

University of Poona

Syllabi for the Three-Year Integrated
B.Sc. Degree Course "85 Pattern"
Non-Semester Third Year B.Sc.

MICROBIOLOGY

(From June 1989)

PAPER V : MEDICAL MICROBIOLOGY

- I. Introduction to latinized medical terminologies. (2)
- II. Outline studies of following diseases (Causative agent, (20)
Host Species, Symptoms and Mode of Transmission)

Human Diseases :

1. Haemorrhagic enteritis
2. Recurrent fever
3. Meningitis
4. Gangrene
5. Plague
6. Whooping cough
7. Gonorrhoea
8. Typhus fever
9. Q-fever
10. Trypanosomiasis
11. Kala-azar
12. Sistosomiasis
13. Herpes
14. Measles and German Measles
15. Small pox and Chicken pox
16. Viral diarrhoea
17. Mumps
18. Common cold
19. AIDS

Veterinary Diseases :

1. Rinderpest
2. Rota viral diarrhoea
3. Vesicular stomatitis
4. Brucellosis
5. Salmonellosis
6. Ranikhet
7. Marek's Disease
8. Distemper
9. Mastitis

III. Detailed study of following Human and Veterinary Diseases. (30)

1. Haemorrhagic septicaemia in Cattle
2. Influenza
3. Poliomyelitics
4. Hepatitis (A and B)
5. FMD
6. Rabies
7. Dermatophytosis
8. Amoebiasis
9. Malaria

IV. Detailed study (Classification, Culture and Biochemical Characters, Antigenic structure, viability pathogenic pathogenesis, clinical & laboratory diagnosis, Epidemiology, Prophylaxis Chemotherapy) of following causative agents. (35)

1. Staphylococci
2. Streptococci
3. *Pseudomonas aeruginosa*
4. *Escherichia coli*
5. Treponema (Venereal and nonvenereal)
6. *Mycobacterium tuberculosis*, *M. leprae*
7. *Clostridium tetani*
8. *Corynebacterium diphtheriae*

V. Introduction to Chemotherapy:

1. General Principles of Chemotherapy
2. Mode of action of following :
 - (a) Penicillin
 - (b) Streptomycin, Tetracyclin, Puromycin
 - (c) Polyoxin
 - (d) Rifamycin, Actinomycin
 - (e) Griseofulvin, Nystatin
 - (f) Sulfonamide, PAS, Trimethoprim.
3. Biochemistry of drug resistance, for the above.

Term End Topics I, II, III

List of Books :

PAPER V : MEDICAL MICROBIOLOGY

1. Davis : *Microbiology* (Maryland; Harper and Row, 1980)
2. Dey, N. C and Dey, T. K. : *Medical bacteriology* (Calcutta, Allied publishers, 1978)
3. Dey, N. C. and Dey, T. K. : *Medical parasitology* (Calcutta, Allied publishers, 1981)
4. Jawetz Ernest, *Review of Medical Microbiology* (Tokyo : Lange Medical, 1974)
5. Cruickshank K. R., *Medical Microbiology*, Vol. 1 (1976), Vol. 2 (1982) (Livingstone, Longman)
6. Burrows, William : *Textbook of Microbiology*, (Philadelphia : W. B. Saunders, 1973)
7. Zinsset, W. : *Microbiology* (Ed. W. K. Joklik New York : Appleton Century Crofts, 1976)
8. Todd, Sanford : *Clinical diagnosis and management by laboratory methods* (Philadelphia, W. B. Saunders, 1979)
9. Dorland's Pocket *Medical Dictionary* (New Delhi, Oxford and IBH, 1969)
10. Ananthanarayan, R. and C. E. Jayaram Paniner : *Textbook of microbiology* (Bombay : Orient Longman, 1986)

11. Emmons, C. W. : *Medical mycology* (Philadelphia, Lea and Febiger, 1970)
12. Franklin, T. J. and Snow, G. A. : *Biochemistry of antimicrobial action* (London : Chapman and Hall, 1981)
13. Smith and Jones : *Veterinary Pathology*
14. Smith and Shastri : *Veterinary Pathology*
15. Doxey, D. L. : *Veterinary Clinical Pathology*
16. Packer M. : *Veterinary Bacteriology and Virology*
17. Jobb-Kennedy : *Pathology of Domesticated Animals*
18. Buxton and Fraser : *Animal Microbiology*
19. Smith : *Veterinary Pathology*

PAPER VI : INDUSTRIAL MICROBIOLOGY

- I. Basics of Fermentation Technology : (4)
 1. Strain improvement :
Technique with suitable examples.
 2. Fermentation media : (5)
 - (a) Raw materials- screening of media, pretreatment and sterilization of media.
 - (b) Buffers and antifouling agents.
 - (c) Control of contamination in fermentations.
 3. Scale up of fermentation process. (2)
 4. General methods of recovery of fermentation products : (10)
 - Centrifugation
 - Flocculation
 - Filtration
 - Solvent extraction
 - Adsorption and elution
 - Distillation
 - Precipitation
 - Crystallization
 - Ion-exchange resins

5. Estimation of fermentation products : (8)
Physical, chemical and biological methods.
6. Quality control in fermentation industry : (5)
Assay
Sterility testing
Pyrogen testing
Toxicity testing
Carcinogenicity testing
Allergy testing
7. Process Economics :
Cost of raw materials, cost of process related to yield of compound, batch loss and depreciation.

II. Biofertilizers :

(Azotobacter, Rhizobium and Blue-green algae).

Production, methods of application and comparison with chemical fertilizers.

III. Fermentation Process :

Large scale of production of :

Beer and Wine

Penicillin, Semisynthetic penicillins and Streptomycin

Acetone, butanol and 2-3 butanediol

Vitamin B₁₂

Citric acid and Lactic acid

Amylases and Proteases

Lysine and Gultamic acid

IV. Biogas Technology :

(a) Raw materials

(b) Organisms involved and their activity

(c) Cultivation of methanogens

(d) Biochemical mechanisms of gas production

(e) Different designs of biogas plants

(f) Applications of Biogas

Term end Topics I and II

*List of Books :***Paper VI : Industrial Microbiology**

1. Casida, L. E. : *Industrial Microbiology* (New Delhi : Wiley eastern, 1984)
2. Miller, Brinton, M. : *Industrial microbiology* (New York : McGraw Hill, 1976)
3. Pepler, H. J. Ed. : *Microbial technology*, Vol. 1 and 2, (New York : Academic Press, 1979)
4. Stanbury, Peter F. and Whitaker Allan, : *Principles of fermentation technology* (New York : Pergamon, 1984)
5. Aiba, Shuichi : *Biochemical Engineering*, 2nd ed. (New York : Academic Press, 1973)
6. Prescott, S. C. and Dunn, C. G. : *Industrial Microbiology* (Ed. by Gerald Reed, USA : AVI Tech, books 1983)
7. Riviere, Jacques : *Industrial applications of microbiology* (London : Surrey University Press, 1977)
8. Wiseman, Alen : *Handbook of enzyme biotechnology* : (New York : Ellis Harwood, 1987)

PAPER VII : MICROBIAL METABOLISM**I. Microbial Enzymes :**

1. Concept of active site, commonly occurring amino acids at active site. (2)
2. Principles of enzyme purification, methods used for purification, Criteria of enzyme purity. (3)
3. Characterisation of enzymes—optimum temperature, pH, thermostability, molecular weight. (5)
4. Principles of measurement of enzyme activities, enzyme assays with suitable examples. (4)
5. Kinetics—Derivation of initial velocity equation by Michaelis-Menten and Brigg's-Haldane approaches, Definition and significance of K_m , K_s and V_{max} , Methods of plotting kinetic data, competitive, Non competitive, and uncompetitive inhibitions. (10)

6. Regulation : Feedback inhibition, feed back repression, enzyme compartmentation, regulation by covalent modification of enzymes, isoenzymes, allosteric enzymes, proteolytic modification. (10)

7. Enzyme cofactors : Vitamins as cofactors and metallo-enzyme. (6)

8. Immobilised enzymes : (3)

(a) Methods of immobilisation of enzymes.

(b) Methods of immobilisation of whole cells.

(c) Applications of immobilised systems.

II. Bioenergetics : (15)

Laws of thermodynamics. Free energy, Entropy, Electron transport chain, its types and components, High energy compounds, ATP structure and ATP formation (substrate level phosphorylation, oxidative phosphorylation, theories of ATP formation) Bioluminescence.

III. Energy Yielding Pathways : (10)

Detailed study of central energy yielding pathways. (with chemical formulae and structure of compounds).

1. EMP, ED, Pentose Phosphate pathways, TCA (Pathway, enzyme involved, ATP yield, key reactions of pathway).

2. Concept of amphibolism.

3. Relation of degradation of fatty acids, amino acids and nucleotides to central energy yielding pathways.

IV. Photosynthesis : (5)

Photosynthetic apparatus, Bacterial photosynthesis, cyclic and noncyclic photophosphorylation, Calvin cycle and other CO₂ fixation pathways, comparative account of plant and bacterial photosynthesis.

V. Nitrogen Fixation : (5)

Biochemistry of biological Nitrogen fixation with reference to *Rhizobium*, *Azotobacter* and *Clostridium*.

VI. Biosynthesis : (10)

Proteins, Nucleic acids, Polysaccharides, Lipids.

(As per dealt with in General Microbiology, R. Y. Stanier)

Term end Topics I

• *List of Books :*

Paper VII : Microbial Metabolism

1. Conn, Erric, C. and Stumpf, P. K. : *Outlines of biochemestry* (New Delhi, Wiley eastern, 1976)
2. Lehinger, Albert L. : *Biochemistry* (New Delhi, Kalyani, 1983)
3. Mandelstam J. and McQuillen, K. Ed. : *Biochemistry of bacterial growth* (London : Blackwell Scientific Publicatio) 1976)
4. Subba Rao, N. S. Ed. : *Recent advances in biological nitrogen fixation* (New Delhi : Oxford and IBII, 1979)
5. Palmer, Trevor : *Understanding enzymes.*
6. Engel, P. : *Enzyme kinetics* (London : Chapman and Hall, 1981)
7. Cohen P. : *Control of enzyme activity.*
8. Lehinger, A. L. : *Bioenergetics.*

PAPER VIII : CLINICAL PATHOLOGY AND IMMUNOLOGY

I. Clinical Pathology :

1. Basic concepts of human physiology in relation to urine, blood, faeces, CSF formation. (4)
2. Haematology—Circulatory system, formation and cytology of blood cells, biochemistry of haemoglobin. Haematological disorders—anaemia, leukaemia, abnormal haemoglobin, blood clotting—haemophilia. (1⁶)
3. Kidney function—Normal structure and function of kidney, kidney function tests and their diagnostic value. (3)
4. Liver function—Normal structure and function of liver, bilirubin metabolism, disorders of liver and their diagnosis. (4)
5. Structure of meninges, formation and functions of C.S.F., C.S.F. examination and its diagnostic value. (2)
6. Histopathological techniques—slide preparation techniques. (6)

7. Biochemical disorders—Diabetes mellitus, Hyperlipaemia Phenylketoneurea and their diagnosis. (6)
8. Blood grouping (ABO and Rh), methods of blood grouping, blood banking, forensic applications, Rh-incompatibility (HDN). (10)

II. Immunology :

1. Antigen : Definition and concept of immunogen, factors affecting immunogenicity, hapten, carrier, determinant site. (6)
2. Immunoglobulins; Structure, classification, theories of antibody formation, primary and secondary response, suppression and tolerance. (10)
3. Serological methods—Agglutination, precipitation, complement fixation test, electrophoretic and gel diffusion techniques, immunofluorescence, radio immunological techniques, ELISA. (10)
4. Other protective mechanisms—Inflammation and healing, Interferon, Complement system. (5)
5. Immunological apparatus—thymus, spleen and lymph nodes. (2)
6. Cells involved in immunity : morphology, formation and functions of macrophages and microphages, mast cells, T and B lymphocytes, plasma cells. (10)
7. Cell mediated immunity. (2)
8. Immune tissue damage : hypersensitivity (Types I to V). Tissue transplantation immunity. (5)
9. Public Health Immunology : (4)
 - (a) Vaccines and Toxoids; types, production, administration schedule in India.
 - (b) Immune sera.
types, production and uses.
 - (c) Quality control of vaccines and sera.
10. Introduction to Monoclonal antibody technique. (7)

For Term End Unit I

*List of Books***Paper VIII : Clinical Pathology and Immunology**

1. Roitt, Evan M. : *Essential immunology* (New Delhi, PPG, publishing, 1984)
2. Weir, D. M. : *Immunology* (Livingston : ELBS and Churchill, 1983)
3. Stites, Daniel P. and Freudenberg : *Basic and clinical immunology* (California : Lange medical, 1982)
4. Bowry, T. R. : *Immunology simplified* (London : ELBS and Oxford University Press, 1984)
5. Hokama
6. Bellanti, Joseph, *Immunology.*
7. Humphery, J. and White : *Immunology for students of medicine.*
8. Hyde and Patnode, *Immunology.*
9. Hood, L. E., Weissman, I. L. and others. *Immunology* (Benjamin Publishers Co.)

PAPER IX : MICROBIAL GENETICS

(Based on Historical accounts and Experimental proof)

L Mutation : (12)

1. Selection and Detection of Mutants based on
 - (a) Relative growth
 - (b) Relative survival
 - (c) Visual detection)
2. Mutation Rate.
Mutation Frequency, Reversion, Suppression.
3. Complementation.

(I). Recombination : (16)

Transformation, Transduction (Generalised and Restricted)
 Conjugation, Sex factor and its Role in conjugation.
 Bacterial chromosome mapping (interrupted mating-experiment, cotransformation and cotransduction).

III. Phage Genetics : (18)

1. One step growth curve, Doerman's experiment for eclipse period.
2. T₄ Phage Mutants : Mutants, Plaque morphology, Host range, cofactor requiring, Acriflavin resistance, Defective lysozyme.
3. T₄ DNA recombination mapping, head protein mutants, (Phage-lytic and lysogenic cycle) plaque morphology mutants and deletion mutants.

IV. Operon Regulation : (10)

Concept of Operon

Positive and negative operons, Lactose operon, Arabinose operon.

V. Extra Chromosomal Inheritance : (16)

1. Plasmid-Definition, types and properties, isolation, plasmid borne characters. Applications of plasmids, Chimaeric plasmids.
2. Kappa particles, Poky and Petit Mutants, Extranuclear inheritance in *Aspergillus*.

VI. Genetics of Streptomyces : (4)

Techniques used for demonstration of heteroclone formation, Four on Four technique. SCP₁, SCP₂ plasmids and heterokaryons. (20)

VII. Genetics of Fungi :

1. Elementary knowledge, Meiosis, Mitosis, Mendel's laws, Heterokaryon formation.
2. Fertility types, tetrad analysis (Neurospora).
3. Parasexual cycle, Heterokaryon (*Aspergillus*).
4. Protoplast fusion, Polyploidy (Yeast).

Term End Topics I, II and III.

*List of Books***PAPER IX : MICROBIAL GENETICS**

1. Stanier, Roger (et al) : *General Microbiology* (London : Macmillan, 1976)
2. Hayes, William : *Genetics of bacteria and their viruses*, (Delhi : CBS, 1984)
3. Luria, S. E. (et al) : *General virology* (New York : John Wiley, 1978)
4. Bainbridge, Biran A. : *Genetics of microbes* (London : Blackie, 1980)
5. Fincham, J.R.S. : *Microbial and molecular genetics* (London : English University Press, 1965)
6. Fincham, J.R.S. : *Fungal Genetics*.
7. Strickberger, Montoe, W. : *Genetics* (New York : McMillan, 1976)
8. Esser, K. : *Genetics of Fungi*.
9. Herskowitz, Irwin H. : *Principles of genetics* (New York : Macmillan, 1977)
10. King : *Handbook of genetics*.
11. Norris and Ribbons, Ed. : *Methods in microbiology*, Vol. 78. (London : Academic Press, 1972)
12. Levy, J. and Campbell, J. : *Companion to microbiology*, Vol. I and II.
13. Stent, Gunther S. : *Molecular genetics* (San Fransisco : W.H. Freeman, 1971)

PAPER X : APPLIED AND ENVIRONMENTAL MICROBIOLOGY

1. Dairy Microbiology : (18)
 1. Milk
 - (a) Definition and composition
 - (b) Types of milk
skimmed, toned, whole

2. Microbiological analysis of raw milk

- (a) Milk flora
- (b) Dye reduction test
- (c) Standard plate count
- (d) MPN for coliform
- (e) Test for mastitis
- (f) Brucella ring test

3. Pasteurization of Milk

- (a) Pasteurization
LTH, HTST and UHT
- (b) Efficiency of pasteurization

4. Spoilage of milk

Succession of microorganisms in Milk; Color and flavour defects, sweet curdling, stormy fermentation, ropiness.

II. Food Microbiology :

(30)

1. Food spoilage

- (a) Chemical and physical properties of food affecting microbial growth (pH Water activity redox potential, nutrients, antimicrobial compounds, biological structure)
- (b) Sources of spoilage microorganisms and their role.
- (c) Types of spoilage.

Change in flavour, color and in other properties of food. Degradation of proteins, carbohydrates and fats.

2. Preservation of food : Principles of food preservation.

3. Microbial food poisoning and food Infection.

4. *Clostridium botulinum**Bacillus cereus**Clostridium perfringens*Aflatoxin (B₁, B₂, G₁, G₂)Food infections (*Salmonella*, *Vibrio*)

5. ISI standards for preserved foods.
6. Fermented foods.
 - (a) Organisms and their role in preparation of Idli, curd and cheese.
 - (b) Process defects and spoilage of above mentioned fermented foods.
 - (c) Advantages of above fermented foods.

III. Agricultural Microbiology : (30)

1. Types of soil and Soil microorganisms.
 Different components of soil, organic matter, mineral matter, water, gases, biological systems, flora and fauna of soil, diversity of flora with soil composition, Rhizosphere microflora, Role of microorganisms in soil fertility; composting and humus formation.
2. Biochemical cycles.
 - (a) C, N, S, P cycles.
 - (b) Cellulose, hemicellulose and lignin degradation.
 - (c) Symbiotic and non-symbiotic nitrogen fixation.
3. Plant pathology
 - (a) Classification of plant diseases based on symptoms—Canker, Mildew (Powdery and downy), Rust, Smuts, Wilts, Spots, Mosaic, Galls, Rots.
 - (b) Epidemiology of plant diseases.
 - (c) General methods of plant disease control :
 Eradication, chemical and Biological control.
 - (d) Study of plant diseases with respect to causative agent, symptoms, mode of transmission prevention and control :
 Citrus canker
 Black stem rust of Wheat
 Downy mildew of Grapes.
 Head smut of Jawar

Whip smut of Sugarcane
 Tikka disease of Groundnut
 Ergot of Bajra
 Wilt of Cotton
 Soft rot of Potato
 Papaya mosaic

IV. Environmental Microbiology : (18)

1. Geomicrobiology :
 - Scope of geomicrobiology
 - Microbial leaching and beneficiation of ore
 - Copper and manganese leaching
 - Laboratory process
 - In situ* leaching
2. Sewage and waste Water :
 - (a) Domestic and Industrial Waste
 - (b) Composition, COD and BOD-determination and their significance
 - (c) Different methods of sewage treatment
3. Water Pollution :
 - (a) Organic and inorganic pollution. Organic matter-phenolics, Oil, grease, inorganic metals, phosphates, nitrates
 - (b) Eutrophication, Biomagnification, Homeostasis
 - (c) Health hazards due to above agents

Term End Exams Topic I, II

List of Books

PAPER X : APPLIED AND ENVIRONMENTAL MICROBIOLOGY

1. De, S. : *Dairy bacteriology*.
2. Eckles, C. H. and Macy, Combes : *Milk and Milk products*. (Bombay : Tata McGraw Hill, 1979)
3. Frazier, W. C. and Westhoff, D. C. : *Food microbiology* (3rd ed. New Delhi, Tata McGraw Hill, 1978)

4. Jay, James M. : *Modern food microbiology*. (New York : D. Van Nostrne, 1978).
5. Banawart : *Basic Food Microbiology*.
6. Alexander, Martin : *Intro. to soil microbiology* (New York : John Wiley, 1977)
7. Subba Rao, N. S. : *Soil microorganisms* (New Delhi : Oxford, IBH, 1977)
8. Dube, H. C. and Bilgrami, K. S. : *Textbook of modern plant pathology* (New Delhi : Vikas Pub. house, 1976)
9. Mundkur, B. B. : *Fungi and Plant disease* (London : Macmillan, 1949)
10. Rangaswamy, G. : *Diseases of crop plants in India* (New Delhi: Prentice Hall, 1972)
11. Zajic, J. E. : *Water pollution* (New York : Marcel Dekker, 1972)
12. Mitchell, Ralph : *Intro. to environmental microbiology*, (New Jersey, Prentice Hall, 1974)
13. Hammer : *Sewage and waste treatment*.
14. Rhodes and Fletcher *Principles of Industrial Microbiology*.

PRACTICAL COURSE I

Clinical Pathology and Biochemistry :

- I. Urine examination—microscopic, chemical and physical examination.
- II. Stool examination—macroscopic and microscopic examination, occult blood test.
- III. Sputum examination—Gram staining, Leishman's staining and Acid fast staining.
- IV. Blood examination :
 1. Haematology :
 - (a) Haemoglobin estimation
 - (b) Total leucocyte count
 - (c) Total erythrocyte count
 - (d) Platelet count
 - (e) ESR, PCV, indices

2. Blood smear examination—Differential Count, RBCs and WBCs
3. Clinical biochemistry :
 - (a) Blood sugar estimation
 - (b) Blood urea estimation
 - (c) Serum cholesterol estimation
 - (d) Serum bilirubin estimation
 - (e) SGPT estimation
 - (f) SGOT estimation
 - (g) Serum protein estimation
- V. ELISA technique— (use Nanchy kit)
- VI. Amylase assay
- VII. Determination of molar extinction coefficient
- VIII. Demonstration of permanent slides :
 1. *Entamoeba histolytica*
 2. *Ascaris* spp.
 3. *Giardia* spp.
 4. *Trichuris* spp.
 5. Hookworm
 6. Malarial parasite

PRACTICAL COURSE 2

General Microbiology and Serology

I. Clinical Bacteriology :

Isolation and identification of following organisms from respective pathological sample :

1. *Staphylococcus aureus*
2. *Streptococcus faecalis*
3. *Salmonella typhi*, *S. paratyphi A* and *S. paratyphi B*.
4. *Shigella* spp.
5. *Escherichia coli*
6. *Proteus vulgaris*
7. *Candida albicans*
8. *Pseudomonas aeruginosa*

II. Agricultural Microbiology :

1. Isolation and identification
 - (a) *Azotobacter* sp.
 - (b) *Rhizobium* sp.
 - (c) *Xanthomonas citri*
 - (d) *Cercospora* sp. (Tikka disease of groundnut)
2. Preparation of biofertilizer
3. Cultivation of fungi and growth measurement
4. Cultivation of actinomycetes
5. Slide culture technique

- III.
 1. Determination of MIC by tube dilution technique
 2. Antibiotic sensitivity test

IV. Serological techniques :

1. Blood grouping and cross matching
2. VDRL test
3. Immunoprecipitation
4. Widal agglutination test (Double dilution technique)
5. Agglutination inhibition (Use Gravindex)

PRACTICAL COURSE 3**Applied Microbiology :**

- I. Estimation of DO and BOD
- II. Measurement of Cell Size by micrometry
- III. Isolation and enumeration of bacteriophage
- IV. U. V. Survival Curve
- V. Isolation of mutants by replica plate technique
- VI. Anaerobic cultivation technique
- VII. Enrichment of following organisms :
 1. Nitrifying bacteria
 2. Cellulose degraders
 3. Iron oxidizers
 4. Sulphate reducers

- VIII. Screening of industrially important organisms :
1. Antibiotic producers—crowded plate technique
 2. Organic acid producers
- IX. Production, recovery and estimation of Citric acid
- X. Microbiological assays of :
1. Streptomycin
 2. Penicillin
 3. Vitamin B₁₂
- XI. Paper chromatography technique
- XII. Determination of fat content and specific gravity of milk
- XIII. Microbiological analysis of milk :
1. DMC
 2. Dye reduction tests
 3. Phosphatase test
 4. Test for Mastitis
- XIV. Total viable count of bacteria, yeasts and molds from Soil/
Milk/Food
- XV. Isolation and identification of lactic cultures from fermented
food (Genus level only)
- XVI. Determination of TDR

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