

**Sant Gadge Baba Amravati University, Amravati**

**Faculty: Science and Technology**

**Programme: B Sc (Microbiology)**

**POs:**

Students of undergraduate general degree programme at the time of graduation would be able to –

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest contexts socio-technological changes.

**PSOs:**

Upon completion of the programme successfully, The students would be able to

1. gain insight of Microbiology starting from history and fundamental knowledge about the microorganisms.
2. acquire the skill in the use and care of basic microbiological equipment and can perform basic laboratory procedures in microbiology.
3. be well-informative about the integral role of microorganisms and different branches of Microbiology.
4. Be acquainted with the basic concept of prokaryotes, their taxonomy, their differentiation from eukaryotes.

**Employability Potential of the Programme:**

Microbiology is a branch of science that deals with study of microorganisms. The microbiological study has wide range of scope ranging from basic sciences to applied sciences. Microbiological study is mainly focused on causative agents of various diseases, microorganisms of agricultural, environmental and industrial use. The production of antimicrobial drugs to cure various diseases is covered in this discipline. Here is an overview of job opportunities where our students has explored and would be helpful for upcoming students as well.

Medical microbiology refers to the use of microbiology in the healthcare industry. Microbiology firms are at the heart of the healthcare industry, whether they're developing diagnostic kits, vaccines, biologics, pharmaceuticals, or medical gear. Microbiology fields such as molecular biology, cell biology, recombinant technology, and immunotherapeutics benefited from the medical sector's evolution. For those interested in a career in Medical Microbiology, there are numerous career prospects in Research and Development, Pharmaceutical Companies, Hospitals, Diagnostic Centers, Manufacturing Sector of Microbiology, and Academic Sector. Many of our students have joined as Microbiologist at renowned pharmaceutical companies. Our students have also joined COVID-19 diagnostic laboratories across various districts, thus helping the society. Beside these students has also joined

vaccine manufacturing institutions.

Previously, this field only focused with the discovery and development of small molecules (drugs), but the industry has evolved throughout time. This industry's horizon has widened. Biopharmaceutics has added a new dimension to the industry. The use of microbiology in drug research and discovery has always been a component of the process, but the addition of biologics as therapeutic elements has resulted in a rise of biotech businesses in the pharmaceutical sector. To begin, consider cell-based treatments, monoclonal antibodies, vaccinations, and other medicines. In this regard our students has got jobs in various pharmaceutical industries.

Low crop yield, crop quality deterioration, weeds, loss of soil fertility, abiotic stress, and biotic stress are just a few of the issues that have plagued agriculture. Microorganisms are also helpful in enhancing the crop productivity. Our students are entrepreneur in this field. The biofertilizers are produced in bulk and are commercialized by few of our students. Incidentally biofertilizers are ecofriendly.

Food microbiology overcomes challenges in food production, processing, and preservation. The production of value-added food products are the greatest examples. Almost all food industries need pure water. The bacterial quality of water is tested by microbiologist. Food industry provides large scope for microbiologist. Our students have occupied jobs at different food industries. Microbiology always helps in introducing technology which aims to enhance the production, processing, packaging and preservation of food also.

Environment microbiology aims to restore the balance between nature, ecology and human interest. Bioremediation and biological intervention is only possible by the way of utilization of techniques of microbiology. All these issues are now being addressed by using biotech processes. Microbes like bacteria, fungi algae and plants are being used in the process of bioremediation.

Beside job opportunities in the sector of agriculture, pharmaceutical and food industries our students are working as research fellow at various National Institutes. Many students are working as Assistant Professor in colleges, Laboratory Technicians at Government and private pathological laboratories.



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|  | <p>d Applied branches of Microbiology : Environmental Microbiology, Medical microbiology Industrial Microbiology, Food and Dairy Microbiology, Genetic engineering and Biotechnology.</p> <p><b>(15 periods)</b></p>   |
| Unit II <b>Microbial diversity &amp; Classification:</b> | <p><b>A. Microbial Diversity:</b></p> <p><b>General characteristics of :</b></p> <ol style="list-style-type: none"> <li>i. Bacteria</li> <li>ii. Viruses</li> <li>iii. Rickettsia</li> <li>iv. Actinomycetes</li> <li>v. Archae</li> <li>vi. Fungi (Including yeasts)</li> <li>vii. Algae</li> </ol> <p><b>B. Bacterial Classification:</b></p> <ol style="list-style-type: none"> <li>i. Definition- Taxonomy, Classification, Taxonomic rank, Identification, Nomenclature</li> <li>ii. Bergey's manual of systematic Bacteriology, General characteristics enlisting all parts with major characters and examples (Vol.I to IV)</li> <li>iii. Methods of Classification: Numerical taxonomy, Genetic relatedness: r-DNA sequencing &amp; phylogenetic tree</li> </ol> <p><b>(15 periods)</b></p>  |
| Unit III <b>Structural Organization of Bacteria:</b>     | <p><b>Structural Organization of Bacteria:</b></p> <ol style="list-style-type: none"> <li>a) Structure of prokaryotic and Eukaryotic cell, its Comparison and Differences.</li> <li>b) Typical Bacterial cell</li> <li>c) Shape, Size, and Arrangement of Bacteria</li> <li>d) Structure and functions of following <ol style="list-style-type: none"> <li>i. Capsule and slime layer</li> <li>ii. Cell wall- Gram positive and Gram negative bacteria.</li> <li>iii. Cytoplasmic membrane- fluid mosaic model</li> <li>iv. Flagella- Arrangement, Mechanism of flagellar movement.</li> <li>v. Pili-Arrangement and function</li> <li>vi. Ribosomes- Prokaryotic and Eukaryotic</li> <li>vii. Plasmid- Definition, General characters, classes</li> <li>viii. Bacterial chromosome</li> <li>ix. Endospores- Structure and arrangements.</li> </ol> </li> </ol> <p><b>(15 periods)</b></p> |
| Unit IV <b>Microscopy and Staining</b>                   | <p><b>A. Microscopy:</b></p> <ol style="list-style-type: none"> <li>a) Definition: Magnification, Resolving power, numerical aperture, focal length</li> </ol>   |

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|   | <p>b) Principles, construction, ray diagram and applications:</p> <p>i) Compound Microscope ii) Dark field microscope iii) Electron Microscope.</p> <p>c. Introduction &amp; application of Fluorescent and Phase contrast Microscope</p> <p><b>B. Staining:</b></p> <p>a) Dyes and Stains- auxochromes, chromophore, mordant</p> <p>b) Principles and Methods of the following techniques:</p> <p>i. Simple staining</p> <p>ii. Differential staining- Gram stain, Acid fast and Endospore staining</p> <p><b>(15 periods)</b></p>  |
| <p>Unit V <b>Microbial Nutrition and Pure Culture Techniques</b></p>  | <p><b>A. Microbial Nutrition:</b></p> <p>i. Basic Nutritional Requirements: Sources of C, N, O, P, S, Energy, Macronutrients, Growth factors, water etc.</p> <p>ii. Media, Synthetic, Nonsynthetic, Liquid and Solid, Semisolid, Differential, Enriched, Selective media. Role of beef extract, yeast extract, peptone, agar in nutrient media.</p> <p>iii. Determination of nutritional requirements: Auxanographic technique, Replica plating technique.</p> <p>iv. Nutritional classification on the basis of source of carbon and energy</p> <p><b>B. Pure Culture Techniques:</b></p> <p>i. Definition- Pure and Mixed culture</p> <p>ii. Methods of Isolation of Pure culture- Streak plate, pour plate and Enrichment culture.</p> <p>iii. Methods of preservation of pure culture- Agar slants, Saline suspension, Overlaying with oil, glycerol stock, Freeze drying/ Lyophilization.</p> <p>iv) Introduction of Microbial cultural collection centre- ATCC, ITCC, MTCC and NCIM</p> <p><b>(15 periods)</b></p> |
| <p>Unit VI if applicable</p>  | <p><b>Not Applicable</b></p>   |
| <p><b>*SEM</b></p> <p><b>Basic Skills of Microbiological Laboratory</b></p> <p>A. Handling and caring of different instruments used in Microbiology laboratory:</p> <ol style="list-style-type: none"> <li>1. Microscope</li> <li>2. Autoclave</li> <li>3. Hot air oven</li> <li>4. Laminar air flow cabinet</li> </ol> |  |

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| <p>B. Preparation of Nutrient media:</p> <p>i. Nutrient broth</p> <p>ii. Nutrient agar</p> <p>iii. PDA</p> <p>C. Motility of bacteria</p> <p>D. Isolation and maintenance of microorganism</p> <ul style="list-style-type: none"> <li>• Isolation of fungi by slide culture technique</li> <li>• Isolation and Maintenance of pure culture of bacteria by - Agar slants, Saline suspension, Glycerol stock, Overlaying with oil, Freeze drying.</li> </ul> |   |
| <p>COs: 1. Student will be able to get employment in different laboratories related with Microbiology work.</p> <p>2 Student will be able to get employment in Microbial culture collection centers dealing with isolation, identification and maintenance of microorganism.</p>   |   |
| <p>**Activities</p>  | <p>1. Demonstration</p> <p>2 Assignment</p> <p>3 Project</p> <p>4. <b>Task</b></p> <p>5. <b>Field visit</b></p> <p><b>( 15 periods)</b></p> |

#### Course Material/Learning Resources

- 1) General Microbiology : Stainer, Roger et. al.
- 2) General Virology : Luria, S.E.
- 3) Fundamentals Principles of : A.J. Salle. bacteriology
- 4) Microbiology : Pelczar, Chan, Krieg.(TMH)
- 5) Text Book of Microbiology : Dubey & Maheshwari (S.Chand, Publication)
- 6) Fundamental of Microbiology : Frobisher
- 7) General Microbiology Vol. I & II : Power & Dagainawala. (Himalaya Publication)
- 8) Zinsser Microbiology : W.K. Joklik
- 9) General Microbiology : W.G. Walter
- 10) Elements of Microbiology : M.J. Pelozar & E.C.S. Chan
- 11) Essays in Microbiology : J.N. Norris & M.H. Richmond
- 12) Microbiology : L. Mckane & J. Kandel (Essentials & Applications)
- 13) Basic Microbiology : Volk
- 14) Chemical Microbiology : Rose
- 15) Elementary Microbiology : Modi (Akta Prakashan) Vol. I & II
- 16) Basic experimental : Ronald M., Atlas, & Alfred Microbiology Miller E.Brown, Kenneth W. Dobra, Lionas (1986) (Prentice Hall - 316 PP)
- 17) General Microbiology : Robert F.Boyd (1984) times mirror / mosby college, Pub. 22 PP

#### List of Books For PRACTICALS

- 1) Microbes in Action : Seely, Wander Mark Tarporewala, Bombay
- 2) A Manual of Microbiology : A.J. Salle. Methods

- 3) Medical Microbiology Vol. II : R. Cruickshank
- 4) Microbiology Methods : Collins
- 5) Difco manual
- 6) Bacteriological Techniques : F.J.Baker
- 7) Introduction to Microbial : Gunasekaran Techniques
- 8) Biochemical methods : Sadashivam & Manickam
- 9) Laboratory Fundamentals of : Alcamo, I.E., Jones and Microbiology Bartlett Publishers.
- 10) A textbook of Practical Microbiology (B Sc Sem 1 &2) : Dr. R. R. Pachori, P.S.Sadar, Dr. A. M. Pande, 2<sup>nd</sup> Edition

Weblink to Equivalent MOOC on SWAYAM if relevant:

Weblink to Equivalent Virtual Lab if relevant:

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

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**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 1<sup>st</sup> Year UG Programme**

**Programme: B. Sc**

**Semester 1**

| <b>Code of the Course/Subject</b> | <b>Title of the Course/Subject</b><br>(Laboratory/Practical/practicum/hands-on/Activity) | <b>(No. of Periods/Week)</b> |
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| <b>MCB lab1</b> | <b>FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL PHYSIOLOGY Lab 1</b> | <b>06/week/batch</b> |
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**COs**

Upon completion of this course successfully, students would be able to

1. acquire the skill in the use and care of basic Microbiological equipment.
2. perform basic laboratory procedures in microbiology; proper collection and forwarding of microbiological and parasitological specimens to the laboratory.
3. demonstrate different staining techniques.
4. acquire skill in bacterial motility.

**\* List of Practical/Laboratory Experiments/Activities etc.**

|   |  |
|---|--|
| 1 | 1. Study and use of different instruments use in Microbiology Laboratory<br>i. Autoclave<br>ii. Hot air oven<br>iii. Bacteriological Incubator<br>iv. Laminar air flow |
| 2 | 2. Demonstration of bacteria from; Soil, Water, Air, Milk, Skin  |
| 3 | 3. Microscopic Examination of bacteria<br>i. Monochrome/ simple staining<br>ii. Gram's staining<br>iii. Negative staining<br>iv. Endospore staining                    |
| 4 | 4. Demonstration of bacterial motility by Hanging drop technique   |
| 5 | 5. Cultivation and Demonstration of<br>i. Yeast- <i>Saccharomyces cereviceae</i> , <i>Candida albicans</i> .<br>ii. Mold- <i>Penicillium</i> , <i>Aspergillus</i>      |
| 6 | 6. Demonstration of<br>a) Protozoa- <i>E. histolytica</i> , <i>Paramecium</i><br>b) Algae - <i>Nostoc</i> , <i>Spirogyra</i>   |
| 7 | 7. Isolation of bacterial Pure culture by<br>i) Streak plate ii) Pour plate  |

**Syllabus Prescribed for 1<sup>st</sup> Year UG Programme**

**Programme: B.Sc**

**Semester II**

| <b>Code of the Course/Subject</b> | <b>Title of the Course/Subject</b>      | <b>(Total Number of Periods)</b> |
|-----------------------------------|---|----------------------------------|
| <b>MCB 2</b>                      | <b>GENERAL AND APPLIED MICROBIOLOGY</b> | <b>90</b>                        |

**COs**

Upon completion of this course successfully, students would be able to

1. apply the knowledge of bacterial growth in industrial productions and determine the growth of bacteria.
2. demonstrate the nature, structure, general properties and replication of viruses as well as acquainted with the knowledge of interferon.
3. apply the concept of microbial control methods for prevention against infections.
4. formulate different microbial products using production strains of microorganisms.
5. evaluate microbe- host relationship in nature, humans and plants.

| <b>Unit</b>  | <b>Content</b>  |
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| Unit I <b>Reproduction and Growth of Bacteria:</b> | <p><b>Reproduction and Growth of Bacteria:</b></p> <p>a) Reproduction: Binary fission, Budding, Fragmentation, Sporulation,</p> <p>b) Growth rate and generation time- Definition, mathematical expression.</p> <p>c) Bacterial growth curve</p> <p>d) Synchronous culture: Definition, methods of isolation (Helmstetter- Cummings Technique) and application.</p> <p>e) Continuous culture: Definition, method (chemostat, and Turbidostat Techniques ) and Application.</p> <p>f) Measurement of Growth:</p> <p>i. Cell number measurement - Breed method and Colony count</p> <p>ii. Cell mass measurement- Turbidity measurement.</p> <p>g) Factors influencing bacterial Growth- Temperature, pH, Gaseous.</p> <p><b>(15 periods)</b></p> |
| Unit II <b>VIRUSES:</b>                            | <p><b>VIRUSES</b></p> <p>i) Discovery of viruses</p> <p>ii) Structure of viruses</p> <p>iii) Classification of viruses (LHT System)</p> <p>iv) Replication of viruses – Lytic cycle (T4), Lysogeny (Lambda phage)</p> <p>v) Cultivation of viruses – Embryo culture, Tissue culture method.</p> <p>vi) Interferon</p> <p><b>(15 periods)</b></p>  |
| Unit III <b>MICROBIAL CONTROL</b>                  | <p><b>MICROBIAL CONTROL</b></p> <p>i) Definition and Terms- Sterilization, disinfection, Antiseptic, Sanitizer, Germicide, Microbiostatis, Antimicrobial agent.</p> <p>ii) Mechanism of cell Injury - Damage of cell</p>  |

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|  | <p>wall, cell membrane, Inhibition of metabolic reactions.</p> <p>iii) Physical Control :- Temperature, osmotic pressure, Radiation, filtration.</p> <p>iv) Chemical Control – Chemistry and mode of action of halogens, heavy metals and their derivatives, Alcohols, Detergents and Gaseous Sterilization.</p> <p>v) Chemotherapeutic agents.- Definition and mode of action of penicillin , tetracycline, Norfloxacin</p> <p><b>(15 periods)</b></p>   |
| Unit IV <b>APPLIED ASPECTS OF MICROORGANISMS IN -</b>  | <p><b>APPLIED ASPECTS OF MICROORGANISMS IN -</b></p> <p>i) Agriculture – Biofertilizers &amp; Biopesticides.</p> <p>ii) Medical – Antibiotics, Vaccines</p> <p>iii) Industrial- Outline of Industrial Microbiology and role of microorganisms in fermented food, beverages, probiotics, Single cell protein &amp; Pharmaceutical products</p> <p>iv) Environmental – Bioremediation, Biodegradation</p> <p><b>(15 periods)</b></p>  |
| Unit V <b>Microbial Interaction</b>  | <p><b>Microbial Interaction</b></p> <p><b>A.</b> Microbial Interaction with nature: positive, negative and neutral associations</p> <p><b>B. a)</b> Microbial interaction with human-Normal flora of the human body-Skin, Nose &amp; Nasopharynx, Respiratory tract, Eye, Mouth, Stomach, External ear, Intestine, Genitourinary tract</p> <p>b) Types of infection</p> <p><b>C.</b> Microbial interaction with plants.</p> <p>a) Rhizosphere, Phyllosphere and Rhizoplane</p> <p>b) Mycorrhizae, fungal and bacterial endophytes</p> <p>c) Symbiotic Nitrogen fixation – Rhizobium, Actinorhizae</p> <p>d) Common plant pathogens</p> <p><b>(15 periods)</b></p> |
| Unit VI if applicable  | <b>Not Applicable</b>   |
| <p><b>*SEM</b></p> <p><b>Biofertilizer Preparation</b></p> <p>A. Introduction, History and concept of biofertilizer</p> <p>Scope and importance of biofertilizer</p> <p>Use of microorganisms for biofertilizer production</p> <p>Classification and characters of biofertilizer</p> <p>B. Production technology: Strain selection, fermentation equipment, sterilization, mass production of carrier base and liquid biofertilizer</p> <p>C. Specification and quality control of bio fertilizer</p> <p>Application technology and Marketing of biofertilizer</p> |   |
| <p>COs: 1. Student can be able to start small scale unit of biofertilizer production and can work as entrepreneur.</p> <p>2. Students will be able to create awareness among farmers for application of biofertilizer in farming which helps in increasing crop yield.</p>   |   |
| **Activities   | <p>1. Demonstration</p> <p>2 Assignment</p> <p>3 Project</p> <p>4 Task</p> <p>3. Field visit</p> <p><b>(15 periods)</b></p>   |

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**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for 1<sup>st</sup> Year UG Programme**

**Programme: B Sc**

**Semester 2**

| Code of the Course/Subject | Title of the Course/Subject<br>(Laboratory/Practical/practicum/hands-on/Activity) | (No. of Periods/Week) |
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| <b>MCB Lab 2</b> | <b><u>GENERAL AND APPLIED<br/>MICROBIOLOGY Lab 2</u></b> | <b>06/week/batch</b> |
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**COs**

Upon completion of this course successfully, students would be able to

1. acquire the skill in the use and care of basic Microbiological equipment.
2. get employment in diagnostic laboratories.
3. analyze the effect of different parameters on growth of bacteria.
4. determine the nutritional requirement of microorganisms.

**\* List of Practical/Laboratory Experiments/Activities etc.**

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|---|--|
| 1 | 1. Study of different Laboratory equipment's used in Microbiology<br>i. pH meter<br>ii. Centrifuge<br>iii. Colorimeter/ spectrophotometer<br>iv. Anaerobic Jar<br>v. Bacteriological filters |
| 2 | 2) Effect of salt, sugar concentration , pH & Temperature on bacterial growth  |
| 3 | 3) Demonstration of oligodynamic action (copper, silver )  |
| 4 | 4) Antibiotic sensitivity test of bacteria.  |
| 5 | 5) Anaerobic culture method – by Anaerobic Jar method / RCMM.  |
| 6 | 6) Demonstration of Replica plate technique / auxanography.  |