

SHIVAJI UNIVERSITY, KOLHAPUR.



***** B+
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New Syllabus For
Bachelor of Science
Part - III
MICROBIOLOGY

Syllabus to be implemented from June 2008 onwards.

Shivaji University, Kolhapur

Revised Syllabus For Bachelor of Science Part – III : Microbiology

1. TITLE : Microbiology

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June 2008 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 vigour 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 COURSE/ PAPER/ :

- 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 Annual.

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

11. STRUCTURE OF COURSE-

1)

THIRD YEAR ----- (NO.OF PAPERS 4)

Sr.No.	Subjects	Marks
1.	Paper – V	100
2.	Paper – VI	100
3.	Paper – VII	100
4.	Paper – VIII	100
5.	Practical – I	50
6.	Practical – II	50
7.	Practical – III	50
8.	Practical – IV	50
	Total	600

2) Structure and Titles of Papers of B.Sc. Course :

B.Sc. I

Paper I : Fundamentals of Microbiology and Basic Biochemistry

Paper II : Microbial Techniques & Applied Microbiology

B.Sc. II

Paper III : Microbial Physiology and Genetics

Paper IV : Basics of Industrial and Medical Microbiology

B.Sc. III

Paper V : Virology and Microbial Genetics

Paper VI : Food Microbiology, Microbial Biochemistry and Industrial Microbiology

Paper VII : Agricultural and Environmental Microbiology

Paper VIII : Immunology and Medical Microbiology

9. **SCHEME OF TEACHING AND EXAMINATION:-**

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

THIRD YEAR

Scheme of Teaching and Examination

Sr. No.	Subject/Paper	Teaching Scheme (Hrs/Week)			
		L	T	P	Total
1	Paper – V	3			12
2	Paper – VI	3			
3	Paper – VII	3			
4	Paper – VIII	3			
5	Practical			5	20
6	Practical			5	
7	Practical			5	
8	Practical			5	
	Total				32

10. SCHEME OF EXAMINATION :- For B.Sc. Part – III

- The examination shall be conducted at the end of each academic year.
- The each Theory paper shall carry 100---- marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Annual Examination of 600 marks.
- Question Paper will be set in view of the /in accordance with the entire Syllabus and preferably covering each unit of syllabi.

13. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

Sr.No.	Title of Old Paper	Title of New Paper
1.	Paper – V : Virology and Microbal Genetics	Virology and Microbal Genetics
2.	Paper –VI : Food, Industrial Microbiology & Microbial Biochemistry	Food, Industrial Microbiology & Microbial Biochemistry
2.	Paper–VII : Agricultural & Environmental Microbiology	Agricultural & Environmental Microbiology
2.	Paper–VIII : Immunology, Serology and Clinical Microbiology	Immunology, Serology and Clinical Microbiology.
3.	Practical – Old	Practical – New

14. OTHER FEATURES :

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

SHIVAJI UNIVERSITY, KOLHAPUR

B.Sc. III – Microbiology

Revised Syllabus from June 2008

Theory Paper – V : Virology and Microbial Genetics

Section – I : Virology

UNIT – I

10

- 1) **The Structural properties of viruses** : Capsids, Nucleic acids and envelope. Structure of T4 bacteriophage, TMV and HIV, brief introduction about viroids and prions :
- 2) **Reproduction of Bacteriophages**
 - a) General outline for phage host interaction.
 - b) One step growth experiment.
 - c) Reproduction of T4 phage.
 - d) Reproduction of MS2 phages.

UNIT – II

10

- 1) **Isolation, cultivation and Purification of viruses**
 - a. **Isolation and cultivation of viruses -**
 - i) Animal virus Tissue culture, chick embryo and live animals.
 - ii) Plant virus, plant tissue culture and insect Tissue culture.
 - iii) Bacteriophages on solid (plaque method) and in liquid media.
 - b. **Purification of viruses using physico-chemical properties**
 - i) Density gradient centrifugation
 - ii) Precipitation

- 2) **Methods of Enumeration of viruses**

- i) Latex droplet method (Direct microscopic count)
- ii) Plaque and pock method.
- iii) End point method – Brief introduction of ID₅₀, LD₅₀, TCD₅₀, PD₅₀ and Muench method for LD₅₀

UNIT – III

8

- 1) **Lysogeny** – Definition of lysogeny and temperate phage, types, lysogeny by lambda phage – adsorption & penetration, genetic map for lysogenic interaction, expression of λ -genes, establishment of repression maintenance of repression, integration of λ -genome in host chromosome.

- 2) Reproduction of animal viruses – Adenovirus and influenza virus.
- 3) Reproductive on of plant viruse - TMV

UNIT – IV

Oncogenesis :

- a) Definition of oncogenesis
- b) Types of cancer
- c) Characteristics of cancer cells.
- d) Hypothesis about cancer.
 - i) Somatic mutation hypothesis
 - ii) Viral gene hypothesis
 - a) Role of DNA viruses with special emphasis on Papova viruses.
 - b) Role of RNA tumor viruses, Provirus theory, Protovirus theory, Oncogene theory.
 - iii) Defective immunity hypothesis.

Section – II (Microbial Genetics)

UNIT – I

8

Basic concepts of bacterial genome -

- a) Structural organization of *E. coli* chromosome – Folded Fiber model.
- b) One cistron – one polypeptide hypothesis.
- c) Molecular mechanism of gene expression
 - i) Concept of operon
 - ii) Pribnow box
 - iii) Genetic regulation in tryptophan operon
 - iv) Nif regulon

UNIT – II

9

1) Mutations

- A) Expression of mutations –
 - a) Time course of phynotypic expression.
 - b) Conditional expression of mutation.
- B) Suppressor mutations (with examples) – Genetic and non-genetic.

2) Methods of isolation and Detection of mutants Based on -

- a) Relative survival
- b) Relative growth
- c) Visual detection

UNIT – III

10

1) Genetic complementation – Cis-trans test

2) Extrachromosomal inheritance :

- a) Kappa particles.
- b) Transposable elements – general properties, Insertion sequences, Transposons, Mu phage.

3) Protein engineering -

- a) Introduction and concept of proteomics.
- b) Methods
- c) Applications

4) Techniques in molecular biology – DNA sequencing (Sanger's method), DNA Finger printing, PCR

UNIT – IV

9

1) Genetic engineering

- a) Introduction
- b) Tools of genetic engineering – Enzymes, Vectors-phage, plasmid and cosmid, DNA probe, linkers and adaptors, Cloning organisms – (Bacteria and Yeasts)
- c) Concepts of gene library.
- d) Techniques –
 - i) Isolation of desired DNA segment.
 - ii) Construction of r-DNA using appropriate vector.
 - iii) Transfer to cloning organisms.
 - iv) Selection of recombinants (Bacteria and Yeasts)
- e) Application of genetic engineering in – Medicine, Agriculture, Industry, Environment.

2) Stem Cells : Introduction and applications

Theory Paper – VI : Food, Industrial Microbiology & Microbial Biochemistry

Section – I : Food & Industrial Microbiology

UNIT – I

8

1) Food Microbiology

- a) Food as a substrate for microorganism.
- b) Food fermentations –
 - i) Idli
 - ii) Curd
- c) Microbial food poisoning.
- I) Role of food in food poisoning
- II) Food poisoning –
 - i) Clostridial
 - ii) Staphylococcal
 - iii) Fungal (alfatoxin)
- d) Food infections
 - i) Salmonellosis
 - ii) Shigellosis

UNIT – II

9

2) Industrial Microbiology

- A) Fermentation Media
 - a) Raw materials
 - b) Inoculum media
 - c) Production media
- B) Preservation of industrially important microorganisms.
- C) Industrial production of**
 - i) Grape wine – Definition, types, production of red table wine, champagne, California sherry, Defects of wine
 - ii) Beer – Definition, types of Beer, Production of larger beer and Ales beer.
 - b) Dairy products – Cheddar Cheese.

UNIT – III

9

Industrial Production of

- 1) Vitamins – Vit. B12
- 2) Amino acids – Lysin
- 3) Biopesticides – Bacillus thuringiensis
- 4) SCP from Microorganisms – Bacteria, Fungi, Algae
- 5) Immunoactive products – Toxoids, Sera & Vaccines.

UNIT – IV

10

1) Down stream processing & product recovery –

Centrifugation, flocculation, filtration, solvent extraction, concentration, adsorption & elution, distillation, precipitation, crystallization, chromatography, wholebroth processing, cross flow filtration (Tangential flow filtration)

2) Testing of sterility, pyrogen, carcinogenicity, toxicity & allergens in case of pharmaceutical products, health care products and food products.

3) Biomethanation

Microbiology and Biochemistry of anaerobic digestion, use of different raw materials, biogas production.

Section – II (Microbial Biochemistry)

UNIT – I

9

Enzymes

- a) Definition, properties, structure, specificity, mechanism of action (Lock & Key, Induced fit hypothesis)
- b) Allosteric enzymes – Definition, models explaining mechanism of action.
- c) Ribozymes and Isoenzymes.
- d) Factors affecting catalytic efficiency of enzymes
 - i) Proximity and orientation
 - ii) Strain and distortion.
 - iii) Acid base catalysis
 - iv) Covalent catalysis
- e) Enzyme kinetics – Derivation of Michaelis Menten equation, Lineweaver Burk Plot, Significant of K_m and V_{max} .
- f) Regulation of enzyme synthesis.
 - i) Positive control – Ara operon
 - ii) Negative control – Lac operon
 - iii) Catabolite repression

UNIT – II

9

1) Extraction & purification of enzymes.

- I) Methods of extraction of intracellular and extracellular enzymes.
 - i) Choice of source and biomass development

- ii) Methods of homogenization – cell disruption methods
- iii) Extraction of membrane bound enzymes.
- II) Purification of enzyme on the basis of –
 - a) Molecular size
 - b) Solubility differences
 - c) Electric charge
 - d) Adsorption characteristic differences
 - e) Differences in biological activity
- 2) Assay of enzymes** – Based on substrate estimation and product estimation.
- 3) Immobilization of enzymes** – methods & applications

UNIT – III

10

- 1) Basic concepts of**
 - a) Glyoxylate bypass
 - b) PP pathway, ED pathway, phosphoketolase pathway
 - c) Pyruvate as key intermediate
 - d) Bioluminescence
- 2) Assimilation of -**
 - a) Carbon
 - b) Nitrogen with respect to N_2 and NH_3 (GOGAI)
 - c) Sulphur

UNIT – IV

8

- 1) Biosynthesis of -**
 - a) RNA
 - b) DNA
 - c) Proteins
 - d) Peptidoglycan

Theory Paper – VII : Agricultural & Environmental Microbiology

Section – I : Agricultural Microbiology

UNIT – I

9

- 1) Introduction to study soil Microbiology.**

- a. Definition
- b. Approaches to study soil Microbiology
- c. Current topics in soil Microbiology.

2) Soil as an environment.

- a. Physical characters.
- b. Chemical characters.
- c. Types of microorganisms in soil and their role in soil fertility.
- d. Soil enzymes.
- e. Microbiological interaction – Symbiosis, Commensalism, Amensalism, Parasitism, Predation.

3) Role of microorganisms in elemental cycle.

- a. Carbon cycle.

UNIT – II

9

1) Role of microorganisms in elemental cycle

- a. Nitrogen cycle
- b. Phosphorous cycle

2) Role of Microorganisms in reclamation of soil.

A) Composting

I) Methods of Production and applications of

- a) Green manure
- b) Town compost
- c) Vermicompost

II) Optimal composting with reference to : Type of Composition of organic waste, availability of microorganisms, Aeration, C:N:P ratio, Moisture content, Temperature, pH, time.

B) Reclamation of saline soils using biomass.

UNIT – III

9

1) Biofertilizers

- a) Introduction
- b) Types

- i) Nitrogen fixing – Azotobacter, Rhizobium, Azolla, Frankia, Cyanobacteria and Azospirillum.
- ii) Phosphate solubilizing Microorganisms.
- iii) Vesicular Arbuscular Mycorrhiza (VAM)
- c) Methods of applications.

2) Biocontrol with reference to

- a) Microbial plant pathogen.
- b) Insects
- c) Weeds

UNIT – IV

9

1) Biodegradation of

- a) Cellulose
- b) Lignin
- c) Pesticides

2) Plant Pathology

- a) Common symptoms produced by plant pathogens
- b) Modes of transmission of plant diseases.
- c) Plant disease
 - i) Citrus Canker
 - ii) Tikka disease of groundnut

Section – II : Environmental Microbiology

UNIT – I

8

1) Air Microbiology

- A) Air pollution
 - a) Sources
 - b) Types
 - c) Effects
 - d) Control
 - e) Depletion of ozone layer – Phenomenon, cause, impact.
- B) Biological safety
- C) Germ free environment
 - a) Methods
 - b) Equipments

- c) Types of animals used
- d) Characteristics of germ free animals
- e) Applications

UNIT – II

9

1) Sewage Microbiology

- a) Types
- b) Chemical characteristics
- c) Microflora
- d) BOD and COD
- e) Treatment and disposal
 - i) Biological treatment : Trickling filter, Activated sludge process, oxidation ponds, Anaerobic digestion, Septic tank.
 - ii) Chemical treatment – Chlorination

2) Marine Microbiology

- a) Types and characteristics of marine microorganisms.
- b) Importance of microorganisms – i) Biological activity
 - ii) Geochemical activity
 - iii) Physico – Chemical activity
- c) Types of microorganism.

UNIT – III

10

1) Environment pollution

- A) Pollutions by toxic elements – Sources and effects.
 - a) Metals – Mercury, Lead, Cadmium, Arsenic, Chromium and Cyanide.
 - b) Oil
 - c) Pesticides
 - d) Radioactive waste
- B) Bioremediation – Approaches, types and applications.
- C) Eutrophication
 - a) Classification of lakes.
 - b) Sources
 - c) Consequences
 - d) Control

2) Environmental Impact assessment – brief introduction.

UNIT – IV

9

1) Petroleum Microbiology

- A) i) Types of compounds in Petroleum
- ii) Utilization of hydrocarbons by microorganisms.
- B) Oil recovery
 - a) Methods – Primary, Secondary and Microbially enhanced.
 - b) Biotechnological solutions of oil recovery

2) Characteristics and treatment of waste generated by

- a) Paper and Pulp Industry.
- b) Sugar and Distillery Industry
- c) Dairy Industry

3) Bioleaching

- a) Introduction
- b) Microorganisms involved
- c) Chemistry of Microbial leaching
- d) Commercial leaching – Slope, heap, in situ leaching
- e) Leaching of Copper and Uranium

Theory Paper – VIII : Immunology, Serology and Clinical Microbiology

Section – I : Immunology and Serology

UNIT – I

9

1) Membrane receptors for antigen and their role in antigen recognition

- a. B cell surface receptor for antigen (BCR)
- b. T cell surface receptor for antigen (TCR)
- c. NK receptors.

2) Immune response

A) Molecular mechanism of antibody production.

- a. Processing and presentation of antigen by Antigen presenting cell.
- b. Triggering of B cell – T_H – B interaction.
- c. Clonal proliferation.
- d. Differentiation and maturation into antibody forming plasma cell.

B) Cell mediated immune response.

- a. Cells involved in CMI
- b. T cell subsets.
- c. Role of Macrophages in CMI

UNIT – III

9

1) Complement –

Nature, Properties, Complement activation by classical and alternate pathway.
Biological consequences of complement activation.

2) Monoclonal antibodies :

- a) Basic concepts – Mouse, Human and Humanized antibodies.
- b) Production of monoclonal antibodies by – hybridoma technology.
- c) Production of Humanized Monoclonal antibodies by recombinant DNA technology.
- d) Applications of monoclonal antibodies in diagnosis, treatment and research.

3) New diagnostic techniques

RIA

Immuno PCR

UNIT – III

9

1) Cytokines

- a. Cytokines as intracellular messengers.
- b. Cytokines produced by different T cells subsets and Macrophages.

c. Effects on cytokines

2) Immunological tolerance

Tolerance induction in adults and neonates cellular mechanism of immunological tolerance.

Termination of tolerance.

3) Human blood group systems A B O & Rh system

4) Interferon

Nature and types

Induction of Interferon

Antiviral action of IFN- α and IFN- β and Immunoregulatory action of IFN- γ

Applications.

UNIT – IV

9

1) Hypersensitivity – Basic concept

Gell and Coombs classification

i) Type I – Anaphylaxis

ii) Type II – Blood transfusion reactions and Hemolytic disease of the Newborn.

iii) Type III – Arthus reaction and serum sickness.

iv) Type IV – Delayed type hypersensitivity – Allergy of infection Allograft rejection.

v) Autoimmune disease :

Conditions that lead to autoimmune diseases.

Immunopathological mechanisms with example.

Treatment of autoimmune disease.

2) Vaccines : Active and Passive Immunization

3

Designing vaccines for active immunization

Live attenuated, Inactive, subunit, conjugate, DNA vaccines.

Section II : Clinical Microbiology

UNIT – I

Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by

- i) Mycobacterium leprae
- ii) Clostridium perfringens
- ii) Treponema pallidum
- iv) Streptococcus pneumoniae
- v) Leptospira interrogans (Leptospirosis)

UNIT – II

8

Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by

- i) Pseudomonas aeruginosa
- ii) Vibrio cholerae
- iii) Neisseria gonorrhoea
- iv) Helicobacter pylori

UNIT – III

9

Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by

- 1) Protozoa : i) Wucheria bancrofti (filarial)/ Plasmodium vivax (malaria)
- 2) Viruses :
 - i) Hepatitis A & B virus
 - ii) Rabies virus
 - iii) Chikungunya virus (CHIKV)
- 3) Fungi : i) Candida albicans

UNIT – IV

10

1) Introduction to chemotherapy

- a) General principles of chemotherapy
- b) Mode of action of Penicillin, Streptomycin, Bacitracin, Tetracycline and Chloramphenicol, Actinomycin D, Sulfonamides, Trimethoprim, Quinolones on microorganisms.
- c) Antiviral drugs : AZT
- d) Antifungal drug : Ketoconazole
- e) Mechanism of drug resistance
- f) Chemoprophylaxis

Books Recommended for Theory

PAPER – V

- 1. General Microbiology – Stanier

2. Microbiology – Prescott, Klein
3. Microbiology – Davis
4. General Virology – Luria
5. Genetics of Bacteria and their Viruses – William Hayes.
6. General Microbiology Vol. II – Powar and Dagainawala
7. Virology – Biswas and Biswas
8. Virology Vol. 4 Topley and Wilson
9. Genetics – Stickberger.
10. Genes – Benjamin Lewin IX ed.
11. The Fundamentals of Nitrogen fixation – Postgate
12. Principles of gene manipulation – Primrose and Old
13. Genetic Engineering – Second Ed. Desmond S. T. Nicholl
14. Recombinant DNA – J. D. Watson
15. Biochemistry – Lehninger
16. Molecular Biology of Gene – J. D. Watson
17. Principles of Genetics – Herskowitz
18. General Microbiology – Stanier

PAPER VI

1. Enzymology – Prise & Stevens
2. Enzymes – Biochemistry, Biotechnology, clinical chemistry by Trevor Palmer.
3. Enzymes – Dixon and Webb
4. Nature of Enzymology – R. L. Foster, Lehniger Principles of Biochemistry by David Nelson & Michale Cox, Fourth edition.
5. General Microbiology – Stanier
6. Principles & techniques of Biochemistry – Wilson & Walker and Molecular Biology 6th edition.
7. Principles of fermentation technology – Peter f. Stanbury & Allan Whitaker (pergamon Press).
8. Principles of Microbial technology – Peppler, Vol. I & II.
9. Industrial Microbiology – Casida
10. Industrial Microbiology – A. H. Patel
11. Industrial Microbiology – Prescott & Dnn
12. Industrial Microbiology – Miller
13. Pharmaceutical Microbiology – Huggo & Russel

14. Modern food Microbiology – Jay & Jay
15. Food Microbiology – Frazier

PAPER VII

1. Soil Microbiology – An exploratory approach - Mark Coyne.
2. Agricultural Microbiology - N. Mukherjee and J. Ghosh.
3. Introduction to Soil Microbiology – Martin Alexander IInd Edition.
4. Agricultural Microbiology – Rangaswamy and Bhagyaraj IInd 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. Environmental Pollution by Chemicals – Walker, Hulchiason.
10. Air Pollution – Stem
11. Biochemistry and Microbiology of Pollution – Higgins and Burns.
12. Environmental Pollution – Laurent Hodge, Holt.
13. Waste Water Treatment – Datta and Rao (Oxford and IBH)
14. Environmental Pollution.
15. Sewage and waste treatment – Hammer
16. Indian journal of environment protection Vol. 14 to No. 2, Feb. 1994. (112-117).
17. Pollution – Kudesia, Pragati Prakashan Meerat.
18. Environment Chemical Hazards – Ram Kumar (Swarup and Sons, New Delhi).
19. Elementary Petroleum Microbiology – Sharpley (Gulf Publishing Co. Texas).
20. Environment and Metal Pollution – Khan (ABD Pub. Jaipur).
21. Environment Pollution – Timmy Katyal (Satke Anmol Pub. New Delhi).
22. Ecology of Polluted Water – Vol. II – Anand Kumar (Aph Pub. Co. New Delhi).
23. Environment Pollution and Management of waste waters by Microbial Techniques – Pathade and Goel (ABD Pub. Jaipur).
24. Environmental Issues and Management – Nature Conservation, India – E. D. Das and Gupta Muzaffarnagar (2000).
25. Current Topics in Environmental Sciences – Tripathi and Pandey (ABD Pub. Jaipur).
26. Air Pollution – Rao and Rao.
27. Air Pollution – Kudesia (Pragati Prakashan Meerut).
28. Aerobiology – Tilak (Satyajeet Prakashan, Pune).

29. Environmental Impact Assessment – R. K. Trivedy.

PAPER VIII

- 1) Kuby Immunology – 6th Edition – Kindt, Goldsby, Osborne
- 2) Roits Essenstial Immunology 11th edition – Delves, Martin, Burton and Roitt.
- 3) Immunology An Introduction – Tizzard 4th edition
- 4) Immunology 5th edition : Richard A Goldsby, Kindt & Kuby
- 5) Basic and clinical Immunology 5th edition – Stites, Stobo, H. H. Fudenberg.
- 6) Microbiology – Davis
- 7) Immunology & serology – Ashim Chakravarty
- 8) Medical microbiology 16th edition by David Greenwood, Richard C B Slack, John Peutherer
- 9) Medical Bacteriology – Dey & Dey
- 10) Medical Bacteriology including Medical Mycology & AIDS – NC Dey & T. K. Dey

B.Sc. Part III : Microbiology Practical Course

Practical – I (Virology and Microbial Genetics)

Major :

1. Isolation of phages (coliphages) from sewage.
2. Effect of U.V. light on bacteria and graphical presentation of result.
3. Isolation of streptomycin – resistant mutants (gradient plate technique)
4. Isolation of Lac negative mutants of E. coli (visual detection method)
5. Isolation of auxotrophic mutants (replica plate technique)
6. Diauxic growth curve of E. coli – Glucose and Lactose

Minor :

1. Isolation of chromosomal DNA from bacteria (J. Marmurs method)
2. Electrophoretic separation of DNA.

Practical – II (Food and Industrial Microbiology)

Major :

1. Assay of amylase DNSA method (by graph)
2. Bio-assay of Vitamin B12
3. Bio-assay of Penicillin.
4. Microbial testing as per FDA standard
 - a) Water :
 - a. Presumptive, confirmed and completed test.
 - b. MPN
 - b) Soft drinks – SPC
 - c) Food – SPC

Minor :

1. Production of wine and examination for pH, colour and alcohol content.
2. Citric acid fermentation, recovery and estimation by titration.
3. Amylase production by Koji Culture method.
4. Isolation of lactic acid bacteria from fermented food.
5. Examination of milk by :
 - d) Direct microscopic count (DMC)
 - e) Quantitative phosphatase test.

Practical – III (Agricultural and Environmental Microbiology)

Major :

1. Isolation of Azotobacter from soil.
2. Isolation of Xanthomonas from infected citrus fruit.
3. Isolation of Rhizobium from root nodules.
4. Isolation of phosphate solubilising bacteria from soil.
5. Determination of BOD of sewage
6. Determination of COD of sewage.

Minor :

1. Estimation of available phosphorous from soil (Stannous chloride method)

2. Estimation of Calcium and Magnesium from soil (EDTA method)
3. Determination of organic carbon content of soil (Walkley and Black method)

Practical – IV (Immunology and Clinical Microbiology)

Major :

1. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics.
 - a) *Pseudomonas aeruginosa*
 - b) *Klebsiella pneumoniae*
 - c) *Candida albicans*

Minor :

1. Determination of sensitivity of common pathogens to antibiotics by paper disc method.
2. Serological tests :
 - a) Widal test – Quantitative
 - b) Rheumatoid arthritis factor detection
 - c) Demonstration of Enzyme Linked Immunosorbent Assay (ELISA)
3. Haematology :
 - d) Estimation of haemoglobin by Drabkin and Sahli's method.
 - e) Determination of ESR of the blood sample (westergren method)
 - f) Total and differential blood cells count.
4. Urine analysis
 - g) Microscopic examination of urine-crystals, RBCs, pus cells and bacteria.
 - h) Physical and chemical examination of urine.
 - i) Test for protein (Acetic acid test)
 - j) Test for ketone bodies (Rothra's test)
 - k) Test for bile salt and bile pigment.

Books recommended for Practical :

1. Medical Lab Technology – Ramnik and Sood, Jaypee brothers (Medical pub. New Delhi)
2. Practical Biochemistry – Plummer
3. APHA (American Public Health Association) Handbook
4. Soil, Plant and Water Analysis – P. C. Jaiswal

5. Biochemical methods – S. Sadasivam, A. Manickam
6. Practical Biochemistry – J. Jayraman
7. Chemical and Biological Analysis of Water – Dr. R. K. Trivedy and P. K. Goel.

Practical Examination

- A) The practical examination will be conducted on four (4) consecutive days for not less than 6 hours on each day of the practical examination.
- B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the least Two (2) places of Microbiological interest (Pharmaceutical industry, Dairy, Research institutes etc.) and submit the report of their visit at the time of examination.

The report should be duly certified by the Head of the Department.

List of the minimum equipments and related requirements for B.Sc.III

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| 1) Replica plating units of genetics experiments | : Two |
| 2) Rotary shaker for fermentation experiments | : One |
| 3) Centrifuge (High Speed) | : One |
| 4) Hot plate | : One |
| 5) Hot air oven | : One |
| 6) Bacteriological Incubator | : One |
| 7) Spectrophotometer | : One |
| 8) Research Microscope | : One for each student |
| 9) Haemocytometer | : Two |
| 10) Hamoglobinometer | : Two |

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| 11) ESR stands and tubes | : Two |
| 12) Separate room for fine instruments of size 10'x15' feet dimension | |
| 13) A separate culture room of at least 10' x 10' feet dimension | |
| 14) Electrophoresis assembly | : Two |
| 15) Laminor air flow cabinet | : one |
| 16) Distillation assembly | : One (Glass) |
| 17) Reflux assembly | : Four |
| 18) Serological Water bath | : One |
| 19) Colony counter | : One |
| 20) Refrigerator | : One |