



Rayat Shikshan Sanstha's

**SADGURU GADAGE MAHARAJ
COLLEGE KARAD**

(An Autonomous College)

Reaccredited by NAAC with 'A+' Grade

Approved Syllabus For

Bachelor of Science

Part - III

MICROBIOLOGY

Syllabus to be implemented w .e. f. June, 2021

REVISED SYLLABUS FOR BACHELOR OF SCIENCE PART - III: MICROBIOLOGY

1. TITLE: Microbiology

2. YEAR OF IMPLEMENTATION: Revised Syllabus will be implemented from June 2021 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.

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

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

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

8. **COURSE STRUCTURE OF B. Sc. III -**

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

B. Sc. III		SEMESTER V				
Sr. No	Subject Title	Paper No	Theory		Practical	
			No of lectures /Week	Credits	No of lectures /Week	Credits
1	Virology (Comp) and Immunology (Comp) and Food and Industrial microbiology (Comp)	IX, X and XI	9	6	10	4
2	Medical Microbiology	XII	3	2	10	4
3	AECC	III	2	2	--	--
4	Total of Semester V	-	14	10	20	08

B. Sc. III			SEMESTER VI			
Sr. No	Subject Title	Paper No	Theory		Practical	
			No of lectures /Week	Credits	No of lectures /Week	Credits
1	Genetics (Comp), Microbial biochemistry (Comp) and Environmental microbiology (Comp)	XIII, XIV and XV	9	6	10	4
2	Medical Microbiology-II	XVI	3	2	10	4
3	AECC	IV	2	2	--	--
4	Total of Semester VI	-	14	10	20	08
5	Total of Semester V and VI	-	28	20	40	16

➤ AECC – Ability Enhancement Compulsory Course

- Total marks of B. Sc. Part III including Skill and AECC = 600
- Total credits of B. Sc. Part III Semester V and VI = 36

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	
IX	40	5	5	V	40	5	5	-	300
X	40	5	5						
XI	40	5	5	VI	40	5	-	5	
XII	40	5	5						
SECC	20	--	--		30				50

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	
XIII	40	5	5	VII	40	5	5	-	300
XIV	40	5	5						
XV	40	5	5	VIII	40= (Lab work -20 and Literature Survey/ Industrial training/ Project	5	-	5	
XVI	40	5	5						
SECC	20	--	--		30				50

9. 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.

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

Sr. No.	TITLE OF SHIVAJI UNIVERSITY PAPER	TITLE OF AUTONOMOUS PAPER
Semester- V (Theory and practical)		
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	Paper BMiT 504 Medical Microbiology-I
		BMiP 505-Practical course BMiP 506-Practical course
Semester-VI (Theory and practical)		
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	Paper BMiT 604 Medical Microbiology-II
		BMiP 605-Practical course BMiP 606-Practical course

11. 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:**
 - i. Fire extinguisher
 - ii. First aid kit
 - iii. Fumigation chamber
 - iv. Stabilized power supply
 - v. Insulated wiring for electric supply.
 - vi. Good valves, distribution pipes & regulators for gas supply.
 - vii. Operational manuals for instruments.
 - viii. Emergency exits.

12. 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
 - i. The Structural properties of viruses: Capsids, Nucleic acids and envelope. Structure of T4 bacteriophages, TMV and HIV, Viroids and prions.
 - ii. Reproduction of Bacteriophages:
 1. One step growth experiment.
 2. 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 λ phage
- b) Integration of λ genome into host genome
- c) Genetic map for lysogenic interaction
- d) Expression of λ 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 hypotheses of cancer and emerging viruses.

Books Recommended:

1. Principles of Virology 4th 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 Dagainawala
8. Virology - Biswas and Biswas
9. Virology Vol. 4- Topley and Wilson
10. Principles 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_H cell
- c) Interaction of B cell and T_H 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 TH cells and Macrophages.
- c) Effects of cytokines
- d) Interferon–properties- types, inducers of Interferon, Mechanism of action- antiviral and immunoregulatory action
- e)

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 - 6th edition - Kuby, Kindt, Goldsby & Osborne.
- 2) Essential Immunology - 11th edition - Delves, Martin, Burton and Roitt.
- 3) Immunology - An Introduction, 4th edition – Tizzard.
- 4) Basic and Clinical Immunology 5th 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: MEDICAL MICROBIOLOGY- I

(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*
- b) *Cryptococcus neoformans*
- c) *Candida albicans*
- d) *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

Lectures – 11

Principle, working and application of -

- i. Electrophoresis
- ii. Chromatography
- iii. U. V. Visible spectroscopy
- iv. 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 5th edition, 1996, Orient Longman
6. Medical Bacteriology-Dey N.C. & Dey T.K. 17th edition 1988, Allied Agency, Calcutta
7. Medical Laboratory Technology; Vol. I, II & III, -Mukharjee K.L. , 10th 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.

BMiP- 505 : Practical Course V

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 immune-electrophoresis.
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- 506 : Practical Course VI

1. Microbiological assay of Penicillin
2. Microbiological assay of 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*

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 MMEquation
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 Prokarytes
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 N₂ and NH₃ (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_m and V_{max} 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
9. 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.

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, Hulchiason.
- 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: MEDICAL MICROBIOLOGY-II
(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) <i>Mycobacterium tuberculosis</i> | ii) <i>Clostridium perfringens</i> |
| iii) <i>Pseudomonas aeruginosa</i> | iv) <i>Vibrio cholerae</i> |
| v) <i>Leptospira interrogans</i> | vi) <i>Streptococcus mutans</i> |

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**
- 2) **General principles of chemotherapy**
- 3) **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, Quinine
- 4) **Drug resistance:** Mechanism of drug resistance and way out to drug resistance
- 5) **Immunoprophylaxis:** Vaccines and Immune Sera
- 6) **Vaccines:** live attenuated, inactive, subunit, conjugate and DNA vaccines
- 7) **Immune Sera:** examples with applications

UNIT IV Principle, Technique, types, advantages and disadvantages

Lectures – 11

- i. ELISA
- ii. FISH Technique
- iii. 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 resistance and Immunoprophylaxis

Books Recommended:

1. Microbiology–Davis B.D, DeBacco, 4th edition,1990 ,J.B.Lippincott Co. NY
2. Text book of Microbiology-Ananthnarayan R and C.E. Jayaram Panikar 5th edition, 1996, Orient Longman
3. Medical Bacteriology-Dey N.C. &Dey T.K. 17th 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. Principles and Practice of Clinical Bacteriology–A.M.Emmerson
6. Antimicrobial chemotherapy- David Greenwood, 5th edition, Oxford university press
7. Medical Laboratory Technology;Vol. III,-Mukharjee K.L. ,10th edition. Tata Mc Graw-Hill Pub Co.
8. Ananthnarayan and Paniker's Textbook of Microbiology –9th edition , Editor Arati Kapil 2013, University Press

BMiP- 605 Practical Course VII

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. β 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- 606 :Practical Course VIII

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 solubilizing bacteria from soil
6. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics.
a) Pseudomonas aeruginosa b) Streptococcus 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