

**Rayat Shikshan Sanstha's**

**YASHAVANTRAO CHAVAN  
INSTITUTE OF SCIENCE, SATARA  
(AUTONOMOUS)**

**Reaccredited by NAAC with 'A+' Grade**

**Proposed Syllabus For**

**Bachelor of Science**

**Part - III**

**MICROBIOLOGY**

Syllabus to be implemented w .e. f. June, 2020

# **REVISED SYLLABUS FOR BACHELOR OF SCIENCE PART - III: MICROBIOLOGY**

**1 TITLE:** Microbiology

**2. YEAR OF IMPLEMENTATION:** Revised Syllabus will be implemented from June 2020 onwards.

**3. PREAMBLE:**

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at first year of three years of B.Sc. degree course. Students learn Microbiology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

**4. GENERAL OBJECTIVES OF THE PROGRAMME :**

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

7. **DURATION:** The course shall be a full time course.

8. **PATTERN:** Pattern of Examination will be Semester.

9. **MEDIUM OF INSTRUCTION:** The medium of instruction shall be in English.

**8. COURSESTRUCTURE OF B. Sc. III -**

1) B. Sc. III : Total Number of Courses - **10**

<b>B. Sc. III</b>		<b>SEMESTER V</b>				
<b>Sr. No</b>	<b>Subject Title</b>	<b>Paper No</b>	<b>Theory</b>		<b>Practical</b>	
			<b>No of lectures</b>	<b>Credits</b>	<b>No of lectures</b>	<b>Credits</b>
<b>1</b>	<b>Virology (Comp) and Immunology (Comp) and Food and Industrial microbiology (Comp)</b>	<b>IX, X and XI</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>4</b>
<b>2</b>	<b>Agricultural microbiology-I Cell biology-I (prokaryotes) Medical Microbiology-I</b>	<b>(Any one among three) XII</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>4</b>
<b>3</b>	<b>Mathematical models to understand microbiology</b>	<b>I</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>
<b>4</b>	<b>AECC</b>	<b>III</b>	<b>2</b>	<b>2</b>	<b>--</b>	<b>--</b>
<b>5</b>	<b>Total of Semester V</b>	<b>-</b>	<b>15</b>	<b>11</b>	<b>23</b>	<b>09</b>

<b>B. Sc. III</b>			<b>SEMESTER VI</b>			
<b>Sr. No</b>	<b>Subject Title</b>	<b>Paper No</b>	<b>Theory</b>		<b>Practical</b>	
			<b>No of lectures</b>	<b>Credits</b>	<b>No of lectures</b>	<b>Credits</b>
<b>1</b>	<b>Genetics (Comp), Microbial biochemistry (Comp) and Environmental microbiology (Comp)</b>	<b>XIII, XIV and XV</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>4</b>
<b>2</b>	<b>Agricultural microbiology-II Cell biology-II (eukaryotes) Medical Microbiology-II</b>	<b>(Any one among three) XVI</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>4</b>
<b>3</b>	<b>Entrepreneurship Development</b>	<b>II</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>
<b>4</b>	<b>AECC</b>	<b>IV</b>	<b>2</b>	<b>2</b>	<b>--</b>	<b>--</b>
<b>5</b>	<b>Total of Semester VI</b>	<b>-</b>	<b>15</b>	<b>11</b>	<b>23</b>	<b>09</b>
<b>6</b>	<b>Total of Semester V and VI</b>	<b>-</b>	<b>30</b>	<b>22</b>	<b>46</b>	<b>18</b>

- AECC – Ability Enhancement Compulsory Course
- Skill Enhancement Course for each subject

**9.**

- Total marks of B. Sc. Part III including Skill and AECC = 800
- Total marks of B. Sc. Part III **Semester V and VI = 40**

**Evaluation structure Class B. Sc. III**  
**SEMESTER- V**

Paper No	ESE	Internal exam		Practical			Submission		Total
		ISE I	ISE II	Practical Course	Exam	Journal	Student Performance	Seminar	
<b>IX</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>V</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>-</b>	<b>300</b>
<b>X</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>XI</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>VI</b>	<b>40</b>	<b>5</b>	<b>-</b>	<b>5</b>	
<b>XII</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>SECC</b>	<b>20</b>	<b>--</b>	<b>--</b>		<b>30</b>				<b>50</b>

**Evaluation structure Class B. Sc. III**  
**SEMESTER- VI**

Paper No	ESE	Internal exam		Practical			Submission		Total
		ISE I	ISE II	Practical Course	Exam/ Report	Journal	Student Performance	Seminar	
<b>XIII</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>VII</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>-</b>	<b>300</b>
<b>XIV</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>XV</b>	<b>40</b>	<b>5</b>	<b>5</b>	<b>VIII</b>	<b>40= (Lab work -20 and Literature Survey/ Industrial training/ Project</b>	<b>5</b>	<b>-</b>	<b>5</b>	
<b>XVI</b>	<b>40</b>	<b>5</b>	<b>5</b>						
<b>SECC</b>	<b>20</b>	<b>--</b>	<b>--</b>		<b>30</b>				<b>50</b>

**10 SCHEME OF EXAMINATION:**

- The examination shall be conducted at the end of each semester of academic year.
- Each theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination and skill based course of 800 marks.
- Question Paper will be set in view of the / in accordance with the entire Syllabus and preferably covering each unit of syllabi.

**11. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS FOR REVISED SYLLABUS**

<b>Sr. No.</b>	<b>TITLE OF SHIVAJI UNIVERSITY PAPER</b>	<b>TITLE OF AUTONOMOUS PAPER</b>
<b>Semester- V (Theory and practical)</b>		
1	Course IX (DSE E 49): Virology	Paper BMiT 501 Virology
2	Course X (DSE E 50): Immunology	Paper BMiT 502 Immunology
3	Course XI (DSE E 51): Food and Industrial Microbiology	Paper BMiT 503 Food and Industrial Microbiology
4	Course XII (DSE E 52): Agricultural Microbiology	<b>Paper BMiT 504 Agricultural Microbiology-I</b>
	-	<b>Paper BMiT 505 Cell biology-I (prokaryotes)</b>
	-	<b>Paper BMiT 506 Medical Microbiology-I</b>
	-	SECCMiT-507 Skill based course- Mathematical models to understand microbiology
		BMiP 508-Practical course
		BMiT 509- Practical course
		SECCMiP-510 Practical course
<b>Semester-VI (Theory and practical)</b>		
5	Course XIII (DSE F 49): Microbial Genetics	Paper BMiT- 601 Microbial Genetics
6	Course XIV (DSE F 50): Microbial Biochemistry	Paper BMiT-602 Microbial Biochemistry
7	Course XV (DSE F 51): Environmental Microbiology	Paper BMiT-603 Environmental Microbiology
8	Course XVI (DSE F 52): Medical Microbiology	<b>Paper BMiT 604 Agricultural Microbiology-II</b>
	-	<b>Paper BMiT 605. Cell biology-II (eukaryotes)</b>
	-	<b>Paprr BMiT 606. Medical Microbiology-II</b>
	-	SECCMiT- 607 Skill based course- Entrepreneurship in Microbiology
		BMiP 608-Practical course
		BMiP 609- Practical course
		SECCMiP-610 Practical course

## **12. OTHER FEATURES :**

- A. **LIBRARY:** Reference and Text Books, Journals and Periodicals,  
Reference Books  
for Advanced studies. - List Attached
- B. **SPECIFIC EQUIPMENTS :** Necessary to run the Course - OHP,  
Computer, L.C.D., Projector
- C. **LABORATORY SAFETY EQUIPMENTS :**
- Fire extinguisher
  - First aid kit
  - Fumigation chamber
  - Stabilized power supply
  - Insulated wiring for electric supply.
  - Good valves, distribution pipes & regulators for gas supply.
  - Operational manuals for instruments.
  - Emergency exits.

## **Nature of Question papers (Theory)**

**As per Guideline of examination cell.**



**SEMESTER V**  
**COURSE IX- BMiT- 501: VIROLOGY**  
**(TOTAL LECTURES-45)**

**Learning objectives-**

The students should be able to understand

1. The basics of Virology regarding- ubiquitous nature of viruses, their harmful and beneficial nature, discovery and properties of viruses.
2. Structural properties of viruses with some examples.
3. Isolation, cultivation, purification and enumeration of viruses
4. Reproduction of plant, animal, and bacterial viruses (with respect to lytic cycle and lysogeny)
5. Oncogenesis, with respect to types of cancer and characteristics of cancerous cell and various hypothesis of cancer.
6. Emerging viruses.

**UNIT – I Basic concept of virology**

Lectures: 12

**1. Introduction:**

- a) **Ubiquitous nature of viruses**
- b) **Beneficial and harmful nature of viruses**
- c) **History of viruses**
- d) **Discovery of viruses**
- e) General properties of viruses
  - 2) The Structural properties of viruses: Capsids, Nucleic acids and envelope. Structure of T4 bacteriophages, TMV and HIV, Viroids and prions.
  - 3) Reproduction of Bacteriophages:
    - a) One step growth experiment.
    - b) Reproduction of T4 phage.

**UNIT – II Isolation, cultivation and Purification of viruses**

Lectures: 11

- 1) Isolation and cultivation of viruses:
  - a) Animal virus - Tissue culture, chick embryo and live animals
  - b) Plant virus – Whole plant, Protoplasts, Insect cell culture
  - c) Bacteriophages - Plaque method
- 2) Purification of viruses based on physico-chemical properties:
  - a) Density gradient centrifugation
  - b) Precipitation
- 3) Methods of Enumeration of viruses
  - a) Latex droplet method (Direct electron microscopic count)
  - b) Plaque and pock method.

### UNIT III Lysogeny and reproduction of virus

Lectures: 11

- 1) Lysogeny
  - a) Introduction
  - b) Definition of lysogeny
  - c) Temperate phages
  - d) Lysogeny by lambda phage
- 2) Events of lysogeny-
  - a) Adsorption and penetration of  $\lambda$  phage
  - b) Integration of  $\lambda$  genome into host genome
  - c) Genetic map for lysogenic interaction
  - d) Expression of  $\lambda$  genes
  - e) Establishment of repression
  - f) Maintenance of repression
- 3) Reproduction of animal virus - Adenovirus.
- 4) Reproduction of plant virus - TMV

### UNIT IV Oncogenesis and emerging new viruses: Lectures: 11

- 1) Oncogenesis:
  - a) Definition of oncogenesis
  - b) Type of cancers
  - c) Characteristics of cancer cells.
  - d) Hypothesis about cancer.
    - i) Somatic mutation hypothesis
    - ii) Defective immunity hypothesis
    - iii) Viral gene hypothesis
  - e) Role of DNA viruses in cancer with special emphasis on Papova viruses.
  - f) Role of RNA tumor viruses
    - i) Provirus theory
    - ii) Protovirus theory
    - iii) Oncogene theory
- 2) **Emerging New Viruses:**
  - a) **Filo viruses**
  - b) **SARS Coronavirus**
  - c) **Influenza virus A**

**Learning outcomes:**

The students should know

1. The basics of Virology regarding- ubiquitous nature of viruses, their harmful and beneficial nature, discovery and properties of viruses
2. Structural properties of viruses with some examples
3. Isolation, cultivation, purification and enumeration of viruses
4. Reproduction of plant, animal, and bacterial viruses (with respect to lytic cycle and lysogeny)
5. Oncogenesis, with respect to types of cancer and characteristics of cancerous cell and various hypothesis of cancer and emerging viruses.

**Books Recommended:**

1. Principles of Virology 4<sup>th</sup> edition Vol.2- S.Jane Flint, Lynn W. Enquist
2. General Microbiology - Stanier
3. Microbiology - Prescott, Klein
4. Microbiology - Davis
5. General Virology - Luria
6. Genetics of Bacteria and their Viruses - William Hayes.
7. General Microbiology Vol. II - Powar and Daginawala
8. Virology - Biswas and Biswas
9. Virology Vol. 4- Topley and Wilson
10. Principals of virology- S.J. Flint
11. Bacterial and Phage Genetics – Birge
12. Virology: Principles and applications John Carter, Venetia Saunders

**SEMESTER V**  
**COURSE X- BMIT- 502: IMMUNOLOGY**  
**(TOTAL LECTURES-45)**

**Learning objectives**

The students should understand,

1. Classification of immune system, different cells and organs of immune system.
2. Properties, activation and pathways of complement system.
3. Molecular mechanism of antibody production.
4. In detail monoclonal antibody production and applications.
5. Characteristics and effects of cytokines and interferons.
6. Immunological tolerance and concept of autoimmunity and diseases
7. Hypersensitivity types and immunotechniques.

**UNIT – I Cells and organs of the immune system and complement** lectures - 12

1) Cells and organs of the immune system:

a) Cells of the immune system

- i) Classification of cells of immune system-Lymphoid and myeloid cells
- ii) Structure and functions of lymphoid cells- T cells and T cell subsets, NK cells, B cells and dendritic cells
- iii) Structure and functions of myeloid cells – Granulocytes, Monocytes and macrophages (receptors present on the surface and cytokines produced )

b) Organs of the immune system

- i) Primary and secondary lymphoid organs - Structure and functions of Thymus, bone marrow, spleen, lymph node and Mucosa associated lymphoid tissue(MALT)

2) Complement:

- a) Nature and Properties of complement, Complement activation by classical and alternative and lectin pathway.
- b) Biological consequences of complement activation
- c) Principle and technique of complement fixation test

**UNIT – II Antibody production** lectures - 11

1) Molecular mechanism of antibody production:

- a) Processing and presentation of antigen by Antigen presenting cell.
- b) Interaction of APC with T<sub>H</sub> cell
- c) Interaction of B cell and T<sub>H</sub> cell
- d) Proliferation and differentiation of activated B cells
- e) Role of follicular dendritic cells in selection of high affinity B cells

f) Role of cytokines in proliferation and differentiation

2) Monoclonal antibodies:

- a) Concepts of Polyclonal and monoclonal antibodies
- b) Production of mouse monoclonal antibodies by hybridoma technology.
- c) Types of monoclonal antibodies- Mouse, Chimeric, Humanized and Human antibodies
- d) Applications of monoclonal antibodies.

### **UNIT –III Cytokines, Immunological tolerance**

lectures - 11

1) Cytokines:

- a) General characters of cytokines
- b) Cytokines produced by different T<sub>H</sub> cells and Macrophages.
- c) Effects of cytokines
- d) Interferon–properties- types, inducers of Interferon, Mechanism of action- antiviral and immunoregulatory action

2) Immunological tolerance

- a) Immunological tolerance
- b) Natural or self-tolerance and induced tolerance
- c) Cellular mechanism of immunological tolerance- Central tolerance and peripheral tolerance
- d) Induction of tolerance using immunosuppressive drugs and monoclonal antibodies and its significance

### **UNIT – IV Hypersensitivity and Immunotechniques**

lectures - 11

1) Hypersensitivity

- a) Basic concept, Gell and Coombs classification
- b) Type I-Anaphylaxis, Mechanism of anaphylaxis, types, hypo sensitization
- c) Type II-Blood transfusion reactions
- d) Type III- Arthus reaction and Serum sickness
- e) Type IV- Delayed type hypersensitivity –Allergy of infection, Allograft rejection.

2) Immunotechniques –

- a) ELISA – Principle, Procedure types and applications
- b) Elispot test Principle, Procedure and applications
- c) Immunofluorescence test -Principle, Procedure, types and applications

### **Learning outcomes**

The students are able to know,

1. Classification of immune system, different cells and organs of immune system.
2. Properties, activation and pathways of complement system.
3. Molecular mechanism of antibody production.
4. In detail monoclonal antibody production and applications.

5. Characteristics and effects of cytokines and interferons.
6. Immunological tolerance and concept of autoimmunity and diseases
7. Hypersensitivity types and immunotechniques.

**Books Recommended:**

- 1) Immunology - 6<sup>th</sup> edition - Kuby ,Kindt, Goldsby & Osborne.
- 2) Essential Immunology - 11<sup>th</sup> edition - Delves, Martin, Burton and Roitt.
- 3) Immunology - An Introduction, 4<sup>th</sup> edition – Tizzard.
- 4) Basic and Clinical Immunology 5<sup>th</sup> edition- Stites, Stobo, H. H. Fudenberg.
- 5) Essentials of Immunology - S. K. Gupta
- 6) Immunology – M. P. Arora
- 7) Textbook of Basic and clinical Immunology- Sudha Gangal, Shubhangi Sontakke University Press
- 8) The elements of Immunology- Fahim Khan, Pearson Publication 2009
- 9) Immunology Second Edition- Vaman Rao.

## SEMESTER V

### COURSE XI-BMiT- 503: FOOD AND INDUSTRIAL MICROBIOLOGY

(TOTAL LECTURES-45)

#### Learning objectives

The students should understand,

1. Source of microorganisms to food
2. Role of microorganisms in food poisoning
3. Methods & Culture collection centers.
4. Industrial Production of Alcohol, antibiotics, organic acid and enzyme.

#### UNIT – I Food Microbiology and Probiotics

lectures – 12

- 1) Food Microbiology
  - a) Introduction
  - b) Food as a substrate for microorganisms: Intrinsic and extrinsic factors
  - c) Food spoilage- spoilage of vegetables and fruits.
  - d) General Principles and methods of food preservation
  - e) Food poisoning:
    - a. Role of microorganisms in food poisoning
    - b. Food poisoning:
      - i) Staphylococcal
      - ii) Fungal (aflatoxin)
    - f) Food infections: food infection: Salmonellosis.
- 2) Probiotics: Concept and applications

#### UNIT – II Industrial Microbiology

lectures – 11

- 1) Strain Improvement
- 2) Scale up of fermentations
- 3) Microbiological assays
- 4) Preservation of industrially important microorganisms: Methods & Culture collection centers.

#### UNIT – III Industrial Fermentation

lectures - 11

- 1) Industrial Production of
  - a) Alcohol: - Organisms used inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery.
  - b) Grape wine: - Definition, types, production of table wine (Red and White) and microbial defects of wine
  - c) Penicillin: - Organisms used Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. Concept of semi synthetic penicillin

- d) Citric acid production-organism used, substrates, production processes, product recovery.
- e) Amylase production-organism used, production processes, purification of amylase, application.

#### **UNIT – IV Downstream processes**

Lecture-11

##### **1) Recovery Techniques and testing-**

- a) Downstream` processing & product recovery :  
Centrifugation, flocculation, filtration, solvent extraction, distillation, precipitation, crystallization and chromatography.
- b) Testing of sterility- pyrogen, carcinogenicity, toxicity and allergens

#### **Learning Outcomes:-**

Students should be able to

1. Understand the role of microorganism in food poisoning.
2. Learn Industrial Production of antibiotic, alcohol, organic acid and enzyme.
3. Learn downstream processing & product recovery of different industrial products.

#### **Books Recommended:**

1. Principles of fermentation technology- Peter F. Stanbury & Allan Whitaker(Pergamon Press).
2. Principles of Microbial technology - Pepler, Vol. I & II.
3. Industrial Microbiology - Casida
4. Industrial Microbiology - A. H. Patel
5. Industrial Microbiology - Prescott & Dnn
6. Industrial Microbiology - Miller
7. Pharmaceutical Microbiology - Huggo & Russel
8. Modern food Microbiology - Jay & Jay
9. Food Microbiology - Frazier
10. Industrial Microbiology- Cruger.
11. Fermentation Technology- A.H.Modi - Vol. I and II



## SEMESTER V

### COURSE XII-BMiT- 504: AGRICULTURAL MICROBIOLOGY-I

(TOTAL LECTURES-45)

#### Learning objectives-

##### The students should-

1. Know physical, Chemical characteristics of soil
2. Know about types of microorganisms in soil
3. Know about Biodegradation of hydrocarbon, pesticide and Plant pathology.
4. Know basic principle and application of bio-analytical techniques.

#### UNIT – I Basics of soil Microbiology

Lectures - 12

- 1) Soil Microbiology.
  - a) Physical characters.
  - b) Chemical characters.
  - c) Types of microorganisms in soil and their role in soil fertility.
- 2) Role of microorganisms in elemental cycle
  - a) Carbon cycle.
  - b) Nitrogen cycle
  - c) Phosphorous cycle

#### UNIT – II Role of Microorganisms in reclamation of soil and composting

Lectures - 11

- 1) Role of Microorganisms in reclamation of soil
- 2) Manure and Compost
  - a) Methods of Production -
    - i) Green manure and farm yard manure
    - ii) City compost- Windrow and pit method.
    - iii) Vermicompost
    - iv) Optimal conditions for composting with reference to - Composition of organic waste, Availability of microorganisms, Aeration, C:N:P ratio, Moisture content, Temperature, pH, Time.

#### UNIT – III Biodegradation and plant pathology

Lectures - 11

- 1) Biodegradation of -
  - a) Pesticides
  - b) Hydrocarbon
- 2) Plant Pathology
  - a) Common symptoms produced by plant pathogens
  - b) Modes of transmission of plant diseases.

- c) Plant diseases -
  - i) Citrus Canker
  - ii) Tikka disease of groundnut
  - iii) Bacterial Blight of Pomegranate.

**UNIT IV Instrumentation-principle, working and application of-**

Lectures - 11

- a) Electrophoresis
- b) Chromatography
- c) U. V. Visible spectroscopy
- d) Atomic absorption spectroscopy

**Learning outcomes-**

**The students should be able to -**

1. Know physical, Chemical characteristics of soil
2. Know about types of microorganisms in soil
3. Know about Biodegradation of hydrocarbon, pesticide and Plant pathology.
4. Know basic principle and application of bio-analytical techniques.

**Books Recommended:**

1. Soil Microbiology - An exploratory approach - Mark Coyne.
2. Agricultural Microbiology - N. Mukherjee and J. Ghosh.
3. Introduction to Soil Microbiology - Martin Alexander IIInd Edition.
4. Agricultural Microbiology - Rangaswamy and Bhagyaraj IIInd Edition
5. Plant diseases - R. S. Singh.
6. Plant pathology - R. S. Mehrotra.
7. Diseases of crop plants in India - G. Rangaswamy.
8. Principles of Soil Science - M. M. Rai.
9. Soils and Soils Fertility- 6th edition-Frederick R.Troeh ( Blackwell publishing Co.)
10. Soil Microbiology- Singh, Purohit, Parihar. ( Agrobios India , 2010)
11. Soil Microbiology and Biochemistry – Ghulam Hassan Dar ( New India Publishing Agency, 2010 )
12. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker
13. Bioinstrumentation by L. Veera Kumari, MIP Publishers Chennai.

**SEMESTER V**  
**COURSE XII- BMiT- 505: CELL BIOLOGY-I**  
**(TOTAL LECTURES-45)**

**Learning Objectives:**

The students should

1. Learn variations in Gram positive and Gram negative bacterial cell wall
2. Know about Archeal cell walls
- 3 Understand in detail different structures and functions of cell organelles and cytoplasmic inclusions
- 4 Know about signaling mechanism in prokaryotes
- 5 Know basic principle and application of bio-analytical techniques

**Unit I: Bacterial cell structure**

Lectures - 11

- a) Structures of components of Gram positive and Gram negative bacterial cell wall with their variations.
- b) Archeal cell wall, structure, chemical composition and functions of Archeal cell membrane
- c) Bacterial cell membrane-Structure, chemical composition and functions
- d) Bacterial Endospore - Ultrastructure, Sporulation and Germination
- e) Flagella – Structure, Mechanism of movement, tactic behavior

**Unit II: Cytoplasmic inclusions**

Lectures - 11

- a) Cytoplasmic inclusions- Chlorobium vesicles, Gas vesicles, Magnetosomes, Carboxysomes.
- b) Reserve food materials –i) Nitrogen ii) non nitrogenous Carbon (Glycogen PHB), Sulphur, Phosphorus
- c) Cell division and differentiation

**Unit III: prokaryotic intercellular signaling**

Lectures - 12

- a) Diffusible and cell-associated signal
- b) Examples of intercellular signalling by bacteria
- c) Quorum sensing and autoinduction
- d) Diversity in prokaryotic diffusible molecules
- e) Specific Signalling Systems
  - i) peptide pheromones: Location of Peptide Pheromone Receptors
  - ii) Intracellular Targets of signalling
  - iii) Two component phosphorelay system

- iv) Pheromones that initiate two component signaling cascades
- v) Mechanism of quorum sensing
- i) competence in *Streptococcus pneumoniae*
- ii) bacteriocin production in *Lactococcus lactis*
- iii) sporulation

#### **UNIT IV Instrumentation-principle, working and application of- Lectures - 11**

- a) Electrophoresis
- b) Chromatography
- c) U. V. Visible spectroscopy
- d) Atomic absorption spectroscopy

#### **Learning outcomes**

Student should be able to

1. Understand structure and functions of different organelles and cytoplasmic inclusions of bacteria.
2. Understand in detail different structures and functions of cell organelles and cytoplasmic inclusions
3. Know about signaling mechanism in prokaryotes
4. Know basic principle and application of bio-analytical techniques

#### **Books Recommended**

1. Microbiology-Michael J. Pelczar, Chan and Krieg, fifth edition, Tata McGraw-Hill
2. Prescott's Principles of Microbiology, Willey, Sherwood, Woolverton, fifth edition, McGraw-Hill
3. Cell signaling in prokaryotes and lower metazoan edited by Ian Fairweather, Springer-science+ Business media, B.V.
4. The microbial world, Roger Y. Stanier, Mcmillan 1987
5. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker
6. Bioinstrumentation by L. Veera Kumari, MIP Publishers Chennai.

## SEMESTER V

### COURSE XII- BMiIT- 506: MEDICAL MICROBIOLOGY (TOTAL LECTURES- 45)

#### Learning Objectives:

Students should

1. Know the cultural and biochemical characteristics, antigenic structure of mode of spread ,prevention and control of selected human pathogens.
2. Know the techniques used for diagnosis of the diseases caused by protozoa, nematodes, bacteria, fungi and viruses
3. Be aware of the emerging diseases in India in future.
4. Know basic principle and application of bio-analytical techniques

#### UNIT I Parasitology

Lectures 12

Habitat, life cycle, pathogenicity, laboratory diagnosis, prevention, control and treatment of the diseases caused by

- a) Protozoa: *Plasmodium vivax* , *Entamoeba histolytica* , *Leishmania donovani*
- b) Nematodes: *Ascaris lumbricoides*, *Wuchereria bancrofti*

#### UNIT II Fungal diseases

Lectures –11

Habitat, pathogenicity, laboratory diagnosis, prevention ,control and treatment of the diseases caused by

- a) *Aspergillus flavus*
- c) *Cryptococcus neoformans*
- d) *Candida albicans*
- e) *Trichophyton rubrum*

#### UNIT III Emerging Microbial Diseases in INDIA

Lectures –11

Antigenic structure, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prevention, control and treatment of diseases caused by-

- a) *Treponema pallidum*
- b) *Neisseria gonorrhoeae*
- c) Ebola virus,
- d) New Corona 19 virus
- e) Nipah virus
- f) Avian influenza(H7N9)

#### UNIT IV Instrumentation-principle, working and application of-

Lectures - 11

- a) Electrophoresis
- b) Chromatography
- c) U. V. Visible spectroscopy
- d) Atomic absorption spectroscopy

## **Learning Outcomes:**

Students could

1. Take preventive measures about spread and control of mode of spread ,prevention and control of human pathogens.
2. Diagnose the diseases caused by protozoa, nematodes, bacteria, fungi and viruses
3. be aware of the emerging diseases in India in future.
4. Know basic principle and application of bio-analytical techniques

## **Books Recommended:**

1. Medical Parasitology : Chatergi
2. Medical Parasitology : Arora and Arora
3. Text book of Medical Lab. Technology Vol I & II : Dr. K. Mukhargi
4. Principles of Virology : S.J. Flint
5. Text book of Microbiology-Ananthnarayan R and C.E. Jayaram Panikar 5<sup>th</sup> edition, 1996, Orient Longman
6. Medical Bacteriology-Dey N.C. & Dey T.K. 17<sup>th</sup> edition 1988, Allied Agency, Calcutta
7. Medical Laboratory Technology; Vol. I, II & III, -Mukharjee K.L. ,10<sup>th</sup> edition. Tata Mc Graw-Hill Pub Co.
8. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker
9. Bioinstrumentation by L. Veera Kumari, MIP Publishers Chennai.

**SEMESTER V**  
**SKILL BASED COURSE**

**SECCMIT-507 - MATHEMATICAL MODELS TO UNDERSTAND MICROBIOLOGY**

**Learning objectives**

The students should understand

1. Measures of Central Tendency
2. Common measures of central tendency-Mean, Mode, Median.
3. Measures of dispersion
4. Mathematical Concept of Growth and Growth rate

**Unit – I**

Lectures - 10

1) **Measures of Central Tendency-Averages**

- a) Definition
- b) Characteristics of Central Tendency
- c) Common measures of central tendency-Mean, Mode, Median.

2) **Measures of dispersion**

- a) Definition
- b) Different measures of dispersion- Range, Quartile deviation, Decile range, Mean deviation, Standard deviation.

**Unit – II**

Lectures - 10

1) **The Mathematics in microbiology**

- a) Measurement of Growth.
- b) Determination of growth rate.
  - 1) Determination of mutation rate.
  - 2) Aeration rate in fermenter.
  - 3)

**Learning outcomes**

On completion of the course, students are able to understand,

1. Measures of Central Tendency
2. Common measures of central tendency-Mean, Mode, Median.
3. Measures of dispersion
4. Mathematical Concept of Growth and Growth rate

**Books Recommended:**

- 1) Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad - UNIT III, IV.
- 2) P.N. Arora, P.K.Malhan (2006) Biostatistics, Himalaya Publishing House, Mumbai
- 3) Robert R. Sokal and F. James Rohlf (1969) Introduction to Biostatistics, 2ndEd, Dover Publications, INC. Mineola, New York
- 4) S. Chand Introduction to biostatistics-A textbook of biostatistics, S. Chand and Company LTD.

## **BMiP- 508 Practical Course**

1. To measure the size of microorganisms using micrometer.
2. Endospore Staining by Dorner's Method.
3. PHB granule staining by Sudan black B staining method.
4. Flagella staining by Bailey's method.
5. Isolation of coli phages from sewage.
6. Demonstration of viruses inoculation by chick embryo technique
7. Perform total leukocyte count of the given blood sample.
8. Perform differential leukocyte count of the given blood sample.
9. Widal test – Quantitative.
10. Demonstration of Rocket immunoelectrophoresis.
11. Demonstration of ELISA test
12. Haematology:
  - a) Estimation of haemoglobin by Sahli's method
  - b) Determination of ESR of the blood sample (Wintrobe method)
  - c) Determination of PCV
  - d) Total and differential blood cells count.

## **BMiP- 509-Practical Course**

1. Microbiological assay of penicillin
2. Microbiological assay of penicillin Vit B12.
3. Production of citric acid and estimation of citric acid.
4. Production of amylase and detection of amylase produced
5. SPC of soft drink.
6. Isolation and identification of Xanthomonas from infected citrus fruit.
7. Isolation of pesticide degrading bacteria from soil.
8. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics.
  - a) *Candida albicans*
  - b) *Aspergillus flavus*

## **SECCMiP- 510 –practicals course**

- 1) Determination of central tendency--Arithmetic mean
- 2) Determination of central tendency—Median
- 3) Determination of central tendency—Mode
- 4) Determination of measures of Dispersion--Mean deviation
- 5) Determination of measures of Dispersion --Standard deviation
- 6) Determination of measures of Dispersion--coefficient of variation
- 7) Determination of measures of Dispersion--Quartile deviation



- 8) Determine Growth rate of E. Coli at 37oC
- 9) Determine mutation rate of E. Coli.

**Books Recommended:**

1. Dixit J. V. (1996)Principles and Practicals of biostatistics , first edition .
2. T. Bhaskarrao (1995), Methods of biostatistics, Paras publications.
3. T. K. Saha, Biostatistics in theory and practicals, Emkkay Publication, New Delhi.
4. Stanier, General Microbiology
5. Rose, Chemical Microbiology

**SEMESTER VI**  
**COURSE XIII BMIT- 601: MICROBIAL GENETICS**  
**(TOTAL LECTURES-45)**

**Learning objectives:**

The students should learn,

1. Basic concepts of bacterial and yeast chromosome
2. Gene regulation regarding transcription and translation
3. The concept of mutation
4. About various techniques in molecular biology
5. The concept of genetic engineering and various techniques used in that field.

**UNIT – I Genome and its regulation**

Lectures - 11

- 1) Basic concepts of bacterial genome -
  - a) Structural organization of *E. coli* chromosome - Folded Fiber model.
  - b) Structure of yeast chromosome
- 2) Regulation of gene expression
  - a) Regulation of transcription elongation – Attenuation, Riboswitches
  - b) Regulation at the level of translation – Role of antisense RNAs and riboswitch
  - c) **Tryptophan operon**
- 3) Global regulatory system

**UNIT – II Mutations and detection of mutants**

Lectures - 11

- 1) Mutations
  - a) Expression of mutations -
  - b) Time course of phenotypic expression.
  - c) Conditional expression of mutation.
  - d) Suppressor mutations (with examples) - Genetic and non-genetic.
  - e) Types of bacterial and viral mutant phenotypes
- 2) Methods of isolation and detection of bacterial and viral mutants based on -
  - a) Relative survival
  - b) Relative growth
  - c) Visual detection

**UNIT – III Advanced genetics** Lectures - 11

- 1) Genetic complementation –
  - a) Cis-trans test
  - b) Concept of cistron , one cistron one polypeptide theory
- 2) Extra chromosomal inheritance :Kappa particles
- 3) Transposable elements - general properties and types.
- 4) Techniques in Molecular Biology –

- a) DNA sequencing (Sanger's method )
- b) Southern blot technique
- c) PCR

## **UNIT – IV Genetic engineering**

Lectures - 12

- 1) Introduction
- 2) Tools of genetic engineering –
  - a) Enzymes- Restriction endonucleases, DNA ligase, Terminal deoxynucleotidyl transferase, Alkaline phosphatase-
  - b) Vectors- Properties of ideal vectors , types of selectable markers Examples - phage, plasmid and cosmid, YAC and BAC
  - c) Cloning organisms –Properties of ideal cloning organism (Bacteria and Yeasts)
- 3) Techniques –
  - a) Isolation of desired DNA segment- Shotgun Method, cDNA synthesis, Chemical Synthesis using PCR
  - b) Construction of r-DNA using appropriate vector- Use of restriction enzymes, Linkers, Adaptors, Homopolymer tails
  - c) Transfer of r DNA into cloning organisms by physical , chemical and biological methods
  - d) Selection of recombinant bacteria and yeasts – Blue and white screening, Colony hybridization technique.
- 4) Construction of genomic and cDNA library
- 5) Application of genetic engineering in –
  - a) Medicine-
  - b) Agriculture
  - c) Industry
  - d) Environment

### **Learning outcomes**

Students are able to,

1. Get an idea about chromosome and its gene regulation
2. Familiar with concept of mutation
3. Understand the methods of isolation and detection of mutants
4. know various techniques in genetic engineering.
5. Understand the applications in genetic engineering.

### **Books Recommended:**

- 1.Genetics - Stickberger.
- 2.Microbiology - Prescott
- 3.Genes - Benjamin Lewin IX ed.
- 4.Principles of gene manipulation - Primrose and Old
- 5.Genetic Engineering - Second Ed. Desmond S. T. Nicholl
- 6.Recombinant DNA - J. D. Watson

7. Biochemistry - Lehninger
8. Molecular Biology of Gene - J. D. Watson
9. Principles of Genetics - Herskowitz
10. General Microbiology – Stanier

**SEMESTER VI**  
**COURSE XIV- BMiT- 602: - MICROBIAL BIOCHEMISTRY**  
**(TOTAL LECTURES-45)**

**Learning objectives-**

The student should-

1. Study Properties, lock and key and induced fit hypothesis, explaining mechanism of enzyme action
2. Understand the concept of Allosteric enzymes, Ribozymes and Isozymes
3. Be able to know the Significance of  $K_m$  and  $V_{max}$  and able to derive MM equation
4. Be able to know the methods of extraction and purification of enzymes
5. Be able to know the methods of performing assays of enzymes
6. Be able to understand Basic concepts of PP, ED, PK and Glyoxylate bypass
7. Know the ways of Modes of ATP generation in Prokaryotes
8. Be able to understand method of Assimilation of carbon, nitrogen and sulfur
9. Be able to understand Biochemical mechanism of biosynthesis of RNA, DNA, Protein, Peptidoglycan and lipopolysaccharide.

**UNIT – I Basics of enzyme**

Lectures - 11

- 1) Properties, structure of active site, specificity, mechanism of action (Lock & Key, Induced fit hypothesis)
- 2) Allosteric enzymes - Definition, properties, models explaining mechanism of action.
- 3) Ribozymes and Isozymes.
- 4) Enzyme kinetics - Derivation of Michaelis-Menten equation, Lineweaver Burk Plot, Significance of  $K_m$  and  $V_{max}$ .
- 5) Regulation of enzyme synthesis.
  - a) Positive control - Ara operon
  - b) Negative control - Lac operon
  - c) Catabolite repression

**UNIT – II Extraction, purification and Immobilization of enzymes**

Lectures - 12

- 1) Extraction & purification of enzymes.
  - a) Methods of extraction of intracellular and extracellular enzymes.
    - i) Choice of source and biomass development
    - ii) Methods of homogenization - cell disruption methods
    - iii) Purification of enzymes on the basis of -
      - b) Molecular size
      - c) Solubility differences
      - d) Electrical charge
      - e) Adsorption characteristic differences
      - f) Differences in biological activity
- 2) Assay of enzymes - Based on substrate and product estimation.
- 3) Immobilization of enzymes - Methods & applications

## UNIT – III Catabolic reactions in bacteria

Lectures - 11

- 1) Basic concepts of -
  - a) Glyoxylate bypass, regulation of TCA cycle
  - b) PP pathway, ED pathway, Phosphoketolase pathway
  - c) Pyruvate as a key intermediate
- 2) Modes of ATP generation-
  - a) Oxidative phosphorylation- chemo-osmotic model
  - b) Photophosphorylation in Cynobacteria- photosynthetic pigments and mechanism
  - c) Substrate level phosphorylation
- 3) Bioluminescence – Occurrence, mechanism & applications.
- 4) Assimilation of -
  - a) Carbon
  - b) Nitrogen with respect to N<sub>2</sub> and NH<sub>3</sub> (GOGAT)
  - c) Sulphur

## UNIT – IV Anabolic reactions in bacteria

Lectures - 11

- 1) Biosynthesis of -
  - a) RNA- Transcription and Post Transcriptional modifications
  - b) DNA- Important features of Replication, process of Replication- role of different proteins and enzymes
  - c) Proteins- Translation and Post- Translational modifications
  - d) Peptidoglycan
  - e) Lipopolysaccharide

### Learning outcomes-

The student is able to understand -

1. Properties, lock and key and induced fit hypothesis, explaining mechanism of enzyme action
2. Allosteric enzymes, Ribozymes and Isozymes
3. Significance of K<sub>m</sub> and V<sub>max</sub> and able to derive MM equation
4. Methods of extraction and purification of enzymes
5. Methods of performing assays of enzymes
6. Basic concepts of PP, ED, PK and Glyoxylate bypass
7. Modes of ATP generation
8. Assimilation of carbon, nitrogen and sulfur
  - a. Biochemical mechanism of biosynthesis of RNA, DNA, Protein, Peptidoglycan and lipopolysaccharide.

### Books Recommended:

1. Enzymology - Prise & Stevens
2. Enzymes - Biochemistry, Biotechnology, clinical chemistry - Trevor Palmer.

3. Enzymes - Dixon and Webb
4. Nature of Enzymology - R. L. Foster,
5. Lehnigers Principles of Biochemistry by David Nelson & Michale Cox, Fifth edition.
6. General Microbiology - Stanier
7. Principles & techniques of Biochemistry - Wilson & Walker,6th edition.
8. Biochemistry - Lubert Stryer

**SEMESTER VI**  
**COURSE XV- BMiT- 603: - ENVIRONMENTAL MICROBIOLOGY**  
**(TOTAL LECTURES-45)**

**Learning objectives-**

The students should

- 1) Understand general characteristics of solid and liquid waste
- 2) Know biological safety in laboratory and pharmaceutical industry
- 3) Know about classification of lakes, sources, consequences and control of Eutrophication
- 4) know about Microbial interactions
- 5) know about Environmental monitoring and bioremediation
- 6) Know concept of bioleaching and characteristics of different wastes

**UNIT – I Characteristics of waste and Eutrophication** Lectures - 11

1. General characteristics of waste
  - a) Liquid waste - pH, electrical conductivity, COD, BOD, total solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease.
  - b) Solid waste- pH, electrical conductivity, total volatile solids, ash.
  - c) Standards as per MPCB.
2. Eutrophication -
  - a. Classification of lakes
  - b. Sources
  - c. Consequences
  - d. Control

**UNIT II- Microbial Interactions** Lectures - 11

- 1) Types of interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation
- 2) Microbe-Plant interaction: Symbiotic and non-symbiotic interaction
- 3) Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

**UNIT – III Environmental monitoring and Bioremediation** Lectures - 11

- 1) Environmental monitoring-
  - a) Cleanroom classification
  - b) Routine EM programme in pharmaceutical industries
  - c) Microbial Control in Cleanrooms
  - d) Bioburden considerations in equipment- biocontamination control.
- 2) Bioremediation - Approaches, types and applications.
- 3) Environmental Impact assessment –Concept and Brief introduction.



## UNIT – IV Characteristics of waste and Bioleaching

Lectures - 12

- 1) Characteristics and treatment of waste generated by
  - a) Sugar Industry.
  - b) Distillery
  - c) Dairy Industry
  - d) Hospital
- 2) Bioleaching
  - a) Introduction
  - b) Microorganisms involved
  - c) Chemistry of Microbial leaching
  - d) Laboratory scale and pilot scale leaching
  - e) In situ leaching - Slope, heap
  - f) Leaching of Copper and Uranium

### Learning outcomes-

The students should be able to-

- 1) Understand general characteristics of solid and liquid waste
- 2) Learn about biological safety in laboratory and pharmaceutical industry
- 3) Understand classification of lakes, sources, consequences and control of Eutrophication
- 4) Learn about Microbial interactions
- 5) Understand Environmental monitoring and bioremediation
- 6) Learn concept of bioleaching and characteristics of different wastes.

### Books Recommended:

1. Environmental Pollution by Chemicals - Walker, Hulchison.
2. Biochemistry and Microbiology of Pollution - Higgins and Burns.
3. Environmental Pollution - Laurent Hodge, Holt.
4. Waste Water Treatment - Datta and Rao (Oxford and IBH)
5. Sewage and waste treatment - Hammer
6. Pollution - Kudesia, Pragati Prakashan Meerat.
7. Environment Chemical Hazards - Ram Kumar (Swarup and Sons, New Delhi).
8. Environment and Metal Pollution - Khan (ABD Pub. Jaipur).
9. Environment Pollution - Timmy Katyal (Satke Anmol Pub. New Delhi).
10. Ecology of Polluted Water - Vol. II - Anand Kumar (Aph Pub. Co. New Delhi).
11. Environment Pollution and Management of waste waters by Microbial Techniques - Pathade and Goel (ABD Pub. Jaipur).
12. Current Topics in Environmental Sciences - Tripathi and Pandey (ABD Pub. Jaipur).
13. Environmental Impact Assessment - R. K. Trivedy
14. Microbial Limit and Bioburden Tests, 2nd edition - Lucia Clontz ( CRC Press )

**SEMESTER VI**  
**COURSE XVI- BMiT- 604: AGRICULTURAL MICROBIOLOGY- II**  
**(TOTAL LECTURES-45)**

**Learning objectives-**

**The students should-**

1. Know about biofertilizer and bio pesticide production
2. Know about Types, production, methods of application and uses of biofertilizers and GM crops.
3. Know about Plant diseases and its control.
4. Understand molecular biology techniques.

**UNIT – I Types, production, methods of application and uses of -**

Lectures – 11

**1) Biofertilizer**

- i) Nitrogen fixing - Azotobacter, Rhizobium, and Azospirillum.
  - ii) Phosphate Solubilizing Microorganisms.
- 2) Bio pesticide- *Bacillus thuringiensis*, *Trichoderma* sp

**UNIT-II Plant diseases**

Lectures - 11

- 1) Microbial Control of Soil Borne Plant Pathogens
  - a) Bio- control mechanisms and ways
  - b) Microorganisms used as bio control agents against- Microbial plant pathogens, Insects, Weeds
- 2) Plant diseases-
  - a) **Black rust of wheat**
  - b) **Bacterial leaf blight**
  - c) **Blast disease of rice**

**UNIT-III Agriculture Biotechnology**

- 1) Secondary Agriculture Biotechnology Lectures-11
  - a) Biotech feed, Silage, biogas, biofuels – advantages and processing parameters
- 2) GM crops - Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.

**UNIT –IV**

Lectures 12

- Principle, Technique, types, advantages and disadvantages of-**
- ELISA**
  - FISH Technique**
  - Microarray technique.**

**Learning outcomes-**

The student is able to understand -

1. About biofertilizer and bio pesticide production
2. About Types, production, methods of application and uses of biofertilizers and GM crops.
3. About Plant diseases and its control.
4. Understand molecular biology techniques.

**Books Recommended:**

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, 1st edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

**SEMESTER VI**  
**COURSE XVI- BMIT- 605: CELL BIOLOGY II (EUKARYOTIC)**  
**(TOTAL LECTURES-45)**

**Learning Objectives:**

The students should

1. Learn structure of eukaryotic cell wall, cell membrane
2. Understand cell- cell interactions and adhesion molecules
2. Understand in detail different structures and functions of cell organelles and know about signaling mechanism in eukaryotes
3. Know the principle, technique, types of ELISA, FISH and microarray techniques

**UNIT I-Structure of Cell**

Lectures-12

- a) Structure of Cell- plant cell, animal cell
- b) Plasma membrane: Structure and transport of small molecules Fluid mosaic model and details
- c) Cell Wall: plant cell,
- d) Extra cellular matrix and cell matrix interactions Cell- Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects)

**UNIT II-Cell organelles**

Lectures-11

- a) Ribosomes, Chloroplast and peroxisomes
- b) Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules

**UNIT III-Cell signaling**

Lectures-11

- a) Signaling molecules and their receptors
- b) Function of cell surface receptors
- c) Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway

**UNIT IV-Principle and practices of microbial techniques**

Lectures-11

Principle, technique, types, advantages and disadvantages of-

- a) ELISA
- b) FISH technique
- c) Microarray technique

**Learning Outcomes:**

The students should be able to

1. Learn structure of eukaryotic cell wall, cell membrane
2. Understand cell- cell interactions and adhesion molecules

2. Understand in detail different structures and functions of cell organelles and know about signaling mechanism in eukaryotes
3. Know the principle, technique, types of ELISA, FISH and microarray techniques

### **Books Recommended**

1. The Cell: A Molecular Approach-**Geoffrey M. Cooper Sixth edition**
2. Cell Biology by Gerald Karp, International students version,**seventh edition**
3. Molecular Biology of the Cell (Sixth Edition) Sixth Edition  
by Bruce Alberts , Alexander D. Johnson, Julian Lewis
4. Principles of microbiology – Ronald M. Atlas, Mosby publications 1995
5. Molecular Cell Biology 2007 , Harvey Lodish , Arnold Berk,**Sixth edition**

**SEMESTER VI**  
**COURSE XVI- BMiT- 606: MEDICAL MICROBIOLOGY**  
**(TOTAL LECTURES- 45)**

**Learning Objectives:**

Students should

1. Know the cultural and biochemical characteristics, antigenic structure of mode of spread, prevention and control of selected human pathogens.
2. Know the principle, technique, types of ELISA, FISH and microarray techniques
3. Basic concept of Chemotherapy, Drug resistance and Immunoprophylaxis

**UNIT – I Bacterial Diseases**

Lectures - 11

Cultural and biochemical characteristics, antigenic structure, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by  
i) *Mycobacterium tuberculosis* ii) *Clostridium perfringens* iii) *Pseudomonas aeruginosa*  
iv) *Vibrio cholerae* v) *Leptospira interrogans* vi) *Streptococcus mutans*

**UNIT – II Viral diseases**

Lectures – 11

Cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by-Viruses:

- i) Hepatitis A & B virus, ii) Rabies virus iii) Dengue virus iv) Influenza virus

**UNIT – III Chemotherapy**

Lectures – 11

1) Chemoprophylaxis

1) General principles of chemotherapy

2) Mode of action of antimicrobial agents:

a) Antibacterial drugs: Penicillin, Bacitracin, Piperacillin, **Murepavadin**, cycloserine, Streptomycin, Tetracycline, Trimethoprim, Sulphonamides and Quinolones .

b) Antiviral drug :AZT,

c) Antifungal drugs: Ketoconazole, Griseofulvin, Nystatin

d) Antiprotozoal drugs: Metranidazole, Mepacrine, **Quinone**

4) Drug resistance: Mechanism of drug resistance and way out to drug resistance

5) Immunoprophylaxis: Vaccines and Immune Sera

a) Vaccines-live attenuated, inactive, subunit, conjugate and DNA vaccines

b) Immune Sera- examples with applications

**UNIT –IV**

**Principle, Technique, types, advantages and disadvantages of-**

**1. ELISA**

**2. FISH Technique**

**3. Microarray technique.**

**Learning outcomes:**

Student is able to

1. Know the morphology, cultural and biochemical characteristics, antigenic structure of mode of spread ,prevention and control of selected human pathogens.
2. Know the principle, technique, types of ELISA, FISH and microarray techniques
3. Basic concept of Chemotherapy, Drug resistanc and Immunophylaxis

**Books Recommended:**

1. Microbiology–Davis B.D, Delbacco, 4<sup>th</sup> edition,1990 ,J.B.Lippincott Co. NY
2. Text book of Microbiology-Ananthnarayan R and C.E. Jayaram Panikar 5<sup>th</sup> edition, 1996, Orient Longman
3. Medical Bacteriology-Dey N .C. &Dey T.K. 17<sup>th</sup> edition 1988, Allied Agency, Calcutta
4. Medical Bacteriology including Medical Mycology &AIDS–T. K. Dey, D. Sinha &N. C. Dey,[New Central Book Agency](#) (Kolkata)
5. Principals and Practice of Clinical Bacteriology–A.M.Emmerson
6. Antimicrobial chemotherapy- David Greenwood, 5<sup>th</sup> edition, Oxford university press
7. Medical Laboratory Technology;Vol. III,-Mukharjee K.L. ,10<sup>th</sup> edition. Tata Mc Graw-Hill Pub Co.
8. Ananthnarayan and Paniker’s Textbook of Microbiology –9<sup>th</sup> edition , Editor Arati Kapil 2013, University Press

## **SEMESTER V**

### **SKILL BASED COURSE**

#### **SECCMIP-607-THEORY PAPER II (SECC II) ENTREPRENEURSHIP DEVELOPMENT**

##### **Unit I Entrepreneurship, Creativity & Opportunities**

**06**

Concept, Classification & Characteristics of Entrepreneur, Creativity and Risk taking, Risk Situation, Types of risk & risk takers, Business Reforms, Process of Liberalization, Reform Policies, Impact of Liberalization, Emerging high growth areas, Business Idea Methods and techniques to generate business idea, Transforming Ideas in to opportunities transformation involves, Assessment of idea & Feasibility of opportunity SWOT Analysis

Information and Support Systems

Information needed and Their Sources: Information related to project, Information related to support system, Information related to procedures and formalities, Support Systems Small Scale Business Planning, Requirements, Govt. & Institutional Agencies, Formalities Statutory Requirements and Agencies.

Market Assessment

Marketing: Concept and Importance Market Identification, Survey Key components Market Assessment

##### **Unit II Business Finance & Accounts**

**06**

Business Finance: Cost of Project Sources of Finance Assessment of working capital Product costing Profitability Break Even Analysis Financial Ratios and Significance

Business Account: Accounting Principles, Methodology Book Keeping Financial Statements Concept of Audit

Business Plan: Business plan steps involved from concept to commissioning, Activity Recourses, Time, Cost

Project Report: Meaning and Importance, Components of project report/profile (Give list), Project Appraisal: 1) Meaning and definition 2) Technical, Economic feasibility 3) Cost benefit Analysis

##### **Unit III Enterprise Management and Modern Trends**

**03**

Enterprise Management: Essential roles of Entrepreneur in managing enterprise



Product Cycle: Concept and importance Probable Causes of Sickness

Quality Assurance: Importance of Quality, Importance of testing E-Commerce: Concept and Process

Microbiology Entrepreneur: Assess yourself-are you an entrepreneur? Prepare project report for botany and study its feasibility.

**Course Work:**

**20**

15 Days internship program and report writing

## BMiP- 608 Practical Course

1. U. V. lethal curve of *E. Coli*.
2. Isolation of auxotrophic mutants by replica plate technique.
3. Isolation of streptomycin - resistant mutants (gradient plate technique)
4. Isolation of chromosomal DNA from bacteria (J. Marmurs method)
5. Agarose Gel Electrophoresis of DNA
6. **Assay of Amylase by DNSA method ( Graphical estimation)**
7. Study of enzyme immobilization by sodium alginate method
8.  $\beta$  Galactocidase induction in *E. coli*
9. Study yeast cell immobilization in calcium alginate gel
10. Study of different phases of mitosis by using onion root tip.
11. Nuclear Staining by Giemsa's Method

## BMiP- 609 Practical Course

1. Determination of BOD of sewage
2. Determination of COD of sewage.
3. Isolation of *Azotobacter* from soil.
4. Isolation of *Rhizobium* from root nodules.
5. Isolation of phosphate solubilising bacteria from soil
6. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics.  
*Pseudomonas aeruginosa* b) *Sreptococcus mutans*
7. Determination of MIC of streptomycin against *E. coli* by broth method.
8. Determination of sensitivity of common pathogens to antibiotics by paper disc method.
9. Urine analysis: Physical and chemical examination of urine.
  - a) Microscopic examination of urine-crystals, RBCs, pus cells and bacteria.
  - b) Test for protein (Acetic acid test)
  - c) Test for ketone bodies (Rothra's test)
  - d) Test for bile salt and bile pigments.
  - e) Test for sugar ( Benedict's method)

### Books Recommended:

1. Stanier, General Microbiology
2. Rose, Chemical Microbiology
3. Laboratory exercise in microbiology, Harley Prescott fifth edition, McGraw Hill companies, 200
4. Experimental microbiology by Rakesh J. Patel, Kiran J. Patel, Aditya publications, volume I
5. Experimental microbiology by Rakesh J. Patel, Kiran J. Patel, Aditya publications, volume II



**Rayat Shikshan Sanstha's**  
**Yashavantrao Chavan Institute of Science, Satara**  
**(Autonomus)**  
**Advance Diploma Course In Microbial Quality Control in**  
**industries**  
**DEPARTMENT OF MICROBIOLOGY**  
**BSC III**  
**Year : 2020-21**

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**Objectives:-**

Education that a student has acquired in his graduate or postgraduate degree in Science, he/she is not adequately equipped to meet the demands when he/she is working in a responsible position in a pharmaceutical or in microbial industry. In most of establishments fresher are not given the job oriented instruction that they need and they find it difficult to adapt themselves to the working situations in which they are called upon to operate.

The Advance diploma course in Microbial quality control in industries offered by the Microbiology Department has specially designed to cater the requirements of such students.

- The course aims at covering the basic techniques and their applications to different fields like pharmaceutical, food, dairy etc.
- Students should get basic knowledge about antimicrobial agent and about efficacy testing.
- Students should also understand tools and techniques used in antimicrobial testing.
- Students should also understand regulations and recommendations about pharmacopeia.
- **Goals :-**

**The specific goal of the Advance diploma course are :**

- To prepare graduate students (B.Sc.) with in depth knowledge and research skill for professionals careers in microbiology.

- Create opportunities for research and scholarship graduate students.
- To provide consultancy services to society.
- Provide an environment which fosters the continuous improvement and innovations in the Subject.
- Inculcate among the students research attitude, skills and value of dignity of labor.

### **Unit I- Ecology of microorganisms. 12**

**A** Introduction, Atmosphere. Microbial content, Reduction of microbial count, Compressed air, Water, Raw or mains water, Softened water, Deionized or demineralized water, Distilled water, Water produced by reverse osmosis, Distribution system, Disinfection of water.

**B** - Microbial transfer from operators, Hygiene & protective clothing, Buildings, Walls & ceilings, Floors & drains, Doors, windows & fittings, Equipments , Pipelines, Cleansing, Disinfection & sterilization ,Microbial checks, Cleaning equipment & utensils.

**C** - Microbial spoilage, Introduction ,Types of spoilage , Infection induced by contaminated Medicines, Chemical & physico- chemical deterioration of pharmaceutical products, Pharmaceutical ingredient susceptible to microbial attack, Observable effects of microbial attack on pharmaceutical products.

### **Unit II- Quality control and Assurance( SOP, GLP, GMP ) 12**

**A**- Introduction Definition, Manufacture. Quality assurance. Good manufacturing practice ( GMP) Quality control. In-process control.

**B**- Control of microbial contamination during manufactures General aspects. Environmental cleanliness of hygiene. Quality of starting materials. Process design. Quality control & documentation. Packaging, storage & transport

**C**- Manufacture of sterile products. Clean & aseptic areas : general requirements. Design of premises. Internal surfaces, fittings & equipment. Services. Air supply, Clothing. Cleaning of disinfection. Operation. Aseptic areas additional requirements . Clothing. Entry to aseptic areas. Equipment & operation. Isolator & blow / fill /seal technology.

**D**- Guide to good pharmaceutical manufacturing practice.

## **Unit III- Testing of pharmaceutical products** 12

### **A- Antimicrobial testing systems-**

A) Introduction- antimicrobial agent, therapeutic ratio, MIC, MBC

### **B- Antimicrobial susceptibility testing-**

1. Use of liquid and solid media
2. Factors affecting susceptibility testing, Guidelines issued by CLSI
3. Susceptibility testing for antibacterial and antifungal agents.

### **C- Diffusion methods-**

1. Agar dilution technique, Gradient plate technique
2. E- Test, Kirby bauer method, stokes method

## **Unit IV-Biopharmaceuticals** 12

### **A- Regulations and recommendations**

1. Regulatory authorities and their role- FDA
2. Concept of pharmacopeia- USP, EP,
3. Concept of pharmacopeia- BP and IP

### **Books recommended for theory-**

1. Handbook of microbiology quality control- Norman A Hodges and Stephen P. Denyer.
2. Pharmaceutical microbiology- 6<sup>th</sup> edition- W.B. Hugo and A.D. Russell
3. Basic experimental microbiology by Ronald M. atlas, Alfred E. Brown
4. The basic pharmacology by – Harper
5. Biochemistry of antimicrobial action – Chapman and Hall, London.
6. Microbial quality assurance in pharmaceuticals by - Sally F. Bloomfield
7. Pharmaceutical quality control Microbiology- A guide Book to the basics, Scott Sutton
8. Pharmaceutical microbiology by- Purohit
9. Industrial, Pharmaceutical microbiology- I, Standard and control editors- Doctor N. Hodge

## **practical Course**

- 1) Microbiological analysis of Air
- 2) Microbiological analysis of Equipments & personels.
- 3) Microbiological analysis of Raw materials & finished products.
- 4) Microbiological analysis of spoiled pharmaceutical products- SPC
- 5) Microbiological analysis of water- MPN
- 6) Presumptive test of water
- 7) Confirm test of water
- 8) Completed test of water
- 9) Extraction of bioactive ingredients from plant and its activity fraction
- 10) Determination of MIC of drug
- 11) Estimation of antimicrobial activity using CLSI
- 12) Determination of microbial load of non-sterile products- Ointment, capsule
- 13) Good laboratory practices (GLP)
- 14) Good manufacturing practices (GMP)
- 15) Quality Assurance- Defination , Rules and Regulations
- 16) Susceptibility testing of antibacterial agent
- 17) Susceptibility testing of antifungal agent
- 18) Susceptibility testing of antiprotozoal agent
- 19) Kirby-Bauer Method- Paper disc diffusion method
- 20) Agar dilution technique
- 21) Diffusion method by E Test
- 22) Diffusion method by Stoke method
- 23) Diffusion method by Gradient plate technique.
- 24) Determination of Phenol Coefficient ratio

### **Learning Outcomes-**

After performing the practical course students will be able to –

1. Evaluate the microbiological analysis of environment in industries.
2. Comprehend the concept of SOP, GMP, GLP in industries.
3. Practically perform antimicrobial testing.

### **Suggested books for practicals-**

1. Introduction to practical biochemistry by- D. Plummer, J Willey and Sons.
2. Introduction to microbial technique by Gunasekaran.
3. Experimental microbiology by Patel and Patel.
4. Biochemistry of antimicrobial action, Chapman and Hall London, Franklin T.J. and Snow G A. 1975
5. Goldsmith A. Aronow L. Kalman S.M. (1969) the basic pharmacology, Harper international edition, New York
6. Kokate C K, Purohit A P, gokhale A B (2000), Pharmacology 4th edition, Nirali prakashan

### **Project**

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Student will have to undertake one project as a part of the course