

SOLAPUR UNIVERSITY SOLAPUR
Ph.D. THEORY COURSE WORK
IN
MICROBIOLOGY
COURSE STRUCTURE

There shall be THREE theory papers each of 100 marks. The first two papers i.e. Paper I and Paper II will be compulsory whereas a student shall have to select any one Paper from amongst three elective papers provided for paper III

1. Paper – I (compulsory): Research Methodology and Information Communication Technology (common Paper to all Faculties) -100 marks
2. Paper II (compulsory) Recent Trends in Microbiology - 100 marks
3. Paper – III (Elective) Advanced Developments in Microbiology -100 marks

The paper- III will have following Electives. Candidate may choose any one Paper.

A) Paper – III (Elective) Advanced Developments in Microbiology
(Medical Microbiology and Immunology)

OR

B) Paper – III (Elective) Advanced Developments in Microbiology
(Environmental and Agricultural Microbiology)

OR

C) Paper – III (Elective) Advanced Developments in Microbiology
(Microbial Technology and Fermentations)

Theory Component: Total Marks 300 marks

Solapur University, Solapur
Ph.D. Course Work Syllabus
Common Paper for Faculty of Science
(w.e.f. June 2014)
Paper No.I: Research Methodology and ICT

1. Scientific Method:

Block schematic of scientific approach, inductive and deductive logic schemes, imperial basis of laws, theory, hypothesis, deductive system, requirements of theory, dynamics of theory construction, rational explanation, scientific explanation, limits of scientific explanation.

2. Formulation of Research Problem:

Criteria of good research, types of research, significance, literature review, purpose, process of literature review, analysis of an article, search engine, formulation of research problems, accuracy of definition, objectives of research, research design, preparation of research article and thesis.

3. Process of Research:

Definations of problem, planning of experiments, data collection and record keeping, results and discussions, presentation of research outcome as a research paper or filing patent.

4. Research Publications and Quality:

Indices, publications, types, Impact factor, calculation of Impact Factor, uses, calculation of immediacy Index, calculation, SCOPUS, h – index, advantages, criticism ISSN, ISBN.

5. ICT:

Various search engines available on internet, normal vs advanced search, key – words, formulation of search statement, Listing various journals in relevant topic, Science abstracts, e – database.

Application of Computers in research, internet browsing, tool bar options, provisions of MS – word, MS – Excel, MS – PowerPoint, Origin.

6.Fundamentals of Data Analysis and Statistical Methods: Types of data and various methods of data collection, Framing of questionnaires, various sampling methods. Statistical techniques for analyzing data: Measures of central tendency, measures of dispersion, measures of asymmetry (Skewness), measure of relationship, simple regression analysis, testing of hypotheses, chi- square test, analysis of variance (ANOVA) and Covariance (ANCOVA).

Reference Books:

1. Research Methods - Ram Ahuja, Rawat Publications
2. Philosophy of Science – Mario Bunge, Transaction Publishers
3. Research Methodology - Methods and Techniques, C. R. Kothari New Age
4. Fundamentals of Statistics - Goon, Gupta and Das Gupta (Vol. I & Vol. II)

PAPER II: Recent Trends in Microbiology

1. Analytical Instrumentation - I

Basic concepts, UV/ Visible Spectroscopy, Atomic Absorption Spectroscopy, NMR, IR, Gas chromatography- GCMS, MSMS.

2. Analytical Instrumentation - II

X-ray Crystallography, Fluorescence Spectroscopy, Measurement of radioactivity-GM counter, Scintillation counting methods, Applications of radioisotopes in biology, Autoradiography.

3. Chromatographic Techniques

Basic concept, Thin Layer Chromatography, Gel filtration, Ion exchange, Affinity & High Performance Liquid Chromatography.

4. Separation Techniques

Centrifugation -preparative & analytical, Ultracentrifugation, Density gradient centrifugation. Electrophoresis- principle, types, applications of PAGE (proteins), Agarose (nucleic acid), Pulse field gel electrophoresis (PFGE), SDS- PAGE, DGGE.

5. Recombinant Techniques

Restriction mapping-RFLP, Cloning strategies, DNA sequencing – manual & automated methods. Southern, Northern, Dot blotting & Hybridization, Polymerase chain reaction-principle, types & applications. Single locus & Multilocus DNA fingerprinting, PCR based DNA fingerprinting –RAPD, AFLP, STRR, & LTRR analysis.

6. Recent advances in bacterial taxonomy

Polyphasic taxonomy, Phylogenetic backbone & Taxonomic framework for prokaryotic systems, 16-s r-RNA gene sequencing, Fingerprinting, Lipid profiling- FAME analysis.

BOOKS RECOMMENDED

1. Bergey's Manual of Systematic Bacteriology (2nd Ed.), Volumes 1 to 4 Springer
2. The Search for Bioactive Compounds from Microorganisms by S. Omura
3. Continuous Culture (Vol. 8) by A. C. R. Dean, D. C. Ellwood and C. G. T. Evans
4. Annual Reviews in Microbiology Volumes 46 & 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds)
5. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante.
6. Advances in Applied Microbiology volumes 6, 10, 17 by D. Perlman and Umbreit (eds)
7. The Physiology and Biochemistry of Prokaryotes by D. White.

A) Paper – III (Elective) Advanced Developments in Microbiology (Medical Microbiology and Immunology)

1. Bacteriology: Morphology, Cultural characteristics, Pathogenicity and Laboratory diagnosis of major bacterial pathogens- *Staphylococcus aureus*, *Bacillus anthracis*, *Corynebacterium diphtheriae*, *Cl. tetani*, *Mycobacterium tuberculosis*, and *Leptospira lacterohaemorrhagiae*, *E. coli*, *Salmonella spp*, *Shigella spp*, *Pseudomonas spp*, *Vibrio cholerae*, and *Neisseria spp*.

2. Virology: general properties of human viruses, Pathogenicity and laboratory diagnosis of viral infections- Hepatitis, Polio, Rabies, Influenza, Measles, Mumps, Rubella, Dengue virus, HIV and Ebola virus.

3. Mycology: General properties, pathogenicity and laboratory diagnosis of infections Cryptococcosis, Maduramycosis, Histoplasmosis, Candidiasis

4. Parasitology: Pathogenicity and Laboratory diagnosis of *Entamoeba histolytica*, *Taenia solium*, *Plasmodium vivax*, *Wucheraria bancrofti*, *Enterobius vermicularis* and *Trichomonas vaginalis*.

5. Immunology: Immunoprophylaxis and Immunotherapy, Regulation of Immune response, Interleukins, Interferon and Lymphokines: synthesis and regulation, recent developments in Monoclonal antibody technology; clinical intervention of monoclonals, Recent Advances in Serological diagnosis.

6. Antimicrobial susceptibility testing: Susceptibility testing of fastidious bacteria, Susceptibility testing of anaerobic bacteria and Special phenotypic methods for detecting antibacterial resistance, Genetic methods for detecting antibacterial and antiviral resistance gene

BOOKS RECOMMENDED

1. Microbiology in the Health Sciences and Diseases by R. Fuerst
2. Immunology – A Short Course by Benjamin and others Wiley – Liss Inc.
3. Immunology by Roitt. Published by Mosby
4. Lecture notes on Epidemiology and Community Medicines by Farner and Miller
5. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
6. Handbook of Practical Immunology by D. W. Weir Volumes 2 & 3
7. Basic and Clinical Immunology by Stites and others (eds).
8. Mechanisms of Microbial diseases by M. Schwachter, G. Medoff and D. Schlessinger. Williams and Wilkins.
9. Mycoplasmas by J. Maniloff (ed). American Society for Microbiology
10. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
11. Medical Bacteriology and AIDS by N. C. Dey and T. K. Dey

B) Paper – III (Elective) Advanced Developments in Microbiology (Environmental and Agricultural Microbiology)

- 1. Industrial waste:** Types of wastes- solid and liquid wastes, general Characteristics of wastes, Microorganisms in waste water Technology: sources of microorganisms, Enrichment, acclimatization and isolation, mass scale production, mixed cultures and preservations, Characteristics and treatment of waste generated by: Tannery, Textile, antibiotic and Dairy wastes, Waste disposal control and regulations: Regulation and limit for disposal of waste into river, oceans and lakes, EIA and EA.
- 2. Effluent treatment systems:**
 - a.** Sewage and waste water treatments systems. Primary, secondary and tertiary treatments. Measurement of treatment efficiencies. .Biological treatments- aerobic versus anaerobic treatments.
 - b.** Biofilms in treatment of waste water: Biofilm development and biofilm Kinetics. Aerobic Biofilms.
 - c.** Bioreactors for waste water treatments: Reactors types and design. Reactors in series. Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment.
 - d** Recent advances in Microbiological waste treatment methods -a. Activated Sludge Process b. Trickling filters c. Anaerobic sludge digestion d. Root zone technology
 - e.** Microbial biosorption technology f. Mass scale production of Effective Microorganisms (EM) for waste treatment. g. Economics of waste treatment
- 3. Bioremediation-** Concept of Bioremediation, Biogeochemical cycles, Bioremediation of organic compounds, Bioremediation of heavy metal and xenobiotic compounds, In situ and Ex situ bioremediation, constrains and priorities of bioremediation, Evaluating Bioremediation, Molecular biotechnological techniques used in bioremediation
- 4. Bioinoculants:** Preparation and applications of biofertilizers: Azotobacter, Rhizobium, Cyanobacteria, Phosphate solubilizers. Biopesticides- Bioinsecticides, Bioherbicides and their application to agriculture.
- 5. Plant Pathology:** Epidemiology of plant diseases and Biological control of soil borne plant pathogens
- 6. Microbiology of the Extreme Environment:**
 - a.** Hot springs, acid springs and lakes
 - b.** Microbial life in hyper saline environments – ecophysiological aspects, sea and salt lakes.
 - c.** Microbial life at low temperatures
 - d.** Microbiology to 10,500 meters under the deep sea.
 - e.** Anaerobic Microorganisms – ecophysiological aspects, principles and techniques for the isolation, enumeration and identification of Methanogens, Dissimilatory Sulphate reducing and Anoxygenic Phototrophic bacteria

BOOKS RECOMMENDED

1. Chemistry and Biochemistry of Biological Nitrogen Fixation by J. R. Postgate. Plenum Press
2. Biofertilizers by L. L. Somani and others. Scientific Publishers, Jodhpur
3. Plant Pathology by J. C. Walker
4. Plant Diseases by R. S. Singh
5. Microbial Ecology by J. M. Lynch
6. Annual Reviews in Microbiology Volumes 46 & 49 by L. N. Ornston, A. Balows and

- E. P. Greenberg (eds). Academic Press
7. Microbes in Extreme Environments by D. J. Kushner
 8. Anaerobes by Shapton. Academic Press
 9. Microbiological Aspects of Anaerobic Digestion – A Laboratory Manual by D. R. Ranade and S. V. Gadre (eds) Agharkar Research Institute, Pune.
 10. Microbiological Aspects of Pollution Control by Dart and Stretton. Surabhi Publishers, Jaipur
 11. Treatment of Industrial Effluents by Callely, Forster and Stafford (eds). Hodder and Stoughton, London
 12. Water Pollution Microbiology by R. Mitchell, Volumes 1 and 2.
 13. Critical Efforts in Applied Chemistry, Vol.II – Topics in Wastewater Treatment by J. M. Sidwick (ed.). Blackwell Scientific Publishing
 14. Industrial Wastewater Treatment by M. N. Rao and R. L. Datta.

C) Paper – III (Elective) Advanced Developments in Microbiology (Microbial Technology and Fermentations)

1. Fermentation- Design of Basic Fermentor/Bioreactor, Types of bioreactors, Computer Control of fermentation process.

Mass transfer in reactors: Transport phenomenon in bioprocess system- mass transfer, heat transfer, oxygen transfer, critical oxygen concentration.

Sterilization of media and air: design of sterilization process (batch and continuous), Sterilization of bioreactors, nutrients, air, products and effluents.

2. Downstream processing- Biomass separation by centrifugation, filtration, flocculation and other recent developments. Recovery of intracellular components- Mechanical and nonmechanical (chemical and enzymatic) methods. Methods for extraction and purification of product. Product formulation- principles and equipments, crystallization Drying, use of different dryers and lyophilization.

3. Enzyme Technology: Commercial production of Enzymes, Immobilization of Enzymes and Cells, Therapeutic applications of Immobilized enzymes; Microbial production of enzymes- Cellulose, Lipase, *Taq* polymerase and restriction endonuclease.

4. Microbial Products: Single Cell Protein- Chlorella, Spirulina, Yeasts, Mushrooms, Economic implications of SCP; Production of Wine, Vinegar and Alcohol.

5. Biotransformation: Types, sources of biocatalysts, techniques of Biotransformation, Product recovery, Biotransformation of steroids, antibiotics.

6. Applications of Microbial Technology: Biosensors- Types and Applications; Fermentative production of Cephalosporins and Tetracyclines; Biosynthesis of Insect Pheromones and Ergot alkaloids; Microbiology and production of Lactic Starter Culture Concentrates

BOOKS RECOMMENDED

1. Industrial Microbiology by L. E. Casida Jr. Wiley International Ltd.

2. Microbial Technology by H. J. Pepler. Academic Press

3. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press

4. Enzyme Biotechnology by S. Sridhar

5. Food Microbiology by M. R. Adams and M. O. Moss

6. Dairy Microbiology Volumes 1 and 2 by R. K. Robinson.

7. Fermentation Microbiology and Biotechnology by E. M. T. El-Mansi and C. F. A. Bryce.