



**Vivekanand Education Society's
College of Arts, Science and Commerce**

(Autonomous)

NAAC Re-Accredited A grade (3rd cycle)
Best College Award- Urban Area, University of Mumbai (2012-15)
Recipient of FIST Grant (DST) and STAR college Grant (DBT)

Affiliated to University of Mumbai

Program: Bachelor of Science (Microbiology)

(VESUSMB)

FIRST YEAR (SEM. I & SEM. II)

As per

Choice Based Semester and Grading System

with effect from Academic Year 2022 - 2023

Program Outcomes

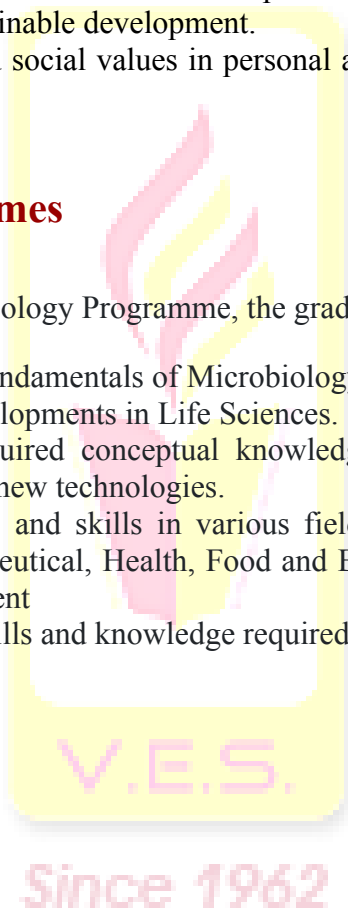
Upon completion of B.Sc Programme, the graduates will have:

1. The required analytical skills to apply appropriate scientific principles and methodologies to solve real world problems
2. The ability to design, carry out experiments and analyze results while accounting for uncertainties in different quantities measured using various scientific instruments.
3. The ability to communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
4. Understand the need for scientific solutions to problems of the environment and society, keeping in mind their sustainable development.
5. Imbibe ethical, moral and social values in personal and social life leading to a cultured and civilized personality.

Program Specific Outcomes

Upon completion of B.Sc. Microbiology Programme, the graduates will:

1. Be well-versed with the fundamentals of Microbiology, which in turn will enable them to comprehend the latest developments in Life Sciences.
2. Be able to apply the acquired conceptual knowledge in real life situations to solve problems as well as create new technologies.
3. Have acquired knowledge and skills in various fields of Microbiology enabling their application in the Pharmaceutical, Health, Food and Biotechnology industries, as well as in protecting the environment
4. Have acquired the basic skills and knowledge required for pursuing a career in Research



F.Y.B.Sc. MICROBIOLOGY THEORY

(SEMESTER I)

| Course Code | Title | Credits & Lectures per Semester | Lec per Week |
|--------------------|--|---------------------------------|--------------|
| VESUSMB101 | Fundamentals of Microbiology | 02 | 03 |
| Unit I | Introduction to Microbiology | 15 Lec | |
| Unit II | The Journey of Microbiology | 15 Lec | |
| Unit III | Cell Structure and Function | 15 Lec | |
| | | | |
| VESUSMB102 | Basic Techniques in Microbiology | 02 | 03 |
| Unit I | Microscopic observation of microbes | 15 Lec | |
| Unit II | Cultivation & Preservation of microbes | 15 Lec | |
| Unit III | Control of Microorganisms | 15 Lec | |
| | | | |
| VESUSMBP101 | Practicals based on VESUSMB101 & VESUSMB102 | 02 | 06 |

V.E.S.
Since 1962

F.Y.B.Sc. MICROBIOLOGY THEORY

(SEMESTER II)

| Course Code | Title | Credits & Lectures per Semester | Lec per Week |
|-------------|--|---------------------------------|--------------|
| VESUSMB201 | Basics of Microbiology | 02 | 03 |
| Unit I | Microbial growth | 15 Lec | |
| Unit II | Prokaryotic diversity | 15 Lec | |
| Unit III | Eukaryotic Microbial diversity and Viruses | 15 Lec | |
| | | | |
| VESUSMB202 | Exploring Microbiology | 02 | 03 |
| Unit I | Human Microbe Interactions | 15 Lec | |
| Unit II | Microbial Biochemistry | 15 Lec | |
| Unit III | Microbial Interactions in the Environment | 15 Lec | |
| | | | |
| VESUSMBP201 | Practicals based on VESUSMB201 & VESUSMBP02 | 02 | 06 |

SEMESTER I

Paper I: Fundamentals Of Microbiology (VESUSMB101)

Objectives:

1. To be acquainted with microorganisms and their applications in various fields
2. To understand the evolution of the field of Microbiology from its beginnings to the current times
3. To understand the fundamental aspects of prokaryotic and eukaryotic cell structure and function

Outcomes:

1. Be acquainted with the subject of Microbiology and its various branches
2. Understand the historical development of the subject and recent developments in the field
3. Understand cell structure and function and the differentiating features of prokaryotic and eukaryotic cells

| Paper I | FUNDAMENTALS OF MICROBIOLOGY VESUSMB101 | 45 LEC. |
|----------------|--|----------------|
| Unit I | Introduction to Microbiology | [15] |
| | 1. Microorganisms - cellular and acellular | 1 |
| | 2. The Place of Microorganisms in the Living world <ul style="list-style-type: none">- Five kingdom classification- Three Domain classification | 2 |
| | 3. Members of the Microbial World <ul style="list-style-type: none">- Bacteria- Archaea- Protists (Algae, protozoa, slime molds, water molds)- Fungi- Viruses, viroids, satellites, prions | 2 |
| | 4. Evolution of microorganisms | 2 |
| | 5. Microbial habitats and extreme environments | 1 |
| | 6. Major fields of Microbiology <ul style="list-style-type: none">- Medical Microbiology and Immunology- Microbial Ecology- Agricultural Microbiology- Industrial and Food Microbiology- Microbial genetics and Molecular Biology- Microbial Biochemistry | 7 |

| | | |
|-----------------|---|---|
| Unit II | The Journey of Microbiology | [15] |
| | <p>1. The Beginnings of Microbiology</p> <ul style="list-style-type: none"> - The Discovery of Microorganisms - The Conflict over spontaneous generation - The Golden age of Microbiology <ul style="list-style-type: none"> o Microorganisms and disease o Koch's postulates o Pure culture techniques o Discovery of viruses o Immunological studies - Discovery of antibiotics and antimicrobial drugs - Beginning of Industrial Microbiology - Beginning of Microbial Ecology - Beginning of Genetics and Molecular Biology <p>2. Recent Advances in Microbiology</p> <ul style="list-style-type: none"> - Recombinant DNA technology - Genetically modified organisms - Development of PCR - Genomics and Bioinformatics - Rise of Biotechnology <p>3. Microbiology in the 21st century</p> <ul style="list-style-type: none"> - Space Microbiology - Nanotechnology - Synthetic Biology | <p>8</p> <p>4</p> <p>3</p> |
| Unit III | Cell Structure and Function | [15] |
| | <p>1. Prokaryotic Cell Structure and Function</p> <ul style="list-style-type: none"> - Microbial cell size, shape and arrangements - Cell wall (Gram positive, Gram negative, archaea), Concept of Mycoplasma, Spheroplast, protoplast, L-form - Cell membrane (bacterial and archaeal) - Endospore - Capsule - Flagella, Fimbriae and Pili - Ribosomes (bacterial and archaeal) - Chromosomal & extra-chromosomal material - Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes) | 09 |

| | | |
|--|---|-----------|
| | 2. Eukaryotic Cell Structure and Function <ul style="list-style-type: none"> - Plasma membrane and Cytoplasmic matrix - Endoplasmic reticulum and Golgi apparatus - Ribosomes - Mitochondria and Chloroplasts - Nucleus–Nuclear Structure - External cell coverings viz Cilia and Flagella | 06 |
|--|---|-----------|

Paper II: Basic Techniques in Microbiology (VESUSMB102)

Objectives:

1. To understand the principles and applications of microscopy and staining
2. To understand the basic concepts of microbial nutrition, cultivation and preservation
3. To learn the physical and chemical methods used to control the growth of microorganisms

Outcomes:

1. Understand the principles and applications of microscopy and staining
2. Be familiar with the basic concepts of microbial nutrition, cultivation and preservation
3. Know the physical and chemical methods used to control the growth of microorganisms

| Paper II | Basic Techniques in Microbiology VESUSMB102 | 45 LEC. |
|-----------------|---|----------------|
| Unit I | Microscopic observation of microbes | [15] |
| | 1. Principles of light microscopy: Lenses and the bending of light, Magnification, resolution, numerical aperture | 03 |
| | 2. The bright field microscope | 02 |
| | 3. Staining of specimens for microscopic observation: Physicochemical basis of staining, Types of stains, Fixatives, Mordants, Decolorizers, Simple and differential staining | 05 |
| | 4. Phase contrast and dark field microscopy | 02 |
| | 5. Fluorescence microscopy (types of fluorescence microscopy - tabulation) | 01 |
| | 6. Introduction to Electron Microscopy | 02 |
| Unit II | Cultivation and preservation of microbes | 15 |
| | 1. Nutritional requirements – Carbon, Nitrogen, Other macronutrients, micronutrients and growth factors | 02 |

| | | |
|-----------------|--|--|
| | 2. Components of culture media - peptone, meat extract, yeast extract, agar, etc 3. Types of Culture media with examples 4. Pure culture techniques 5. Cultivation of anaerobes 6. Enrichment culture technique 7. Preservation of microorganisms | 02 03 03 01 02 02 |
| Unit III | Control of Microorganisms | [15] |
| | 1. Definition of frequently used terms & Rate of microbial death 2. Physical methods of microbial control <ul style="list-style-type: none"> - Dry & Moist heat - Electromagnetic radiations - Bacteria proof filters - Low temperature - Osmotic pressure - Desiccation 3. Chemical methods of microbial control <ul style="list-style-type: none"> - Phenolics - Alcohols - Heavy metals and their compounds - Halogens - Quaternary ammonium compounds - Dyes - Detergents - Aldehydes - Peroxygens - Sterilizing gases - Nanoparticles | 02 06 07 |

Semester I Practicals VESUSMBP101

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|--|
| Paper I Fundamentals of Microbiology |
| 1. Introduction to the Microbiology lab and its equipments 2. Safety in the Microbiology laboratory <ol style="list-style-type: none"> a. Fire safety - explain what to do in case alcohol or cotton catches fire, take precautions to avoid gas leakage, avoid sleeves with hanging parts, tie up hair b. Chemical safety - Pipetting corrosive chemicals using rubber teat method or auto-pipettes, Keeping fuming liquids covered c. Biosafety - Discarding culture containing glassware appropriately, Precautions |

to be taken on accidental spillage of/ breakage of culture containers, Discard of highly infectious pathogenic samples like T.B. infected sputum etc

3. Omnipresence of Microorganisms
 - a. Wet mount of pond water
 - b. Demonstration of presence of microorganisms in air, soil & surfaces
 - c. Macro and microscopic examination of spoiled bread and Fruit/Vegetable.
4. Aseptic transfer technique
5. Making curd and alcohol (Group Expt.)
6. Micrometry - measure size of Yeast & Bacillus (Demonstration)
7. Study of Motility (Hanging Drop Preparation) (Demonstration)
8. Special staining:
 - a. Cell wall,
 - b. Capsule,
 - c. Endospore
 - d. PHB,
 - e. Metachromatic granules,
 - f. Flagella (Demonstration)

Paper II Basic Techniques in Microbiology

1. Parts of a microscope
2. Monochrome staining
3. Negative Staining
4. Gram Staining
5. Preparation of Culture Media:
 - a. Liquid medium (Nutrient Broth, Sabouraud's broth)
 - b. Solid Media (Nutrient agar, Sabouraud's agar)
 - c. Preparation of slants, butts & plates
6. Inoculation techniques and Study of Growth:
 - a. Inoculation of broth, slant and butt (of pigment producers)
7. Isolation and study of colony characteristics:
 - a. Isolation of *E. coli* and *S. aureus* on N.A
 - b. Isolation of yeast on Sabouraud's agar
 - c. Use of Enriched, differential & Selective Media: (Blood agar, MacConkey) - spot inoculation
8. Methods of Preservation of cultures - refrigeration, paraffin overlaying, glycerol stocks
9. Effect of lab disinfectant on surfaces
10. Effect of alcohol sterilization of glassware
11. Effect of UV light on bacteria (demonstration)
12. Effect of Osmotic Pressure on bacteria
13. Effect of heavy metals on bacteria (Oligodynamic action)
14. Effect of dyes on bacteria (disc diffusion method)

References

Paper I FUNDAMENTALS OF MICROBIOLOGY

Unit I: Introduction to Microbiology

1. Prescott, Hurley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Michael T .Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.

Unit II: The Journey of Microbiology

1. Web link : A Brief History of Microbiology and Immunology
2. Prescott ,Hurley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.

Unit III: Cell structure and Function

1. Microbial Life - Staley, Gunsalus, Lory and Perry, 2nd edition, Sinauer Associates Inc.

Paper II Basic techniques in Microbiology

Unit I: Microscopic observation of microbes

1. Prescott, Hurley.Klein-Microbiology, 10th edition, International edition, McGraw Hill.
2. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.

Unit II: Cultivation and preservation of microbes

1. Prescott, Hurley.Klein-Microbiology, 10th edition, International edition, McGraw Hill.
2. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.

Unit III: Control of Microorganisms

1. Prescott ,Hurley.Klein-Microbiology, 10th edition, International edition, McGraw Hill.
2. Microbiology, An Introduction by Tortora, Funke & Case 9th and 11th edition, Pearson education.

SEMESTER II

Paper I: Basics of Microbiology (VESUSMB201)

Objectives:

1. To learn the fundamental concepts of microbial growth
2. To be acquainted with the diversity of prokaryotic species
3. To be familiarized with the diversity of eukaryotes
4. To be introduced to viruses

Outcomes:

At the end of the course students will:

1. Appreciate the factors controlling microbial growth
2. Be acquainted with the vast array of members of the microbial community and learn their importance

| Paper I | Basics of Microbiology VESUSMB201 | 45 LEC. |
|---------|--|---------|
| Unit I | Microbial growth | 15 |
| | 1. Bacterial population growth - Growth curve - The mathematics of growth | 03 |
| | 2. Continuous culture of microorganisms | 02 |
| | 3. Measurement of bacterial growth - Microscopic counts - Viable counts - Measuring cell mass | 04 |
| | 4. Influence of environmental factors on microbial growth - Temperature, pH, Osmolarity, Oxygen, Pressure, Radiation | 06 |
| Unit II | Prokaryotic Diversity | 15 |
| | 1. Archaeobacteria a. Crenarchaeota b. Euryarchaeota c. Korarchaeota d. Nanoarchaeota | 3 |

| | | |
|------------------------|---|---------------------------------|
| | <p>2. Bacteria</p> <p>a. Nutritional diversity Chemoorganotrophs, chemolithotrophs, photoorganotrophs, photolithotrophs - oxygenic, anoxygenic</p> <p>b. Morphological diversity</p> <p>a. Gram positive cocci: (<i>Staphylococcus, Streptococcus, Micrococcus, Ruminococcus</i>)</p> <p>b. Gram negative cocci (<i>Neisseria, Veillonella</i>)</p> <p>c. Gram positive rods - Endospore forming regular rods (<i>Bacillus, Clostridium</i>), Non Spore forming regular rods (<i>Lactobacillus</i>), Irregular non sporing rods (<i>Corynebacterium, Arthrobacter, Propionibacterium, Mycobacteria</i>)</p> <p>d. Gram negative rods - Aerobic (<i>Pseudomonas, Azotobacter, Rhizobium</i>), Facultative anaerobic (<i>Coliforms, Salmonella, Shigella, Vibrio</i>), Anaerobic (<i>Bacteroides, Fusobacterium</i>)</p> <p>C. Special categories of bacteria</p> <p>a. Actinomycetes</p> <p>b. Spirochaetes</p> <p>c. Mycoplasma</p> <p>d. Budding, appendaged and sheathed bacteria</p> <p>e. Gliding bacteria: Fruiting (<i>Myxobacteria</i>), Non-fruiting (<i>Cytophaga, Beggiatoa</i>)</p> <p>f. Obligate intracellular parasites (<i>Rickettsiae, Chlamydiae</i>)</p> | <p>12</p> |
| <p>Unit III</p> | <p>Eukaryotic microbial diversity and Viruses</p> | <p>15</p> |
| | <p>1. Fungi</p> <p>a. Morphology :molds , yeasts and dimorphism</p> <p>b. Classification : Zygomycetes, Ascomycetes, Basidiomycetes,Deuteromycetes.Oomycetes (water molds),</p> <p>c. Cultivation</p> <p>d. Significance of fungi: decomposition, biodeterioration, associations lichen, mycorrhizae, pathogens, fermented foods(Tabulate)</p> <p>2. Protozoa</p> <p>a. Morphology</p> <p>b. Nutrition and metabolism</p> <p>c. Reproduction</p> | <p>4</p> <p>3</p> |

| | | |
|--|---|----------|
| | <ul style="list-style-type: none"> d. Classification e. Significance f. Major Categories of Protozoa Based on motility, reproduction. Medically important Protozoa (tabulation), Life cycle of Entamoeba | |
| | <p>3. Algae</p> <p>Introduction</p> <p>Classification</p> <ul style="list-style-type: none"> - Primary - Secondary <p>Significance of Algae: Biological, Medical and economic importance of Algae. (Tabulate)</p> <p>Differences between Algae and Cyanobacteria</p> | 4 |
| | 4. Slime molds | 1 |
| | <p>5. Viruses</p> <p>Characteristics, types (based on host), structure, life cycle</p> | 3 |

Paper II: Exploring Microbiology (VESUSMB202)

Objectives:

1. To learn about the human microbiota and host-pathogen interactions
2. To be introduced to the basic chemistry of a cell and understand the structure and function of biomolecules
3. To learn about various types of interactions between microorganisms and higher organisms

Outcomes:

At the end of the course students will:

1. Be aware of the impact of normal microbiota on human lives and begin to understand the significance of host pathogen interactions
1. Realize the importance of biomolecules in cellular chemistry
2. Be familiarized with the multiple associations between microbes and higher organisms

| | | |
|-----------------|---|----------------|
| Paper II | Exploring Microbiology VESUSMB202 | 45 LEC. |
| Unit I | Human-Microbe interactions | 15 |
| | <ol style="list-style-type: none"> 1. Human Microbe Ecosystem <ul style="list-style-type: none"> a. Important Terminologies - Normal microbiota, germ free life, Gnotobiosis | 8 |

| | | |
|----------------|--|---|
| | <p>b. Normal Microbiota of Human body</p> <ol style="list-style-type: none"> 1. Development of Normal Microbiota 2. Normal microbiota of - Skin Nose, pharynx, mouth Respiratory Tract Eye and External Ear Gastrointestinal tract Genitourinary tract <p>c. Human Microbiome project - (Significance only)</p> <p>2. Host Pathogen Interaction</p> <ol style="list-style-type: none"> a. Important terms - Infection, Pathogen - (primary/opportunistic), Pathogenicity, Virulence, Virulence factor, ID50 b. Measurement of virulence - LD50 c. Koch's and River's postulates d. Infection Cycles-Concepts of modes of transmission-Direct/indirect/Horizontal/vertical/ vehicle/vector/reservoir e. Portals of entry of pathogens | 7 |
| Unit II | Microbial Biochemistry | 15 |
| | <p>1. Introduction to Biochemistry</p> <ol style="list-style-type: none"> A. Chemical foundations B. Versatility of carbon C. Functional groups of important biomolecules D. Configuration and conformation E. Water - The basis of life <p>2. Chemical constituents of life</p> <p>A. Carbohydrates - The molecules of support and energy</p> <ul style="list-style-type: none"> - The functions of Carbohydrates - Classification of Carbohydrates - Monosaccharides /simple sugars - structural aspects <ul style="list-style-type: none"> - Glyceraldehyde : The reference carbohydrate - D and L isomers - Epimers and enantiomers - Structure of Glucose - Pyranose and Furanose structures, Mutarotation - Disaccharides <ul style="list-style-type: none"> - Reducing and nonreducing - Maltose, sucrose, lactose - Oligosaccharides, and trisaccharides | <p style="text-align: center;">3</p> <p style="text-align: center;">4</p> |

| | | |
|-----------------|--|---|
| | <ul style="list-style-type: none"> - Polysaccharides <ul style="list-style-type: none"> - Homopolysaccharides : Starch, Cellulose, glycogen , inulin - Heteropolysaccharide : peptidoglycan, agar <p>B. Lipids- The fuel molecules</p> <ul style="list-style-type: none"> - Classification of lipids - Functions of lipids - Structure of fatty acid and phospholipids <p>C. Amino acids - Building block of proteins</p> <ul style="list-style-type: none"> - General structure - Classification - Properties of amino acids- Optical and Ampholytes <p>D. Proteins - The molecules of biological specificity</p> <ul style="list-style-type: none"> - Structure of proteins - Proteins as biocatalysts (Enzymes) <p>E. Nucleic acids and nucleotides - Informational molecules</p> <ul style="list-style-type: none"> - Functions of nucleic acids - Structure of nucleotides - Structure of DNA(in brief Watson and Crick model) - Structure of RNA and types | <p>2</p> <p>2</p> <p>2</p> <p>2</p> |
| Unit III | Microbial Interactions in the Environment | 15 |
| | <ol style="list-style-type: none"> 1. Types of Microbial Interaction - Mutualism, Cooperation, Commensalism, Predation, Parasitism, Amensalism, Competition 2. Plants as microbial habitats (Legume-root nodule, Mycorrhizae, Agrobacterium) 3. Animals as microbial habitats <ol style="list-style-type: none"> a. Termites b. Rumen symbiosis c. Bioluminescent bacteria d. Symbiotic associations at hydrothermal vents e. Associations in coral reefs | <p>3</p> <p>5</p> <p>7</p> |

Semester II Practicals VESUSMBP102

Paper I Basics of Microbiology

1. Viable count: Spread plate and Pour plate (Demonstration)
2. Cell count by Haemocytometer
3. Preparation of Brown's opacity tubes for cell count
4. Effect of pH and temperature on growth of bacteria
5. Comparison of shaker and static cultures on growth (Fungal and Bacterial)
6. Study of Phases of Growth curve (Demonstration)
7. Study and cultivation of Aerobic and Anaerobic spore bearers
8. Study of Actinomycetes by Slide culture technique
9. Cultivation of algae or BGA (Demonstration)
10. Study of protozoa (Demonstration)
11. Study of morphological characteristics of fungi by Wet Mount
12. Spot test for bacteriophage (Demonstration)

Paper II Exploring Microbiology

1. Qualitative detection of Carbohydrates- Benedicts, Molisch's test.
2. Qualitative detection of Proteins, amino acids- Biuret, Ninhydrin.
3. Protein precipitation from milk (isoelectric point) - (Demonstration)
4. Solubility of lipids in different solvents
5. Study of enzyme activity (amylase and protease) - Spot test
6. Study of normal flora of skin
7. Study of biofilm by submerged slide technique
8. Study of lichens
9. Study of Rhizobium
10. Study of bioluminescent bacteria (Demonstration)

References

Paper I: Basics of Microbiology

Unit I: Microbial Growth

1. Prescott ,Hurley.Klein-Microbiology, 10th edition, International edition, McGraw Hill.
2. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.

Unit II : Prokaryotic Diversity

1. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.
2. Lim and Daniel.Microbiology,Second edition, Boston, McGraw Hill International 1998

Unit III :Eukaryotic microbial diversity and Viruses

1. Microbiology Essentials & Applications by Larry McKane and Judy Kandel, 2nd Edition, McGraw Hill Inc.
2. Microbiology - An evolving Science Joan Slonczewski & John Foster, 4th Edition, WW Norton & Company, New York

Paper II: Exploring Microbiology

Unit I: Human-Microbe interactions

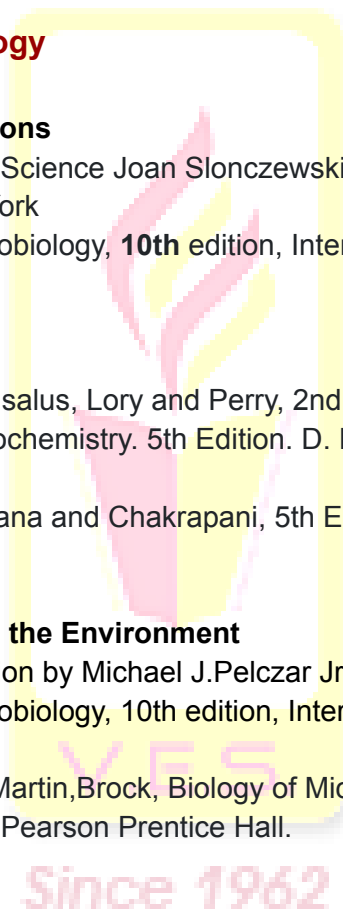
1. Microbiology - An evolving Science Joan Slonczewski & John Foster, 4th Edition, WW Norton & Company, New York
2. Prescott ,Hurley.Klein-Microbiology, **10th** edition, International edition, McGraw Hill

Unit II: Microbial Biochemistry

1. Microbial Life - Staley, Gunsalus, Lory and Perry, 2nd edition, Sinauer Associates Inc.
2. Lehninger. Principles of Biochemistry. 5th Edition. D. Nelson and M. Cox. W.H.Freeman and Company. New York
3. Biochemistry - Satyanarayana and Chakrapani, 5th Edition , ELSEVIER , Books and Allied

Unit III: Microbial Interactions in the Environment

1. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg
2. Prescott ,Hurley.Klein-Microbiology, 10th edition, International edition, McGraw Hill.
3. Michael T.Madigan & J.M.Martin,Brock, Biology of Microorganisms 12thEd. International Edition 2006, Pearson Prentice Hall.



Modality of assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25% marks in the first part & by conducting the Semester End Examinations with 75% marks in the second part. Practical Examination will be only at the end of the Semester for 50 marks for each theory paper.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Internal Assessment: It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment : It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.

A. Theory - Internal assessment 25%

25 marks

| Sr No | Evaluation type | Marks |
|-------|--|-------|
| 1. | <ul style="list-style-type: none">- Project based learning activities (Group Research/ Case studies/ Reports / Assignments / Presentations / Skit / Poster / etc.),- Class Test (multiple choice questions / objective) | 20 |
| 2. | <ul style="list-style-type: none">- Active participation in routine class activity- Overall conduct as a responsible student, with respect to good behaviour, leadership qualities, interpersonal skills etc. | 05 |

Project Based Learning (PBL) Is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.

Suggested topics for PBL

Semester I

- Places in India with extreme environments and types of organisms found
- Industries producing products related to Microbiology
- History of Microscopy
- Run simulations of microscopy lens available on Nikon, Canon and other websites
- Ibiology videos on microscopy
- Ibiology videos on discovery of eukaryotic organelles

- Evolution of eukaryotic cell
- Nobel laureates in Life Sciences of 21st Century
- Contribution of Indian biologists
- The Scientific Method (Hypothetico-deductive method)
- Comparing Nutritional requirements of Human with that of prokaryotes
- Plant based substitutes of culture Media
- Story of any important discovery/experiment by a scientist - (explain the background, the actual work and its significance) and present as ppt/skit
- Astrobiology
- Applications of recombinant DNA technology
- Application of Anaerobes
- Methods used to control growth of Microbes at home
- Mechanism of action of antimicrobial products commonly available in the market

Semester II

- Explore unusual associations in microbial communities
- Role/Significance of the association in the ecology
- Methods to study the interactions
- Visualizing the biomolecule structures online
- Visit to microbiome websites
- List of endemic diseases in India and their features
- Plotting of Growth Curve in Excel
- Industrial and Clinical significance of organisms

B. Theory - External examination - 75%

75 marks

Semester End Theory Assessment

Duration - Each paper shall be of 2.5 hours duration.

1. Theory question paper pattern :-
 - a. There shall be three compulsory questions, one based on each unit
 - b. Each question shall carry 25 marks
 - c. Each question shall be subdivided into three sub questions a, b and c with internal choice in each
 - i. Sub-question 'a' shall consist of 2 questions of 5 marks each
 - ii. Sub-question 'b' shall consist of 5 questions of 2 marks each
 - iii. Sub-question 'c' shall consist of 5 questions of 1 mark each

| Question no. | Details | Marks |
|--------------|--|-----------|
| Q1. | Based on Unit 1 | 25 |
| | a. Attempt the following (Any two of four) | 10 |
| | b. Attempt the following (any five out of seven) | 10 |
| | c. Attempt the following (any five out of eight) | 5 |
| Q2. | Based on Unit 2 | 25 |
| | a. Attempt the following (Any two of four) | 10 |
| | b. Attempt the following (any five out of seven) | 10 |
| | c. Attempt the following (any five out of eight) | 5 |
| Q3. | Based on Unit 3 | 25 |
| | a. Attempt the following (Any two of four) | 10 |
| | b. Attempt the following (any five out of seven) | 10 |
| | c. Attempt the following (any five out of eight) | 5 |

C. Semester End Practical Assessment

50 marks

| | Section 1 Based on Paper 1 | 50 Marks |
|---|-----------------------------------|-----------------|
| A | Technique 1 | 20 |
| B | Technique 2 | 10 |
| C | Spots/Quiz | 10 |
| D | Viva | 05 |
| E | Journal | 05 |
| | Section 2 Based on Paper 2 | 50 Marks |
| A | Technique 1 | 20 |
| B | Technique 2 | 10 |
| C | Spots/Quiz | 10 |
| D | Viva | 05 |
| E | Journal | 05 |

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/ Coordinator / In-charge of the department ; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

SEMESTER I

| Course | VESUSMB101 | VESUSMB102 | Grand Total |
|-------------------|-------------------|-------------------|--------------------|
| Theory | 100 | 100 | 200 |
| Practicals | 50 | 50 | 100 |

SEMESTER II

| Course | VESUSMB201 | VESUSMB202 | Grand Total |
|-------------------|-------------------|-------------------|--------------------|
| Theory | 100 | 100 | 200 |
| Practicals | 50 | 50 | 100 |

V.E.S.

Since 1962