

ಮಂಗಳೂರು  
MANGALORE



ವಿಶ್ವವಿದ್ಯಾನಿಲಯ  
UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/No: MU/ACC/CR.7/2020-21/A8

ಕುಲಸಚಿವರ ಕಛೇರಿ

ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199

Office of the Registrar

Mangalagangothri - 574 199

ದಿನಾಂಕ/Date: 03.11.2020

### **NOTIFICATION**

Sub: Revised Syllabus of Microbiology as a core course for B.Sc degree programme under Choice Based Credit System - reg.

Ref: Decision of the Academic council meeting dated 06.10.2020 vide Agenda No: 1:13(2020-21)

Pursuant to the above, the revised Syllabus of Microbiology as a core course for B.Sc degree programme under Choice Based Credit System which was approved by the Academic council at its meeting held on 06.10.2020 is hereby notified for implementation with effect from the Academic year 2020-21.

Copy of the syllabus shall be downloaded from the Mangalore University website [www.mangaloreuniversity.ac.in](http://www.mangaloreuniversity.ac.in)

REGISTRAR.

To:

- 1) The Principals of the Colleges concerned.
- 2) The Registrar (Evaluation), Mangalore University.
- 3) Prof. M. Jayashankar, Chairman, U.G BOS in Microbiology, Department of Studies in Microbiology, P.G Centre, Jnana Kaveri Campus, Chikka Aluvara, Kodagu.
- 4) The Assistant Registrar/ Superintendent, Academic Section, O/o the Registrar, Mangalore University.
- 5) The Director, DUIMS, Mangalore University - with a request to publish in the Website.
- 6) Guard File.

**MANGALORE UNIVERSITY**  
**SYLLABUS AND SCHEME**  
**CHOICE BASED CREDIT SYSTEM**

**B.Sc. MICROBIOLOGY**

| <b>I SEMESTER</b>    |                  |   |            |                        |            |      |       |         |
|----------------------|------------------|---|------------|------------------------|------------|------|-------|---------|
| Group                | Course Code      | Title of Courses  | Hrs / week | Duration of Exam (hrs) | Max. Marks |      |       | Credits |
|                      |                  |   |            |                        | IA         | Exam | Total |         |
| Group I<br>Core      | B.Sc MB -C-134   | General Microbiology  | 4          | 3                      | 20         | 80   | 100   | 2       |
|                      | B.Sc MB - P-135  | PRACTICAL - I   | 3          | 3                      | 10         | 40   | 50    | 1       |
| Group II<br>Elective | B.Sc MB - CE-136 | Basics in Microbiology and Biosafety                            | 2          | 2                      | 10         | 40   | 50    | 1       |
| <b>II SEMESTER</b>   |                  |   |            |                        |            |      |       |         |
| Group I<br>Core      | B.Sc MB -C- 184  | Microbial Taxonomy and Microbial Culture Techniques             | 4          | 3                      | 20         | 80   | 100   | 2       |
|                      | B.Sc MB-P- 185   | PRACTICAL -II   | 3          | 3                      | 10         | 40   | 50    | 1       |
| GroupII<br>Elective  | B.Sc MB- CE-186  | Microbial Diversity   | 2          | 2                      | 10         | 40   | 50    | 1       |
| <b>III SEMESTER</b>  |                  |   |            |                        |            |      |       |         |
| Group I<br>Core      | B.Sc MB -C- 234  | Basic Biochemistry, Microbial Physiology and Microbial Genetics | 4          | 3                      | 20         | 80   | 100   | 2       |
|                      | B.Sc MB -P- 235  | PRACTICAL - III   | 3          | 3                      | 10         | 40   | 50    | 1       |
| GroupII<br>Elective  | B.Sc MB -CE-236  | Microbial Techniques  | 2          | 2                      | 10         | 40   | 50    | 1       |

| <b>IV SEMESTER</b>   |                    |  |               |                              |            |      |             |           |
|----------------------|--------------------|--|---------------|------------------------------|------------|------|-------------|-----------|
| Group I<br>Core      | B.Sc MB-C- 284     | Molecular Biology<br>and Recombinant<br>DNA Technology                               | 4             | 3                            | 20         | 80   | 100         | 2         |
|                      | B.Sc MB-P- 285     | <b>PRACTICAL -IV</b>   | 3             | 3                            | 10         | 40   | 50          | 1         |
| Group II<br>Elective | B.Sc MB-OE-<br>286 | Environmental<br>Microbiology  | 2             | 2                            | 10         | 40   | 50          | 1         |
| <b>V SEMESTER</b>    |                    |  |               |                              |            |      |             |           |
| Group                | Course Code        | Title of Courses   | Hrs /<br>week | Duration<br>of Exam<br>(hrs) | Max. Marks |      |             | Credits   |
|                      |                    |  |               |                              | IA         | Exam | Total       |           |
| Group I<br>Core      | B.Sc MB-C-334      | Agricultural and<br>Environmental<br>Microbiology                                    | 3             | 3                            | 20         | 80   | 100         | 2         |
|                      | B.Sc MB-C-335      | Medical<br>Microbiology and<br>Immunology  | 3             | 3                            | 20         | 80   | 100         | 2         |
|                      | B.Sc MB- P-<br>336 | <b>PRACTICAL -V</b>  | 4             | 4                            | 20         | 80   | 100         | 2         |
| <b>VI SEMESTER</b>   |                    |  |               |                              |            |      |             |           |
| Group                | Course Code        | Title of Courses   | Hrs /<br>week | Duration<br>of Exam<br>(hrs) | Max. Marks |      |             | Credits   |
|                      |                    |  |               |                              | IA         | Exam | Total       |           |
| Group I<br>Core      | B.Sc MB-C-384      | Food and Industrial<br>Microbiology  | 3             | 3                            | 20         | 80   | 100         | 2         |
|                      | B.Sc MB-C- 385     | Computer<br>Applications in<br>Biology, Basic<br>Biostatistics and<br>Bioinformatics | 3             | 3                            | 20         | 80   | 100         | 2         |
|                      | B.Sc MB -P-<br>386 | <b>PRACTICAL - VI</b>  | 4             | 4                            | 20         | 80   | 100         | 2         |
| <b>Grand Total</b>   |                    |  | 56            |                              |            |      | <b>1400</b> | <b>28</b> |

Dr. B. S.Gunashree  
Member

Dr. I. K.Manjula  
Member

Prof.. M.Jayashankar  
BOS Chairman

**MANGALORE UNIVERSITY**

**B. Sc. MICROBIOLOGY**

**CHOICE BASED CREDIT SYSTEM**

**SYLLABUS AND SCHEME**

(Approved in the BOS in Microbiology on 17<sup>th</sup>, January, 2020)

REVISED ON 10<sup>TH</sup> Aug, 2020

**2020-21**

**Question paper pattern for B.Sc. Microbiology**  
**University practical examination**  
**(Common to I, II, III, IV Semester)**

**Time:3 Hours**

**Max. Marks:40**

- |  |                |
|--|----------------|
| Q. No. 1. Conduct the experiment A and report the result | 12 Marks       |
| Q. No. 2. Conduct the experiment B and report the result | 8 Marks        |
| Q. No. 3. Identify and comment on C, D, and E            | 3X5 = 15 Marks |
| Q. No. 4. Class record                                   | 5 Marks        |

**V Semester**

**Time:4Hours**

**Max. Marks:80**

- |  |                |
|--|----------------|
| Q. No. 1. Conduct the experiment A and report the result | 15 Marks       |
| Q. No. 2. Conduct the experiment B and report the result | 10 Marks       |
| Q. No. 3. Identify and comment on C, D, E, F and G       | 5X5 = 25 Marks |
| Q. No. 4. Class record                                   | 5 Marks        |
| Q. No. 5. General Viva Voce                              | 5 Marks        |
| Q. No. 6. Report on field Trip                           | 15 Marks       |

**VI Semester**

**Time; 4Hours**

**Max. Marks: 80**

- |  |                |
|--|----------------|
| Q. No. 1. Conduct the experiment A and report the result | 15 Marks       |
| Q. No. 2. Conduct the experiment B and report the result | 10 Marks       |
| Q. No. 3. Identify and comment on C, D, E, F and G       | 5X5 = 25 Marks |
| Q. No. 4. Class record                                   | 5 Marks        |
| Q. No. 5. Viva Voce                                      | 5 Marks        |
| Q. No. 6. Project report                                 | 20 Marks       |

**Question paper pattern for B.Sc. Microbiology**  
**Internal assessment practical examination**  
**(I Semester)**

**MaxMarks: 20**

- |  |               |
|--|---------------|
| Q. No. 1. Conduct the experiment A and reporttheresult | 10Marks       |
| Q. No. 2. Conduct the experiment B and reporttheresult | 4Marks        |
| Q. No. 3. Submission ofbacterialslices (03)            | 3X2 = 06Marks |

**(Common to II, III, IV Semester)**

**Max. Marks: 20**

- |  |         |
|--|---------|
| Q. No. 1. Conduct the experiment A and reporttheresult | 12Marks |
| Q. No. 2. Conduct the experiment B and reporttheresult | 08Marks |

**V and VI Semester**

**Max. Marks : 40**

- |  |               |
|--|---------------|
| Q. No. 1. Conduct the experiment A and reporttheresult | 10Marks       |
| Q. No. 2. Conduct the experiment B and reporttheresult | 05Marks       |
| Q. No. 3.Submission offungalslices (05)                | 5X5 = 25Marks |

**Question paper pattern for B.Sc. Microbiology**  
**University Theory examination**  
**(Common to I , II, III, IV, V and VI Semester)**

Time -3Hours

Max. Marks : 80

**Part A**

1. Write any TEN of the following: 10X2 = 20Marks

**Part B**

Answer one set of questions from each unit

**UNIT I**

- |      |         |         |
|------|---------|---------|
| 2 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

- |      |         |         |
|------|---------|---------|
| 3 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

**UNIT II**

- |      |         |         |
|------|---------|---------|
| 4 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

- |      |         |         |
|------|---------|---------|
| 5 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

**UNIT III**

- |      |         |         |
|------|---------|---------|
| 6 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

- |      |         |         |
|------|---------|---------|
| 7 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

**UNIT IV**

- |      |         |         |
|------|---------|---------|
| 8 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

- |      |         |         |
|------|---------|---------|
| 9 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

**Question paper pattern for B.Sc. Microbiology**  
**Internal Assessment Theory examination**  
**(Common to I, II, III, IV, V and VI Semester)**

Time-1:30Hours

**Max. Marks: 40**

**Part A**

1. Write any 5 of the following:5X2 = 10 Marks

**Part B**

**Answer One set of questions from each unit**

**UNIT I**

|      |         |         |
|------|---------|---------|
| 2 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

|      |         |         |
|------|---------|---------|
| 3 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

**UNIT II**

|      |         |         |
|------|---------|---------|
| 4 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |

OR

|      |         |         |
|------|---------|---------|
| 5 a. | 5Marks  | 15marks |
| b.   | 10Marks |         |



**Question paper pattern for B.Sc. Microbiology –  
Elective Course - Theory examination  
(Common to I , II, III and IV Semester)**

Time-2.00Hours

Max. Marks :40

**Part A**

**1. Write any 5 of the following:5X2 = 10 Marks**

**Part B**

**Answer one set of questions from each unit**

**UNIT I**

- |   |                |         |
|---|----------------|---------|
| 2 | a.      5Marks | 15marks |
|   | b.      5Marks |         |
|   | c.      5Marks |         |

OR

- |   |                |         |
|---|----------------|---------|
| 3 | a.      5Marks | 15marks |
|   | b.      5Marks |         |
|   | c.      5Marks |         |

**UNIT II**

- |   |                |         |
|---|----------------|---------|
| 4 | a.      5Marks | 15marks |
|   | b.      5Marks |         |
|   | c.      5Marks |         |

OR

- |   |                |         |
|---|----------------|---------|
| 5 | a.      5Marks | 15marks |
|   | b.      5Marks |         |
|   | c.      5Marks |         |

**Question paper pattern for B.Sc. Microbiology**  
**Elective Course –Internal Assessment examination**  
**(Common to I,II, III and IV Semester)**

Time-2.00Hours

Max. Marks :20

**Part A**

1. Write any 5 of the following:

5X2 = 10Marks

**Part B**

**Answer one of the following questions**

**1X10=10 marks**

- 2 a. 5Marks  
b. 5 Marks

OR

- 3 a. 5Marks  
b. 5 Marks

## I SEMESTER:

### B.Sc MB – C- 134: General Microbiology (Theory)

Total 48 hrs - 4 hrs/week

#### UNIT I: Introduction to Microbiology

12hrs

- Discovery of Microorganisms Microbes and origin of life. Haeckel's
- three kingdom classification and Whittaker's five kingdom classification
- History and scope of Microbiology as a modern science- Branches of Microbiology
- Contribution of Antony Von Leuwenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming and Iwanovsky to the development of Microbiology
- Microorganisms- Types and significance in general (Beneficial and Harmful).

#### UNIT II: Microscopy and Analytical techniques

12 hrs

- **Microscopy:** Principles of Microscopy- Magnification, Resolving power, Numerical aperture, Tube length and Focal length.
- **Light Microscopy:** Principle, construction, working and applications of a) compound microscope c) Dark field microscope d) Phase contrast microscope Disadvantages of Light Microscopes- Spherical and Chromatic aberrations
- **Electron Microscopy-** Specimen preparation for electron microscope (Freeze etching and Metal shadowing); Principle, construction, working and applications of TEM and SEM
- Working principles and applications of – Centrifuge, Ultracentrifuge, Spectrophotometer

#### UNIT III: Sterilization Techniques 12 hrs

1. Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbiocidal agents, micro biostatic agents and antimicrobial agent.
2. **Physical methods of sterilization-**
  - A) Heat – a) Dry heat – Hot Air Oven and Incineration b) Moist heat – Autoclave, Pressure Cooker. c) Tyndalization (fractional sterilization).
  - B) Filtration – Types of filters, Laminar airflow.
  - C) Radiation methods :UV radiation,  $\gamma$ -rays and cathode rays.
3. **Chemical methods of sterilization:**

Use and mode of action of Alcohol, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents.

#### UNIT IV: Staining Techniques

12hrs

- a. Stains, Definition, Nature of stains, Types of stains, Mechanism of dye action
- b. General procedure of staining of bacteria and fungi.
- c. Classification of staining techniques: Principle, procedure and applications of a) Simple staining and negative staining b) Differential Staining- Grams and acid fast staining c) Structural staining – cell wall, endospore, flagella and capsular staining

## I SEMESTER

### B.Sc MB – P- 135: Practical - I

1. Safety measures in Laboratory
2. Study of compound microscope- Construction, working, principle, care to be taken while using the microscope. Use of oil immersion objective.
3. Study of instruments-Autoclave, hot air oven. Laminar air flow chamber, colony counter, inoculation loop and needle, Incubator, centrifuge, pH meter, and colorimeter/spectrophotometer.
4. Study of aseptic techniques-preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes, transfer of media and inoculum. Cleaning and sterilization of glasswares
5. Simple staining technique for bacteria
6. Negative staining technique
7. Gram's staining Technique
8. Endospore staining Technique
9. Staining and mounting of algae and fungi
10. Study of bacterial motility by hanging drop technique
11. Submission of 3 bacterial slides (permanent) for the internal assessment examination

## I SEMESTER

### B.Sc MB – CE- 136: BASICS IN MICROBIOLOGY AND BIOSAFETY

Total 24 hrs - 2 hrs/week

#### UNIT I

1. Discovery of Microorganisms. History and scope of Microbiology. Branches of Microbiology.
2. Contribution of Antony Von Leuwenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming and Iwanovsky to the development of Microbiology. Microorganisms- Beneficial and Harmful.
3. Microbial Standards for Foods and Water - BIS standards for common foods and drinking water.

#### UNIT II

12 hrs

1. Biosafety: -Introduction; Good microbiological practices, Introduction to Biological Safety Cabinets; Primary Containment for Biohazards;
2. Biosafety Levels; Biosafety Levels of Specific Microorganisms; Biosafety guidelines Government of India.
3. Discarding biohazardous waste - Methodology of Disinfection, Autoclaving & Incineration
4. Bioethics: Animal Rights: Making New Strains of Animal: Ethical limits of Animal use: Regulations.

#### REFERENCES:

1. Baird R M, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt' Ltd.
3. Harrigan WF (1998) Academic Press. Laboratory Methods in Food Microbiologr, 3rd ed.
4. Jay JM, loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.
5. Laboratory Exercises in Microbiology, George. A. Wistreich & Max.D. Lechtman, 3 rd Ed, Glencoe Press, London.
6. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
7. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
8. Gurumani, N. Research Methodology, For Biological Sciences. MJP Publishers, Chennai 2006
9. Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997). Sudbury, M.A.; Jones and Barlett Publishers.
10. Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5th Edition, Oxford Univerisity Press. 2000.

#### Important Links:

<http://www.w3.org/IPR/>; <http://www.wipo.int/portal/index.html.en>

## II SEMESTER

### B.Sc MB- C- 184: Microbial Taxonomy and Microbial Culture Techniques

Total 48 hrs - 4 hrs/week

#### UNIT I: General account of Bacteria and Cyanobacteria 12 hrs

- Bacteriology, Size, Shape and arrangement of bacterial cells, Fine structure, composition and function of Eubacterial cell wall, cell membrane, cytoplasm, nucleoside, flagella, Pili/fimbriae, slime layer, capsule, spores and cysts
- Classification of Bacteria, reproduction of bacteria
- General characteristics, classification, cell structure and reproduction of Cyanobacteria Parallelism between bacteria and cyanobacteria

#### UNIT II: General account of Fungi and Protozoa 12 hrs

- Mycology, Salient features, Ultra structure of fungal cell
- Classification, reproduction and significance of major groups of fungi (Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes). Type study of *Rhizopus*, *Aspergillus*, *Penicillium*, *Yeast* and *Fusarium*.
- Protozoa-General features, classification and significance.

#### UNIT III: Viruses, Rickettsia, Chlamydia, Mycoplasma, Actinomycetes and Archaea 12hrs

- Virology, Definition, history of virology, General characteristics of viruses – size, shape and
- Chemical composition, properties used for classification of viruses, Importance of viruses.
- General features and significance of Viroids and Prions.
- General features and significance of Rickettsia, Chlamydia, Mycoplasma and Actinomycetes
- General features and significance of Archaea

#### UNIT IV: Culturing of microorganisms 12hrs

1. Culture media- Characteristics, Types of media  
Preservation and maintenance of cultures. Microbial culture collection centres
2. Nutritional requirements of microorganisms-Macronutrients, micronutrients and growth factors. Nutritional types of microorganisms: Autotrophs and heterotrophs, phototrophs and chemotrophs.
3. Growth rate and generation time, Bacterial growth curve – phases of growth and their significance. Physical factors affecting growth of microorganisms: Temperature, pH and Oxygen. synchronous growth, Continuous cultivation-chemostat and turbidostat
4. Counting of bacteria-Viable count- SPC, Total count-DMC and turbidimetric estimation.

## II SEMESTER

### B.Sc MB - P- 185: Practical II

1. Preparation of media- Nutrient broth, Nutrient agar, PDA
2. Isolation of microorganisms: Spread plate, Pour plate techniques, Streaking technique, Swab technique and point inoculation
3. Serial dilution agar plating technique
4. Study of colony characteristics of Bacteria.
5. Measurement of size of cells by micrometry
6. Enumeration of microorganisms by Haemocytometer
7. Study of bacterial growth curve
8. Study of effect of pH and temperature on bacterial growth
9. Type study of *Aspergillus*, *Penicillium*, *Yeast*, *Rhizopus* and *Fusarium* (Specimens)
10. Study of protozoa- Amoeba, Paramecium and Euglena. (Permanent slides)
11. Study of Blue green algae- *Nostoc*, *Oscillatoria* and *Spirulina*. (Specimens)

**II SEMESTER**  
**B.Sc MB - CE - 186 MICROBIAL DIVERSITY**

**Total 24 hrs - 2 hrs/week**

**UNIT I: Diversity of microorganisms in nature 12 hrs**

- Biodiversity- definition, Basic concept of Biodiversity. Distribution and significance of microorganisms in soil, water and air.
- Microbes of extreme environments, Thermophiles, acidophiles, alkaliphiles, halophiles, barophiles and their survival mechanisms.
- Space microbiology: Historical development of space microbiology. Geomicrobiology: Microbes in metal extraction
- Microbes in the degradation of wastes: Microbial degradation of pesticides

**UNIT II: Importance and Conservation of Microbial Diversity 12 hrs**

- Introduction-Importance of microbial diversity in agriculture (GM crops), forestry, environment, industrial & food biotechnology, animal & human health. Metagenomics.
- Importance of conservation. In situ conservation and Ex situ conservation.
- Role of culture collection centers in conservation.

**References**

1. Alexopoulos, C. J. and Mims, C. W. 1979. Introductory Mycology. III edition, Wiley Eastern, New Delhi.
2. Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2001. Introduction to Modern Virology. 5th edn. Blackwell publishing, USA. Ghosh, A. 2003. Natural Resource Conservation and Environment Management. Aph Publishing Corp. Calcutta.
3. Landecker, E. M. 1972. Fundamentals of Fungi. Prentice-Hall, Angelwood Cliff, New Jersey.
4. Madigan M.T., Martinko M. J. and Parker, J. 2003. Brock Biology of microorganisms. Pearson education., New Jersey.
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7. Satyanarayana, T. and Johri, B. N. 2005. Microbial Diversity – Current Perspectives and Potential Applications. I K Int. Pvt. Ltd. New Delhi.
8. Stainer, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. K. 1986. General Microbiology. Mc Millan Edu. Ltd. London.
9. Stanley J.T. and Reysenbach A.L. 1977. Biodiversity of microbial life. John Wiley & Sons Inc. Publication. New York. Wagner, E.K. and Hewlett, M.J. 1999. Basic Virology. Blackwell Science.



### III SEMESTER

#### B.Sc MB- C-234: Basic Biochemistry, Microbial Physiology and Microbial Genetics

**Total 48 hrs 4 hrs/week**

##### **UNIT I: Basic Biochemistry 12 hrs**

- Biomolecules –Introduction, Properties of water, acids, bases, pH and Buffers.
- A brief account of the properties, classification and importance of carbohydrates, lipids and Proteins.
- Enzymes–Introduction, properties, nomenclature and classification, Mechanism of enzyme Action, effect of various factors influencing enzyme activity, enzyme inhibition,
- Bioenergetics–Free energy, ATP and its production, other high energy compounds, Oxidation – Reduction reactions, energy coupling reactions, exothermic and endothermic reactions

##### **UNIT II: Microbial Physiology 12 hrs**

- Respiration: Glycolysis, TCA and ETS, oxidative phosphorylation, pentose phosphate pathway. Anaerobic respiration, Fermentation – Fermentative modes in microorganisms – alcoholic, lactic acid – hetero and homo lactic acid fermentation.
- Bacterial photosynthesis – photosynthetic pigments of prokaryotes, Types of bacterial photosynthesis- Cyclic and non-cyclic photophosphorylation, Oxygenic and anoxygenic photosynthesis
- Comparison of photosynthesis in bacteria and green plants.

##### **UNIT III: Microbial Genetics 12 hrs**

- .Fundamentals of Genetics, Genomic organisations in prokaryotes and eukaryotes.
- Nucleic acids: Chemical compositions of DNA & RNA, Watson & Crick model of DNA, Types of DNA: A,B,C,D,Z and H, Supercoiling of DNA,Single stranded and Circular DNA Structure of RNA , Types of RNA-rRNA,tRNA (Clover Leaf Model),mRNA
- DNA replication in Prokaryotes: Semi, Conservative and dispersive methods, Rolling circle model and Cairn's model (Theta model)., origin of replication, Primers and templates, replication fork, unidirectional and bidirectional replication.

##### **UNIT IV: Genetic Recombination and Mutations 12 hrs**

- Genetic recombination in bacteria: Conjugation, F+ vs F- , Hfr + vs F-, F - vs F-, Transformation: Griffith's experiment and mechanism, Transduction: generalized and specialized.
- Mutations-Definition and types; Molecular basis of mutation, detection and isolation of mutants (Replica plate method). Transposable elements – a brief account
- Damage and repair of DNA: Photoreactivation&SOSrepair.
- Genotypic and phenotypic variations in microorganisms

### **III SEMESTER**

#### **B.Sc MB – P – 235: PRACTICAL III**

1. Fermentation of carbohydrates by microorganisms
2. Starch hydrolysis test
3. Gelatin liquefaction test
4. Catalase test
5. Oxidase test
6. TSI agar test
7. IMViC test
8. Urease test
9. Effect of carbon sources on growth of microorganisms.
10. Estimation of reducing sugar glucose by DNS method
11. Estimation of protein by Biuret method

### **III SEMESTER**

#### **B.Sc MB – CE - 236: Microbial Techniques**

**Total 24 hrs - 2 hrs/week**

#### **UNIT**

**I:**

**14hrs**

General Characteristics of bacteria, fungi and Cyanobacteria. General Characteristics and Ultra structure of bacterial, fungal, cyanophycean cell. An overview of bacterial size, shape and arrangement. Cultural methods of bacteria- solid state and submerged, fungi and cyanobacteria. Types of inoculation- Streak plating, ZigZag, parallel streaking, Point inoculation, Stab culturing

#### **UNIT**

**II:**

**10hrs**

Bacterial motility, Simple and Negative staining, Differential staining- Grams Staining and Aic fast staining of bacteria. Difference between Gram positive and gram negative cell wall. Lactophenol cotton blue staining of fungi.

## IV SEMESTER

### B.Sc MB - C-284: Molecular Biology and Recombinant DNA Technology

Total 48 hrs - 4 hrs/week

#### UNIT I: Molecular Biology 12 hrs

- Central Dogma of Molecular Biology, gene concept, Genetic code, Gene – protein relationship: one gene – one enzyme and one gene– polypeptide concept, colinearity of genes and proteins.
- Protein Synthesis in Prokaryotes- Ribosomes, types of RNA involved transcription, translation and mechanism of protein synthesis and inhibitors of protein synthesis. General account of reverse transcription.
- Regulation of gene expression in prokaryotes- The operon concept, Induction and repression, The lac operon and tryptophan operon.

#### UNIT II: Molecular Biology of Cancer 12 hrs

- Molecular Biology of Cancer: Mechanism of transformation of cells, Physical and chemical carcinogens, role of carcinogens & oncogenes in cancer,
- Oncogene proteins- Protein Kinases, growth factors, the *ras* proteins, Tumor repressor genes, Protein Kinases and transformation
- Viral oncogenes: Structure & detection of integrated viral DNA.

#### UNIT III: Recombinant DNA technology

12 hrs

- History and fundamentals of r-DNA technology Tools for r-DNA technology- Restriction enzymes, Ligases and other DNA modifying enzymes
- Gene cloning vectors- Salient features of Plasmids (properties, types - pBR322 and pUC18 series vectors), Cosmids, Phagemids, shuttle vectors and bacteriophages ( $\lambda$  and M 13), Vectors for plants: *Agrobacterium tumifaciens*, Vectors for Animals: SV 40.
- Applications of Genetic engineering- Production of insulin, hepatitis B vaccine, Gene therapy and transgenic plants. Potential hazards and safeguards-GM foods and genetically modified organisms.

#### UNIT IV: Molecular Techniques

12 hrs

- Macromolecular separation by chromatography- Principle and applications of paper, TLC, gel and column chromatography
- Electrophoresis, Principles and Types-gel and PAGE
- Blotting techniques- Western, Southern and Northern , PCR and its applications

Nano–biotechnology - Concept and application Nanotechnology using microorganisms

## IV SEMESTER

### B.Sc MB- P- 285: PRACTICAL IV

1. Preparation of buffers-citrate and phosphate buffers.
2. Estimation of DNA by Diphenylamine method.
3. Estimation of RNA by Orcinol method.
4. Test for antibiotic sensitivity and determination MIC of antimicrobial agents.
5. Separation of amino acids by paper Chromatography
6. Separation of amino acids/carbohydrate by Thin layer Chromatography
7. Demonstration of protein/DNA separation by gelelectrophoresis
8. Extraction of DNA from yeast.
9. Study of effect of UV light on microorganisms
10. Charts on genetic engineering. a) pBR 322 b) pUC 18 and 19 c) SV40  
d) Bacteriophages- Lambda e) Gene cloning f) Selection of recombinants by replica plate technique

## **IV SEMESTER**

### **B.Sc MB - OE - 286: ENVIRONMENTAL MICROBIOLOGY**

**Total 24 hrs - 2 hrs/week**

#### **UNIT-I 14hrs**

1. Distribution of microorganisms in the aquatic environment, Water pollution-sources, water purification in municipalwatersupply, Biological indicators of water pollution, Water as a medium for transmission of diseases-Mode, general symptoms andcontrol
2. Municipal waste water treatment- Primary (screening, coagulation and sedimentation), secondary (trickling filter, activated sludge process, oxidation pond), Teritiary (reverse osmosis, ion exchange method)
3. Air as a medium for transmission of diseases-Mode, general symptoms and control. Allergy and airpollution

#### **UNIT-II 10hrs**

1. Microbes in extreme environment: Diversity of microorganisms in extreme environments. An account of Thermophiles, acidophiles, alkalophiles, halophiles, barophiles and their survival mechanisms(adaptations).
2. Bioremediation -definition, Microbes in bioremediation

## V SEMESTER

### B.Sc MB- C- 334: Agricultural and Environmental Microbiology

Total 48 hrs - 4 hrs/week

#### UNIT I: Soil and agriculture Microbiology

12 hrs

- Soil composition, physical characteristics of soil-mineral particles, organic residues, water and gases, Soil microflora – bacteria, fungi, algae, protozoa and virus.
- Plant microbe interaction: Rhizosphere, Phyllosphere, mycorrhiza association. Interaction among microorganisms- neutralism, commensalism, antagonism and parasitism. Bio geochemical cycles- Carbon, Nitrogen, Phosphorus and sulphur.
- Microorganisms in agriculture- PGPR (plant growth promoting Rhizobacteria) and their uses.
- Biofertilizers – General account production, mode of applications, advantages and limitations of *Rhizobium*, *Azotobacter*, *Azospirillum* and Cyanobacteria.

#### UNIT II: Plant Pathology

12 hrs

- History of Plant Pathology, Symptoms, modes of transmission and types of plant diseases. Parasitism, Disease Development and pathogenecity, Host range of pathogens, Disease triangle, Diseases cycle / Infection cycle,
- Host parasite interaction, role of secondary metabolites in disease development (toxins, hormones, enzymes). Defence mechanism (Pre-existing structural and chemical defences, Induced structural and biochemical defences)
- A study of symptoms, etiology, epidemiology and control of the plant diseases- TMV, Citrus canker, Koleroga of areca nut, Rust of coffee, Rust of sorghum, Blast disease of paddy, Tikka disease of groundnut. Integrated management of plant diseases

#### UNIT III Microbiology of Air and water:

12 hrs

- Air microflora of indoor and outdoor environment, Factors affecting air flora, Techniques of trapping air borne microorganisms. Air as a medium for transmission of diseases- Mode, general symptoms and control. Allergy and air pollution.
- Distribution of microorganisms in the aquatic environment, Water pollution- sources, water purification in municipal water supply, Biological indicators of water pollution, Water as a medium for transmission of diseases- Mode, general symptoms and control
- Municipal waste water treatment- Primary (screening, coagulation and sedimentation), secondary (trickling filter, activated sludge process, oxidation pond), Tertiary (reverse osmosis, ion exchange method)

#### UNIT IV: Microbes in extreme environment and Geomicrobiology

12 hrs

- Microbes in extreme environment: Diversity of microorganisms in extreme environments. An account of Thermophiles, acidophiles, alkalophiles, halophiles, barophiles and their survival mechanisms (adaptations).
- Bioremediation -definition, Microbes in bioremediation, Factors affecting bioremediation and types, advantages and disadvantages. A general account of microbial degradation of pesticides
- Bioleaching of copper and bio-mining- microbes in petroleum product formation

## **B.Sc MB – C - 335: Medical Microbiology and Immunology**

**Total 48 hrs - 4 hrs/week**

### **UNIT I: Medical Microbiology**

**12 hrs**

1. Introduction to Medical Microbiology: History, Development and scope of Medical Microbiology. Normal flora of human body,
2. Microbial infections: Types of infections, modes of transmission, portal of entry: Skin infection, Urinary tract infection, Sexually transmissible infection, Infection of the central nervous system,
3. Infections of circulatory system, Oral cavity and respiratory infection, Gastrointestinal infection. Nosocomial infection
4. Introduction to Anaerobic cultivation of microbes Collection and transport of clinical specimens: Microbial examination of urine, stool, sputum, CSF, Aspiration fluids.

### **UNIT II: Infectious diseases**

**12 hrs**

1. Epidemiology and Pathogenesis, Laboratory diagnosis and Prevention of diseases caused by Viruses: Chicken pox, Rabies, hepatitis, AIDS.
2. Bacteria: Tuberculosis, cholera, Typhoid, Botulism, Shigellosis, Salmonellosis, Rat fever Tetanus.
3. Diseases caused by Fungi: Candidiasis, Dermatomycosis, Aspergillosis and Anthrax
4. Emergent Diseases: Hemorrhagic fever, Swine flu, SARS, Chikungunya, Ebola.

### **UNIT III: Immunology**

**12 hrs**

1. Introduction to Immunology: An overview of immune system, Phagocytes, Natural killer cells, mast cells, basophils and Dendritic cells
2. Immunity: Types: Innate immunity, Acquired immunity and nonspecific immunity. Humoral or antibody mediated immunity, cell mediated immunity. Antigens and Antibodies: properties of antigen,
3. Antibodies – structure, types and function, monoclonal antibodies and its clinical applications,

### **UNIT IV: Antibiotics**

**12 hrs**

1. Chemotherapy : General introduction
2. Antibiotics: Definition; Characteristics of antibiotics, antimicrobial spectrum of antibiotics
3. Mode of action; Penicillin (Cell wall affecting), streptomycin, tetracycline, (Protein synthesis inhibiting), polymyxin (cell membrane damaging), Amphotericin B (Antifungal); Metronidazole (antiprotozoal), AZT (antiviral antibiotics)
4. Standardization of Antibiotics: MIC, Tube dilution method, Diffusion method-well and disc diffusion.



## V SEMESTER

### B.Sc MB - P - 336: PRACTICAL V

1. Estimation of Organic Carbon by Chromic acid method.
2. Isolation of microorganisms from rhizosphere and non rhizosphere soil.
3. Isolation and identification of *Rhizobium* from root nodules.
4. Test for ammonification in soil.
5. Determination of quality of seeds by ferric chloride method
6. Determination of blood group – antigen antibody reaction.
7. Snyder's test for Dental caries.
8. Isolation of microorganisms from skin, mouth, and wounds.
9. Study of the plant diseases: TMV, Citrus canker, Koleroga of areca nut, Rust of coffee, Blast disease of paddy, Tikka disease of groundnut.
10. Study of the human diseases: Chicken pox, Tuberculosis, Typhoid, Botulism, Shigellosis, Salmonellosis, Tetanus, Candidiasis, Aspergillosis
11. Isolation of microbes from air by plate exposure method.
12. Estimation of DO, BOD, CO<sub>2</sub> in water.
13. Standard analysis of water.
14. Field trip related to agricultural research institute, hospital/diagnostic laboratories and submission of report.

**VI SEMESTER**  
**B.Sc MB – C-384: Food and Industrial Microbiology**

**Total 48 hrs - 4 hrs/week**

**UNIT I: Food Microbiology**

**12 hrs**

1. Introduction to food microbiology: Definition, concepts and scope. Food as substrate for microbes. Factors influencing microbial growth in food-Extrinsic and intrinsic factors.
2. Principles of food preservation- Physical (anaerobic conditions, high temperatures, low temperatures, drying, Canning, processing, Heat treatment) and Chemical preservation, food additives
3. Contamination and food spoilage: Principles and general account  
A general account Hazard analysis critical control points (HACCP) and Good manufacturing process (GMP) IPR and Patents.

**UNIT II: Dairy Microbiology**

**12 hrs**

1. Microbiology of raw milk, Milk as a vehicle of pathogens, Sources of Contamination of milk, Prevention of contamination of raw milk, Microbial examination of milk-SPC, DMC, and reductase test,
2. Biochemical activities of microbes in milk, Methods of milk preservation-sterilization and pasteurization, Microbiological standards for milk and milk products.
3. Fermented dairy products-Cheese, Yoghurt and buttermilk.

**UNIT III: Fermentation Technology**

**12 hrs**

1. Introduction, Concepts and Scope. Construction of a typical fermenter and types of fermenters, Industrial Microorganisms: Screening, Isolation. Identification and characterization of industrially important microbes.
2. Strain improvement- mutation, recombination and genetic manipulation.
3. Media for Industrial Fermentations: Continuous and batch culture, Media formulation, growth factors, carbon, nitrogen, Energy and Mineral sources, buffers, inhibitors, precursors, inducers, Oxygen requirements, Antifoam agents and others, Sterilization: Media and Fermenter sterilization

**UNIT IV: Industrial production of metabolites**

**12 hrs**

1. Secondary metabolites, Industrial production of ethyl alcohol, wine, vinegar,
2. Vitamin B-12, gibberellins and Penicillin. Production of biogas. Production of Fungal and Bacterial Amylase and proteases
3. Downstream processing: A general account of steps in recovery and purification of fermented products. Solid matter, Foam separation, Precipitation, Filtration, Centrifugation, Cell disruption, Solvent recovery.

**VI SEMESTER**  
**B.Sc MB – C - 385: Computer Applications in Biology,**  
**Basic Biostatistics and Bioinformatics**

**Total 48 hrs - 4**  
**hrs/week**

**UNIT I: Introduction-10hrs**

- History of Computers, Operating system - MS Windows, MS Word, MS-Excel – Data tabulation and graph generation, MS-PowerPoint - project presentation.

**UNIT II: Computer Applications in Biology 12hrs**

- Computers in Taxonomy and Systemic Data Analysis in Microbiology – Introduction, Applications in clinical microbiology, fermentation – Technology, Drug – Designing. Various software's used.

**UNIT III: Biostatistics 14hrs**

- Introduction, Basic concepts of biostatistics-population, data, sample. Nature and scope of statistical methods and their limitations.
- Classification of data, Tabulation of data, Graphical and diagrammatic presentation of data.
- Measures of central tendencies, mean (Arithmetic, geometric and harmonic mean), media and mode.
- Standard error- uses, variance, Introduction and uses of coefficient of variation
- Frequency distribution-Introduction, Frequency distribution with class intervals, without class intervals and Cumulative Frequency distribution

**UNIT IV: Bioinformatics 12 hrs**

- Bioinformatics – Introduction, history, biological sequences/ proteomics, genomics,
- Microarray- DNA and protein microarray
- Search engines, databases-types.
- Bioinformatic tools-BLAST, FASTA, Applications

## **VI SEMESTER**

### **B.Sc MB - P - 386: PRACTICAL VI**

1. Enumeration of bacteria and fungi from spoiled fruits and vegetables, curds, canned food and spoiled food.
2. Determination of quality of milk by MBRT method
3. Phosphatase test for milk.
4. Estimation of lactic acid content in milk.
5. Estimation of lactose content in milk.
6. Enumeration of bacteria in raw and pasteurized milk by SPC method.
7. Preparation of wine.
8. Estimation of total acidity of wine.
9. Estimation of alcohol percentage by specific gravity method
10. Production and estimation of microbial protease enzyme by submerged fermentation method
11. Production and estimation of microbial amylase enzyme by submerged fermentation method
12. Tabular and Graphical representation of biological Data
13. Sequence alignment using BLAST
14. Minor project work and report shall be submitted for evaluation

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