible enzyme.
- d) Feature of enzyme substrate reactions.
- e) Mechanism of enzyme action - lock and key hypothesis and Induced fit hypothesis.
- f) Classification of enzymes.

Unit IV- Nucleic Acids

- a) DNA
 - i. Composition – Structure of purines, Pyrimidines, Structure of nucleoside nucleotide.
 - ii. Structure of DNA - Watson and Crick's double helical model, salient features.
 - iii. Functions of Mitochondrial and chloroplast DNA.
- b) RNA - Composition – Structure and function of mRNA, tRNA, rRNA

Learning outcomes

1. Study the structure and functions of chemical cellular materials.
2. Imbibe the basics of macromolecules like DNA, RNA and proteins.
3. Understand the essentials of enzymology and the mechanism of various enzymes.
4. Learn the fundamentals of carbohydrates with their structures

Books recommended for Theory

1. Principles of Biochemistry by Nelson and Cox (Lehninger) 5th edition **(UNIT I To IV)**
2. Biochemical Methods by Sadasivam and Manickam
3. Biochemistry by U.Satyanarayana and U. Chakrapani**(UNIT I To IV)**
4. General Microbiology Vol. II by Powar and Daginawala, Himalaya Publications **(UNIT I & II)**
5. Biochemistry by Berg ,Tymoczko and Stryer 7th edition **(UNIT III & IV)**
6. Biochemistry by Powar and Chatwal, Himalaya Publishing House **(UNIT I To IV)**

Paper IV

MJ-BMiT23-202 Microbial Physiology

(Credits: 02)

Unit I- Microbial Nutrition

07

- Nutrition requirement of microorganisms– water & macronutrients
- Micronutrients , carbon , energy , hydrogen , nitrogen , sulphur, phosphorus, growth factor auxotrophs, prototrophs , fastidious organisms.
- Nutritional types of microorganisms depending on carbon and energy source.

Unit II - Culture Media

07

- Common components of culture media and their functions.
- Types of culture media – Natural and Synthetic, Semi synthetic, Differential, Enriched , Enrichment, Selective , Transport, Indicator media.

UnitIII - Bacteriological techniques

08

- Pure culture techniques – History, Serial dilution technique, Streak plate technique, Spread plate technique , Pour Plate technique.
- Maintenance of stock cultures - agar slants and agar stabs.
- Preservation of microbial culture – sub culturing, overlaying with mineral oils, Lyophilization.
- Cultivation of anaerobic bacteria by using media components and by exclusion of air or oxygen.

Unit IV-Microbial Flora of the Healthy Human Host

08

Introduction of

- Origin of normal flora
- Normal flora and the human host - Use of germfree animal/ Gnotobiotic life – germfree animals versus normal animals, other uses of germfree animals.
- Occurrence of the normal flora – Skin, eye, respiratory tract, intestinal tract, genitourinary tract

Learning outcomes-

- Learn the basic concepts of microbial nutrition and the various groups of microorganisms grouped as per their nutritional requirements.
- Study the concept of culture medium, its types and the components used in it.
- Understand the techniques employed for isolation of pure culture.
- Learn the various techniques used for cultivation of anaerobes.

5. Study the ecological distribution of micro organisms in different ecospheres.
6. Comprehend the varied types of microbial interactions and their significance.
7. Study the significance of the commensals of the human body.

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14. Microbiology. Pelzar 5th edition (Unit IV)

1. Preparation and sterilization of Nutrients broth/agar, MacConkey's agar, Sabouraud's agar,
2. Isolation of bacteria by streak plate technique, pour plate technique, Spread plate technique
3. Demonstration of laboratory equipments - Colorimeter, Laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter.
4. To detect the ability of bacteria to produce amylase enzyme.
5. To detect the ability of bacteria to produce catalase enzyme.
6. To detect the ability of bacteria to produce caseinase enzyme.
7. Staining of bacterial Capsule by Maneval's method
8. Staining of bacterial Cell wall by Chance's method
9. Staining of bacterial Volutin granule by Albert's method
10. Observation microorganisms present on
 - a) teeth tarter
 - b) skin -swab method

Learning outcomes:

1. Students should know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
2. Students should be able to prepare cotton plugs, wrapping of plates and pipettes
3. Students should be able to prepare smear and examine bacteria using various staining procedures/techniques.
4. Students should be able to determine efficacy of sanitizers.
5. Students should understand use of copper metal as bactericidal agent in day to day life.
6. Student should be able to weigh ingredients, adjust the pH of medium and operate the autoclave.
7. Student should be able to carry out various techniques of isolation.
8. Student should be able to operate anaerobic jar.
9. Student should understand mechanism of enzyme activity and their applications.
10. Student should be able to detect protein and types of carbohydrate in given sample.
11. Students should be able to learn to critically observe and record the observations of all experiments.

Table activity-

1. Small exhibition on fermented foods and dairy products.
2. Poster display of merits of biofertilizers and biopesticides.

Books recommended for Practical

1. Stains and Staining procedures by Desai and Desai
2. Medical Microbiology by Cruickshank Vol.II
3. Bacteriological techniques by F.J. Baker
4. Experimental Microbiology by Rakesh Patel Vol. I and Vol. II
5. Handbook of Media for Clinical and Public Health Microbiology by Ronald Atlas
6. Practical Handbook of Microbiology by Emanuel Goldman and Lorrence Green
7. Introduction to Practical Biochemistry by D. Plummer , J Wiley and Sons
8. Introduction to Microbial Techniques by Gunasekaran
9. Laboratory Methods in Biochemistry by J. Jayraman
10. Laboratory Manual for Practical Biochemistry ShivrajaShankara YM
11. Introduction to Practical Biochemistry by Sawhney and Singh
12. A Biologist's guide to principles, techniques of Practical Biochemistry by K.Wilson and K.H. Goulding, Edward Arnold Publication

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B.Sc. Part -I

Microbiology (Minor)

Syllabus to be implemented from July 2023 onward

B.Sc. I SEMESTER I

Minor Microbiology

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	Course II		MN-BMiT23-102 Microbiology Paper-II		Course II				
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B.Sc. I SEMESTER II

Level	Major DSC	Practical	Minor	Practical Minor	OE/GE		SEC	AEC	Total credits
4.5	Course III	Practical course- II	MN-BMiT23-201 Microbiology Paper-III	MN-BMiP23-203 Microbiology Practical-II	Course III	Practical course-II	SEC-I	English	22
	Course IV		MN-BMiT23-202 Microbiology Paper-IV		Course IV				
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Semester I + Semester II

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Department of Microbiology
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- 6) To develop their ability to apply the knowledge of Microbiology in day to day life.
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B.Sc. Part-I, Minor Microbiology

Semester-I Paper – I

MN-BMiT23-101 Introduction to Microbiology

(Credits: 02)

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- a) Theory of abiogenesis and biogenesis
- b) Contributions of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister, Paul Ehrlich, Edward Jenner.

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- a) Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology.
- b) Introduction- types of microflora, beneficial & harmful activities of organisms

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- b) Applied areas of Microbiology
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Paper-II

MN-BMiT23-102 Bacteriology

(Credits: 02)

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- b. Cytology-Structure, chemical composition and functions of –
 - i. Cell wall- Gram positive and Gram negative Bacteria
 - ii. Cell membrane, mesosomes.
 - iii. Capsule, slime layer.
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- a. Types of Microscopes – Light (phase contrast, dark field, interference, fluorescent microscope), Electron Microscope
- b. Light Microscope – Parts, image formation, magnification, numerical aperture (uses of oil immersion objective) resolving power and working distance. Ray diagram and applications.
- c. Electron Microscope –Parts, principle of image formation, Ray diagram and applications.
- d. Comparative study of compound and electron microscope.

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- b. Classification of stain – acidic, basic and neutral.
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- a. Definitions of sterilization, disinfection & sanitization.
- b. Physical agents of control of microorganisms- temperature (dry heat and moist heat). Filtration (asbestos and membrane filter)
- c. Chemical agents for control of microorganisms- mode of action, applications and advantages of –
 - i. Phenolic and phenolic compound.
 - ii. Alcohol (Ethyl alcohol)
 - iii. Halogen compounds (Chlorine and Iodine)
 - iv. Heavy metal (Cu and Hg)

Learning outcomes-

1. Study the morphological and cytological characters of the bacterial cell with emphasis on their functionality.
2. Imbibe the basics of stains and staining techniques for comprehensive study of bacteria and other microbes.
3. Understand the importance of Gram's staining in the bacterial taxonomical classification systems.
4. Comprehend the biological concepts of sterilization and disinfection.
5. Learn the mode of action of different chemicals and substances employed as disinfectants for the control of micro organisms.
6. Study the basic principles of autoclave and hot air oven.

Books recommended for Theory

1. Microbiology by Pelczar ,M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
3. Fundamentals of Microbiology by Frobisher ,Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition **(UNIT II & III)**
4. Medical Microbiology Vol.I and II by Cruick Shank R., Duguid J. P., Marmion B.P., Swain R.H.A., XIIth edition , Churchill Livingston , New York. **(UNIT IV)**
5. A textbook of Microbiology by Ananthnarayan- Orient Logman , Bombay **(UNIT IV)**
6. General Microbiology by Stanier R.Y.V thedction, McMilan, London **(UNIT I)**
7. General Microbiology Vol. II by Powar and Dagainawala, Himalaya Publications **(UNIT I)**
8. Microbiology by Prescott, Herley and Klein, IIndedition **(UNIT I to IV)**
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT III)**
10. Microbiology by C. P. Baveja **(UNIT II)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**

1. Preparations of-
 - a) stains (0.5% basic fuchsin, 0.5% crystal violet),
 - b) Reagents (phosphate buffer of pH 7, 1 N and 1M solutions of HCL and NaOH),
 - c) physiological saline.
2. Preparation of a) cotton plugs for test tubes and flasks.
b) Wrapping of plates and pipettes.
3. Use, care and study of compound microscope.
4. Demonstration of laboratory equipment: - Incubator, Autoclave, Hot air oven, Seitz filter, Distilled water plant, anaerobic jar.
5. Microscopic Examination of Bacteria by Monochrome staining method
6. Microscopic Examination of Bacteria by Negative staining method.
7. Microscopic Examination of Bacteria by Gram's staining method
8. Microscopic Examination of motility of Bacteria by Hanging drop technique.
9. To study microbicidal effect of alcohol
10. To study efficacy hand sanitizer.

B.Sc. Part-I, Minor Microbiology

Semester-II Paper-III

MN-BMiT23-201 Biochemistry

(Credits: 02)

Unit I- Carbohydrates

- a) Families of monosaccharide's - aldoses, Ketoses, Triose, Tetroses, Pentoses, Hexoses.
- b) Definitions, classifications and brief account of -
 - i. Monosaccharides- classification based on aldehyde & ketone, groups, structure of ribose, deoxyribose, glucose, galactose and Fructose.
 - ii. Disaccharides - Concept of reducing and non reducing sugar, Glycoside bonds, Structure of lactose and sucrose.
 - iii. Polysaccharides structure and biological role of starch, glycogen and cellulose.

Unit II - Proteins

- a) Amino acids the building blocks of proteins, General formula of amino acids and concept of zwitterion, Classification of amino acids.
- b) Primary structure of proteins
- c) Oligopeptides – Structure and function of naturally occurring glutathione, insulin and Synthetic aspartame.
- d) Secondary structure of proteins, peptide unit and its salient feature . The alpha helix, β pleated sheet and their occurrence in proteins.
- e) Tertiary and quaternary structure of proteins, Forces holding the polypeptide together.
- f) Functions of proteins.

Unit III - Enzymes

- a) Definitions.
- b) Structure – Concept of apoenzyme, Coenzyme, Cofactor prosthetic group and active site.
- c) Types – extracellular, intracellular, constitutive and inducible enzyme.
- d) Feature of enzyme substrate reactions.
- e) Mechanism of enzyme action - lock and key hypothesis and Induced fit hypothesis.
- f) Classification of enzymes.

Unit IV- Nucleic Acids

- a) DNA
 - i. Composition – Structure of purines, Pyrimidines , Structure of nucleoside , nucleotide.
 - ii. Structure of DNA - Watson and Crick's double helical model, salient features.
 - iii. Functions of Mitochondrial and chloroplast DNA.
- b) RNA - Composition – Structure and function of mRNA, tRNA, rRNA

Learning outcomes

1. Study the structure and functions of chemical cellular materials.
2. Imbibe the basics of macromolecules like DNA, RNA and proteins.
3. Understand the essentials of enzymology and the mechanism of various enzymes.
4. Learn the fundamentals of carbohydrates with their structures

Books recommended for Theory

1. Principles of Biochemistry by Nelson and Cox (Lehninger) 5th edition **(UNIT I To IV)**
2. Biochemical Methods by Sadasivam and Manickam
3. Biochemistry by U.Satyanarayana and U. Chakrapani**(UNIT I To IV)**
4. General Microbiology Vol. II by Powar and Daginawala, Himalaya Publications **(UNIT I & II)**
5. Biochemistry by Berg ,Tymoczko and Stryer 7th edition **(UNIT III & IV)**
6. Biochemistry by Powar and Chatwal, Himalaya Publishing House **(UNIT I To IV)**

Paper IV

MN-BMiT23-202 Microbial Physiology

(Credits: 02)

Unit I- Microbial Nutrition

09

- a. Nutrition requirement of micro organisms– water & macronutrients
- b. Micronutrients , carbon , energy , hydrogen , nitrogen , sulphur, phosphorus, growth factor auxotrophs, prototrophs , fastidious organisms.
- c. Nutritional types of microorganisms depending on carbon and energy source.

Unit II - Culture Media

09

- a. Common components of culture media and their functions.
- b. Types of culture media – Natural and Synthetic , Semi synthetic , Differential, Enriched , Enrichment, Selective , Transport, Indicator media.

Unit III - Bacteriological techniques

09

- a. Pure culture techniques – History , Serial dilution technique , Streak plate technique , Spread plate technique , Pour Plate technique.
- b. Maintenance of stock cultures - agar slants and agar stabs.
- c. Preservation of microbial culture – sub culturing, overlaying with mineral oils, Lyophilization.
- d. Cultivation of anaerobic bacteria by using media components and by exclusion of air or oxygen.

Unit IV-Microbial Flora of the Healthy Human Host

09

Introduction of

- a) Origin of normal flora
- b) Normal flora and the human host - Use of germfree animal/ Gnotobiotic life – germfree animals versus normal animals, other uses of germfree animals.
- c) Occurrence of the normal flora – Skin, eye, respiratory tract, intestinal tract, genitourinary tract

Learning outcomes-

1. Learn the basic concepts of microbial nutrition and the various groups of microorganisms grouped as per their nutritional requirements.
2. Study the concept of culture medium, its types and the components used in it.
3. Understand the techniques employed for isolation of pure culture.
4. Learn the various techniques used for cultivation of anaerobes.

5. Study the ecological distribution of micro organisms in different ecospheres.
6. Comprehend the varied types of microbial interactions and their significance.
7. Study the significance of the commensals of the human body.

Books recommended for Theory

1. Microbiology by Pelczar ,M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication).
(UNIT I to IV)
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
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8. Microbiology by Prescott, Herley and Klein, II nd edition **(UNIT I to IV)**
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT III)**
10. Microbiology by C. P. Baveja **(UNIT II)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**

Learning outcomes-

1. Learn the basic concepts of microbial nutrition and the various groups of microorganisms grouped as per their nutritional requirements.
2. Study the concept of culture medium, its types and the components used in it.
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7. Study the significance of the commensals of the human body.

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10. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT III)**
11. Microbiology by C. P. Baveja **(UNIT II)**
12. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to III)**
13. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**
14. Microbiology. Pelzar 5th edition (Unit IV)

1. Preparation and sterilization of Nutrients broth/agar, MacConkey's agar, Sabouraud's agar,
2. Isolation of bacteria by streak plate technique, pour plate technique, Spread plate technique
3. Demonstration of laboratory equipments - Colorimeter, Laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter.
4. To detect the ability of bacteria to produce amylase enzyme.
5. To detect the ability of bacteria to produce catalase enzyme.
6. To detect the ability of bacteria to produce caseinase enzyme.
7. Staining of bacterial Capsule by Maneval's method
8. Staining of bacterial Cell wall by Chance's method
9. Staining of bacterial Volutin granule by Albert's method
10. Observation microorganisms present on
 - a) teeth tarter
 - b) skin -swab method

Learning outcomes:

1. Students should know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
2. Students should be able to prepare cotton plugs, wrapping of plates and pipettes
3. Students should be able to prepare smear and examine bacteria using various staining procedures/techniques.
4. Students should be able to determine efficacy of sanitizers.
5. Students should understand use of copper metal as bactericidal agent in day to day life.
6. Student should be able to weigh ingredients, adjust the pH of medium and operate the autoclave.
7. Student should be able to carry out various techniques of isolation.
8. Student should be able to operate anaerobic jar.
9. Student should understand mechanism of enzyme activity and their applications.
10. Student should be able to detect protein and types of carbohydrate in given sample.
11. Students should be able to learn to critically observe and record the observations of all experiments.

Table activity-

1. Small exhibition on fermented foods and dairy products.
2. Poster display of merits of biofertilizers and biopesticides.

Books recommended for Practical

1. Stains and Staining procedures by Desai and Desai
2. Medical Microbiology by Cruickshank Vol.II
3. Bacteriological techniques by F.J. Baker
4. Experimental Microbiology by Rakesh Patel Vol. I and Vol. II
5. Handbook of Media for Clinical and Public Health Microbiology by Ronald Atlas
6. Practical Handbook of Microbiology by Emanuel Goldman and Lorrence Green
7. Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons
8. Introduction to Microbial Techniques by Gunasekaran
9. Laboratory Methods in Biochemistry by J. Jayaraman
10. Laboratory Manual for Practical Biochemistry ShivrajaShankara YM
11. Introduction to Practical Biochemistry by Sawhney and Singh
12. A Biologist's guide to principles, techniques of Practical Biochemistry by K.Wilson and K.H. Goulding, Edward Arnold Publication

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
(An Autonomous College - Affiliated to Shivaji University, Kolhapur)

Accredited By NAAC with A⁺ Grade (CGPA 3.63)

National Education Policy (NEP-2020)

Syllabus for

B.Sc. Part -I

Microbiology (Open/Generic Elective)

Syllabus to be implemented from July 2023 onward

B.Sc. I SEMESTER I

Microbiology: Generic Elective

Level	Major DSC	Practical	Minor DSE	Practical Minor	OE/GE		IKS	AEC	Total credits
4.5	Course I	Practical course- I	Course I	Practical course- I	Paper I General Microbiology	Practical course- I	Introduction of Vedic Microbiology	English	22
	Course II		Course II		Paper II Techniques in Microbiology				
Credits	2+2= 4	2	2+2= 4	2	4	2	2	2	

B.Sc. I SEMESTER II

Level	Major DSC	Practical	Minor	Practical Minor	OE/GE		SEC	AEC	Total credits
4.5	Course III	Practical course- II	Course III	Practical course-II	Course III Microbial Nutrition and Control	Practical course -II	SEC-I	English	22
	Course IV		Course IV		Course IV Water and Sewage Microbiology				
Credits	4	2	4	2	4	2	2	2	

Semester I + Semester II

44

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
Department of Microbiology
B. Sc. I: 2023-24

- The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.
- The units of the syllabus are well defined, taking into consideration the level and capacity of students.
- This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students.
- The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research.

Course Outcomes (COs)

- General knowledge of the development of Microbiology and particularly the progression from classical Microbiology to the modern Microbiology
- Laboratory skills and exposure to a variety of important experiments as isolation of microorganisms, staining, qualitative analysis of biomolecules, antimicrobial effect and instrumentation study.
- In communication skills written and oral skills develop for dissemination of scientific results in report, article, or oral presentation formats; standard citation methods; ethics in science and scholarship and its importance to scientific inquiry and professionalism.
- The new and updated syllabus is based on a basic and applied approach with vigor and depth.

GENERAL OBJECTIVES OF THE COURSE / PAPER :

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in Microbiology.
- 3) To expose the students to various emerging areas of Microbiology.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To develop their ability to apply the knowledge of Microbiology in day to day life.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To develop skills required in various industries, research labs and in the field of human health.

B.Sc. Part-I, Generic Elective

Semester-I Paper - I

GE-BMiT23-101 General Microbiology (Credits: 02)

Unit I - History and Scope of Microbiology

07

A. History and mile stones in microbiology:

1. Contributions of

- a) Antony von Leeuwenhoek
- b) Edward Jenner
- c) Louis Pasteur
- d) Robert Koch
- e) Ivanowsky
- f) Joseph Lister
- g) Alexander Fleming
- h) Martinus W. Beijerinck
- i) Sergei N. Winogradsky
- j) Hargobindsingh Khorana.

B. Scope of Microbiology:

1. Introduction to applied branches of Microbiology: a) Air b) Water c) Sewage d) Soil e) Dairy f) Food g) Medical h) Industrial

C. Beneficial and harmful activities of microorganisms.

Unit II Types of Microorganisms

08

A. Classification of microorganisms –Whittaker’s five kingdom

B. General characteristics of:

- a) Acellular microorganisms-Viruses, Viroids, Prions
- b) Cellular microorganisms- with emphasis on distribution, occurrence and morphology.
 - i) Bacteria,
 - ii) Algae,
 - iii) Fungi and
 - iv) Protozoa;

C. Structure and differences of Prokaryotic and eukaryotic cell.

D. Bacterial Cell organization

- a. Morphology – Size, shape, arrangement.
- b. Cytology-Structure, chemical composition and functions of –

- i. Cell wall- Gram positive and Gram negative Bacteria
- ii. Cell membrane, mesosomes.
- iii. Capsule, slime layer.
- iv. Surface appendages – flagella, pili.

Books recommended :

1. Microbiology by Pelczar ,M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
3. Fundamentals of Microbiology by Frobisher ,Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition **(UNIT I to IV)**
4. Medical Microbiology Vol.I and II by Cruick Shank R., Duguid J. P., Marmion B.P., Swain R.H.A., XIIthedition , Churchill Livingston , New York. **(UNIT I)**
5. A textbook of Microbiology by Ananthnarayan- Orient Logman , Bombay **(UNIT I)**
6. General Microbiology by Stanier R.Y.V thedion, McMilan, London **(UNIT I to IV)**
7. General Microbiology Vol. I by Powar and Dagainawala, Himalaya Publications **(UNIT I to IV)**
8. Microbiology by Prescott, Herley and Klein, IInd edition **(UNIT I to IV)**
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT I to IV)**
10. Microbiology by C. P. Baveja **(UNIT I to IV)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I to IV)**
13. Microbiology. Pelzar 5th edition (Unit IV)

Paper-II

GE-BMiT23-102 Techniques in Microbiology

(Credits: 02)

Unit I – A. General Principles of Microscopy

08

1. Types of microscopes:
 - a) light microscopes
 - b) electron microscopes,
2. Compound microscopy:
 - a) Parts b) Image formation c) Magnification d) Numerical aperture e) Resolving power
 - f) Working distance g) Ray diagram

B. Stains and Staining procedures

1. Definition of dye and stain
2. Classification of stains – Acidic, Basic and Neutral
3. Principles, Procedure, Mechanism of staining procedures
 - a) Monochrome staining
 - b) Negative staining
 - c) Differential staining : Gram's staining, Acid fast staining

Unit II A. Isolation of Microorganisms from natural environment.

07

1. Pure culture techniques – Streak plate, Spread plate, Pour Plate.
2. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air.

B. Preservation of microbial cultures by –

1. Subculturing,
2. Overlaying cultures with mineral oils
3. Storage at low temperature,
4. Lyophilization.

C. Systematic study of pure cultures:

1. Morphological characteristics.
2. Cultural characteristics - Colony characteristics on solid media, growth in liquid media.
3. Biochemical Characteristics - Sugar fermentation, H₂S gas production
4. Detection of enzyme activity – Amylase, Caseinase, Catalase

Books recommended for Theory

1. Microbiology by Pelczar ,M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
3. Fundamentals of Microbiology by Frobisher ,Hindsill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition **(UNIT II & III)**
4. Medical Microbiology Vol.I and II by Cruick Shank R., Duguid J. P., Marmion B.P., Swain R.H.A., XIIthedition , Churchill Livingston , New York. **(UNIT IV)**
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8. Microbiology by Prescott, Herley and Klein, IIIndedition **(UNIT I to IV)**
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat **(UNIT III)**
10. Microbiology by C. P. Baveja **(UNIT II)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**

GE-BMiP23-103 Practical Course: I

Credit :2

1. Preparations of- a) stains (0.5% basic fuchsin, 0.5% crystal violet),
b) Reagents (phosphate buffer of pH 7, 1 N and 1M solutions of HCL and NaOH),
c) physiological saline.
2. Preparation of - a) cotton plugs for test tubes and flasks.
b) Wrapping of plates and pipettes.
3. Use, care and study of compound microscope.
4. Demonstration of laboratory equipment: - Incubator, Autoclave, Hot air oven, Seitz filter, Distilled water plant, anaerobic jar.
5. Microscopic Examination of Bacteria by Monochrome staining method
6. Microscopic Examination of Bacteria by Negative staining method.
7. Microscopic Examination of Bacteria by Gram's staining method
8. Microscopic Examination of motility of Bacteria by Hanging drop technique.
9. To study microbicidal effect of alcohol
10. To study efficacy hand sanitizer.

B.Sc. Part-I, Generic Elective
Semester-II Paper-III
GE-BMiT23-201 Microbial Nutrition and Control

Unit I	A. Microbial Nutrition	15
	1. Nutritional requirements of microorganisms:	
	a) Water;	
	b) Micronutrients;	
	c) Macronutrients	
	d) Carbon,	
	e) Energy source	
	f) Oxygen and Hydrogen	
	g) Nitrogen,	
	h) Sulfur and Phosphorous	
	i) growth factors.	
	2. Concept of auxotroph, Prototroph and fastidious organisms based on Growth factors.	
	3. Nutritional types of microorganism based on carbon and energy sources.	
	a. Autotrophs b. Heterotrophs	
	c. Phototrophs d. Chemotrophs	
	e. Photoautotrophs f. Chemoautotrophs	
	g. Photoheterotrophs h. Chemoheterotrophs.	
	B. Culture media:	
	1. Components of media,	
	2. Types of media based on-	
	a. Physical state- Solid media, liquid media, semisolid media	
	b. Chemical nature -Natural media, Synthetic media, complex media	
	c. Function - Selective media, Differential media, Enriched media, Enrichment media	
	C. Cultivation of microorganisms:	
	1. Use of culture media for cultivation.	
	2. Conditions required for growth of the microorganisms	
Unit II	A. Control of Microorganisms	15
	1. Definitions of –	
	a) Sterilization	
	b) Disinfection	
	c) Antiseptic	
	d) Germicide	
	e) Microbiostasis	
	f) Antisepsis	
	g) Sanitization	
	2. Mode of Action and application of-	
	a) Physical agents:	

- i) Temperature – Dry heat, Moist heat,
- ii) Desiccation,
- iii) Ultrasonication
- iv) Radiations – U.V. Ray, Gamma rays,
- v) Filtration– Asbestos and Membrane filter
- b) Chemical Agents:
 - i)Phenol and Phenolic compounds
 - ii)Alcohols (Ethyl alcohol)
 - iii)Halogen compounds (chlorine and iodine)
 - iv)Heavy metals (Cu and Hg)
 - v)Fumigation by Gaseous Agents –
 - vi)Ethylene oxide,
 - vii)Beta-propiolactone
 - viii)formaldehyde
 - ix)Osmotic Pressure

Books recommended for Theory

1. Principles of Biochemistry by Nelson and Cox (Lehninger) 5th edition (**UNIT I To IV**)
2. Biochemical Methods by Sadasivam and Manickam
3. Biochemistry by U.Satyanarayana and U. Chakrapani(**UNIT I To IV**)
4. General Microbiology Vol. II by Powar and Daginawala, Himalaya Publications (**UNIT I & II**)
5. Biochemistry by Berg ,Tymoczko and Stryer 7th edition (**UNIT III & IV**)
6. Biochemistry by Powar and Chatwal, Himalaya Publishing House (**UNIT I To IV**)

Paper IV

GE-BMiT23-202 Water and Air Microbiology (Credits: 02)

Unit I	A. Water Microbiology: 1. Sources of microorganisms in water. 2. Fecal pollution of water. 3. Indicators of fecal pollution 4. Routine Bacteriological analysis of water. a. SPC b. Tests for Coli forms i) Qualitative test Detection of coliforms -Presumptive test, Confirmed Test, Completed test. Differentiation between coliforms –IMViC test, Eijkman test. ii) Quantitative – MPN, Membrane filter technique 5. Municipal water purification process and it's significance.	15
Unit II	Milk Microbiology B. Milk Microbiology 1. General composition of Milk. 2. Sources of contamination in milk 3. Spoilage of milk – a.Change in Colour and flavor, b.curdling and ropiness 4. Microbiological examination of Milk – a.SPC b. dye reduction tests : i) MBRT test, ii) Resazurin test 5. Pasteurization (definition, types of methods used) – a. LTH (Low Temperature Holding) b. HTST (High Temperature Short Time) c. UHT (Ultra High Temperature) 6. Efficiency of Pasteurisation – Phosphatase test (Qualitative)	15

Books recommended for Theory

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8. Microbiology by Prescott, Herley and Klein, IIndedition (**UNIT I to IV**)
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, AktaPrakashanNadiad, Gujarat (**UNIT III**)
10. Microbiology by C. P. Baveja (**UNIT II**)
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill (**UNIT I to IV**)
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition (**UNIT I**)

GE-BMiP23-203 Practical Course II

Credit :2

1. Preparation and sterilization of Nutrients broth/agar, MacConkey's agar, Sabouraud's agar,
2. Isolation of bacteria by streak plate technique, pour plate technique, Spread plate technique
3. Demonstration of laboratory equipments - Colorimeter, Laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter.
4. To detect the ability of bacteria to produce amylase enzyme.
5. To detect the ability of bacteria to produce catalase enzyme.
6. To detect the ability of bacteria to produce caseinase enzyme.
7. Staining of bacterial Capsule by Maneval's method
8. Staining of bacterial Cell wall by Chance's method
9. Staining of bacterial Volutin granule by Albert's method
10. Observation microorganisms present on
 - a) teeth tarter
 - b) skin -swab method

Learning outcomes:

1. Students should know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
2. Students should be able to prepare cotton plugs, wrapping of plates and pipettes
3. Students should be able to prepare smear and examine bacteria using various staining procedures/techniques.
4. Students should be able to determine efficacy of sanitizers.
5. Students should understand use of copper metal as bactericidal agent in day to day life.
6. Student should be able to weigh ingredients, adjust the pH of medium and operate the autoclave.
7. Student should be able to carry out various techniques of isolation.
8. Student should be able to operate anaerobic jar.
9. Student should understand mechanism of enzyme activity and their applications.
10. Student should be able to detect protein and types of carbohydrate in given sample.
11. Students should be able to learn to critically observe and record the observations of all experiments.

Table activity-

1. Small exhibition on fermented foods and dairy products.
2. Poster display of merits of biofertilizers and biopesticides.

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
(An Autonomous College - Affiliated to Shivaji University, Kolhapur)

Accredited By NAAC with A⁺ Grade (CGPA 3.63)

National Education Policy (NEP-2020)

Syllabus for

B.Sc. Part -I

Microbiology (Major)
Indian Knowledge System (IKS)

‘Vedic Microbiology’

Syllabus to be implemented from July 2023 onward

B.Sc. I SEMESTER I**Minor Microbiology**

Level	Maj or DS C	Practical	Minor DSE	Practical Minor	OE/GE		IKS	AEC	Total credits
4.5	Course I	Practical course- I	Course I	Practical course- I	Course I	Practical course- I	Vedic Microbiology	English	22
	Course II		Course II		Course II				
Credits	2+2= 4	2	2+2= 4	2	4	2	2	2	

Rayat Shikshan Sanstha's
Sadguru Gadage Maharaj College, Karad
Department of Microbiology
B.Sc. Part-I, Major Microbiology
Semester-I : Indian Knowledge System (IKS)

GENERAL OBJECTIVES OF THE PAPER:

Students will be able to,

1. Study the concept of Veda.
2. Study the contribution of Rishis or Gurus in Vedic Microbiology.
3. Study microbiological phenomenon explained in Vedas
4. Study scientific approach behind traditional Indian Knowledge system

Credits 02	<u>IKS-Mi23-101: Vedic Microbiology</u>	No. of hours
<u>UNIT - I</u>	Introduction to Vedas	(15)
	<ol style="list-style-type: none"> 1. Origin of Vedas <ol style="list-style-type: none"> 1.1 Introduction 1.2 Mahavakya of Vedas 1.3 Vedic Rishies pertaining to Microbiology: Agastya, Rishi Kanva, Rishi Badarayani, Rishi Charak, Maharishi Sushruta, Rishi Catana 1.4 Concept of atoms and molecules in Vedic period 2. Names and Classification of Germs <ol style="list-style-type: none"> 2.1 Classification of organisms 2.2 Major groups of Germs (Krimis) in Vedas 2.3 Microbial diversity 3. Human Health and Pathogenic Germs (Krimis) <ol style="list-style-type: none"> 3.1 Introduction, Hymns of Healthy life 3.2 Disease defense by good health 3.3 Kshudrarog in humans (Jaundice, Mumps and Smallpox) 	
<u>UNIT - II</u>	Controlling of Germs (Krmis)	(15)
	<ol style="list-style-type: none"> 1. Prevention of infection 2. Precaution of Spread 3. Elimination of Pathogens <ol style="list-style-type: none"> 3.1 Destruction of microorganisms 3.2 Use of Sunrays 4. Eradication of Pathogens <ol style="list-style-type: none"> 4.1 Use of medicinal plants 	

Course Outcomes:

Students should be able to,

- Explore Vedic Knowledge Microbiology.
- Explain the contribution of Vedic rishis in Microbiology
- Evaluate different traditional methods for control of microorganisms
- Explain Vedic mantras describing microorganisms.

Reference Book

1. Dubey R. C. Vedic Microbiology: A Scientific View; Aastha Prakashan Banarasidass,2020
2. Anjista C. F.; Kurup S.; Vedic Microbiology-Gurus of Vedic Microbiology