

Ph.D. MICROBIOLOGY

(2013-2014)

Revised SYLLABUS

PAPER I RESEARCH METHODOLOGY

Unit - I Scientific research and scientific writing

Importance and need for research ethics and scientific research. Formulation of hypothesis - types and characteristics. Designing research work. Scientific writing - characteristics. Logical format for writing thesis and papers. Essential features of abstract, introduction, review of literature, materials and methods and discussion. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems.

Unit - II Biostatistics

Collection and classification of data - diagrammatic and graphic representation of data. Measurement of central tendency - standard deviation - normal distribution - test of significance based on large samples. Student *t* test. Correlation and regression - Chi square test for independence of attributes - ANOVA.

Unit - III Basic concepts of computers

History of computers, concept of computer hardware, concept of computer - languages, concept of computer software.

Computer application in Biology

Spreadsheet tools: Introduction to spreadsheet applications, features, using formulae and functions, data storing, features for statistical data analysis. Generating charts/graph and other features, tools Microsoft excel or similar presentation tools: Introduction features and functions. Power point. Presentation, customizing and showing presentation. Introduction to internet, use of internet and WWW, use of search engines.

Unit - IV Bioethics

Bioethics - Definition – Principles of Bio ethics –General issues related to environmental release of genetically modified microorganisms. Ethical issues related to the use of animal as models for microbial diseases- Animal ethics norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects. Ethical issues related to research in embryonic stem cell cloning.

Unit -V Biosafety

Biosafety – Introduction. Different levels of biosafety. Guidelines for recombinant DNA research activities in microorganisms. Good Laboratory Practices (GLP). Containments – Types. Basic Laboratory and Maximum Containment microbiology Laboratory research.

Reference Books

1. Christian Lenk, Nils Hoppe, Roberto Andorno (2007). Ethics and Law of Intellectual Property: Current Problems in Politics, Science and Technology, Ashgate Publisher (p) Ltd.
2. Felix Thiele, Richard E. Ashcroft (2005). Bioethics in a Small World. Springer.
3. John Bryant (2005) Bioethics for Scientists. John Wiley and Sons
4. Recombinant DNA safety guidelines (January1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
5. Paul Sanna and Alan Wright Windows 8.1 Absolute Beginner's Guide (2013), How Que Publishing
6. Web Wise Seniors, The Internet for Beginners, 2005, Web Wise Seniors, Inc.
7. Kothari, C.R., 2013. Research methodology Methods and Techniques, New Age International Pvt Ltd Publishers., New Delhi.
8. Anderson, J., Duros, B.H. and Poole, M. 2011. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi. MIBC201 Core Paper IV Medical Microbiology

PAPER - II ADVANCES IN MICROBIOLOGY - I

Unit - I Soil Microbiology

Broad significance of soil Microorganisms - Characteristic of soil Microorganisms – Enzymes of soil microorganisms – Microbial Biochemistry – Plant – Soil Microorganisms interactions – Factors affecting the activities of soil microorganisms – Microbial degradation of pesticide compounds in soil.

Unit - II Environmental Microbiology

Concept & Scope of Environmental Microbiology – soil pollution – water pollution – Air pollution – Oil pollution- Biomining of metals – solid wastes Management. Microbial control of environmental pollution and Bio remediation– Microbial degradation of Xenobiotics. Environmental laws, Biological warfare

Unit - III Food Microbiology

Food micro flora - spoilage organisms - Food poisoning - Intoxication and infection - Quality management in food industries - Fermented foods - SCP. Microbial enzymes - Genetically modified foods.

Unit - IV Industrial Microbiology:

Concept and scope of industrial Microbiology – strain improvement; Bioreactors – types, design and functional characteristics. Scale up of fermentations. Production of organic solvents , organic acids and amino acids. Third generation antibiotics , Bioassay techniques of antibiotics. Production of microbial inoculants, Principles of immobilization – different kinds of immobilization techniques and their uses in industries. Intellectual property rights (IPR) Patents, Trademark, copyright, Design registration and know- how – patent system India – patenting microorganisms and microbial products.

Unit - V Medical Microbiology:

Diagnostic Microbiology - General methods for isolation and identification of bacteria - typing of bacterial isolates - Sero diagnosis Antimicrobials - General characters and drug resistance – antiviral and anti- parasitic drugs.

References Books

1. Mishra R.R., (2004). Soil Microbiology. CBS Publishers & Distributors., New Delhi.
2. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (2006). Modern Soil Microbiology, Marcel Dekker INC, New York, HongKong.
3. Stanbury, P.F., Whittaker, A. and Hall, S.J., 2009. Principles of fermentation technology, 2nd edition, Pergamon press.
4. Cassida, J.E., 2007. Industrial Microbiology, New Age International
5. Frazier, W.C and Westhoff D.C 2013. Food Microbiology. TATA McGraw Hill Publishing Company Ltd. New Delhi.
6. Jay, J.M.2013. Modern Food Microbiology. 7th Edn. CBS Publishers and Distributors, New Delhi.
7. Asthana D.K. and Meera Asthana, 2005. Environment: Problems and Solutions, S.Chand and Company Ltd., New Delhi.
8. Gerald collee. J and Anthony Simmons 2000. Practical Medical Microbiology. Longman Singapore (P) Ltd, Singapore.
9. Greenwood, D. Slack R.B and Peutherer J.F (2012). Medical Microbiology, 18th Edn Churchill Livingstone, London

PAPER - III ADVANCES IN MICROBIOLOGY - II

UNIT - I Microbial Physiology

Microbial Energetic, Microbial enzymes, Metabolism of Carbohydrate, Alternate pathways of Carbohydrate Metabolism, Gluconeogenesis, Utilization of sugars other than glucose, Lipid metabolism, Nitrogen metabolism, Nucleic acid metabolism, Photosynthetic bacteria, Autotrophic Mechanisms in bacteria, Microbial Stress Responses to different conditions.

UNIT – II Microbial Genetics

Generalized reproductive cycles of microbes: Viruses, Bacteria, Neurospora, Saccharomyces, Chlamydomonas and Acetabularia. Viral Genetics: Phage Phenotypes, Phenotypic Mixing, Bacterial Genetics: Bacterial Transformation, Bacterial Conjugation, Hfr conjugation. Transduction: Generalized and specialized transduction, Mutation and mutagenesis, Fungal and algal genetics.

UNIT - III Molecular Biology and Genetic Engineering

DNA as Genetic material, DNA replication, Differences in prokaryotic and eukaryotic DNA replication, Gene expression, Regulation of gene expression in prokaryotes, eukaryotes and bacteriophages, Gene silencing, Importance of gene cloning and future perspectives, Enzymes in genetic engineering, Cloning vectors, Applications of Genetic Engineering, Antisense technology, Safety of rDNA technology, Ethical, Legal, Social and Environmental Issues related to rDNA technology.

UNIT - IV Agricultural Microbiology

Introduction to Agricultural Microbiology, Plant pathology, Diagnosis of plant diseases, Parasitism and disease development, Entry of pathogens to the host, Effect on physiology of Host, Plant disease epidemiology, Environment and Plant diseases, Defense Mechanism of Plant Disease, Plant Diseases and their management, Host pathogen interaction, Biofertilizer, PGPR, Biopesticides.

UNIT - V Immunology

Antigens and Antibodies, Immunogenicity versus Antigenicity, Factors that influence immunogenicity Antigen processing and presentation, MHC molecules. Antibodies – structure and function, antibody diversity, monoclonal antibodies and its clinical applications, Immunity, Innate immunity, Acquired immunity, humoral or antibody mediated immunity, cell mediated immunity. Immunological disorders: Hypersensitivity Type I to Type IV.

Reference books:

1. Moat A.G. Foster J.W. Spector M.P. 2009. Microbial Physiology (4th ed). Wiley.
2. White, D., 2006 The Physiology and Biochemistry of Prokaryotes, Oxford University Press
3. Friedberg EC, Walker GC, Siede W. (2006). DNA repair and mutagenesis. ASM press
4. Malavinski GM & Freifelder D (1998) Essentials of Molecular biology 3 edition, John & Bartlett Publisher.
5. S A Waksman, Soil Microbiology. Nabu Press, 2011
6. Atlas Ronald, M., Bartha, and Richard (1997). Microbial Ecology 4th Edition. Benjamin/Cummings Publishing Company, California.
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby W. H. Freeman, 2007. Immunology

PAPER – IV – A- ENVIRONMENTAL MICROBIOLOGY

Unit – I Environment and Ecosystems

Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit – II Eutrophication

Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physico-chemical and biological measures to control eutrophication

Unit – III Aerobiology

Droplet nuclei, aerosol, assessment of air quality, - solid – liquid – impingement methods – Brief account of air borne transmission of microbes – viruses – bacteria and fungi, their diseases and preventive measures.

Unit – IV Waste treatment techniques

Wastes – types – solid and liquid wastes characterization – solid – liquid; treatments – physical, chemical, biological – aerobic – anaerobic – primary – secondary – tertiary; solid waste treatment – saccharification – gasification – composting, Utilization of solid wastes – food (SCP, mushroom, yeast): fuel (ethanol, methane) fertilizer (composting), liquid waste treatment – trickling – activated sludge – oxidation pond – oxidation ditch.

Unit – V Bioremediation & Global environmental problems

Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay Behavior, biomagnifications and degradative plasmids, hydrocarbons, substituted hydrocarbons, Oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its Environmental impact assessment and ethical issues. Ozone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for management. . Containment of acid mine drainage applying biomining [with reference to copper extraction from low grade ores].

Reference books

1. Bioremediation: Principles and Applications (Biotechnology Research) by R L. Crawford , D L. Crawford 2005.. Cambridge University Press
2. Pollution: Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
3. Wastewater Microbiology: A Handbook for Operators, T. Glymph.(2005) Amer Water Works Assn
4. Environmental Biotechnology. B.C. Bhattacharyya, R Banerjee.(2007) Oxford University Press
5. Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2001 by Lawrence P. Wacekett, C. Douglas Hershberger. ASM Publications.
6. A Manual of Environmental Microbiology. 2nd Edition. 2007 by Christon J. Hurst (Chief Editor), ASM Publications.

PAPER IV- B - INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Unit – I

History and chronological development of industrial microbiology. Industrially important strains – Isolation and preservation. Inoculums development for various fermentation process. Strain development – mutation, recombinant DNA technology and plasmid fusion.

Unit – II

Fermentation – submerged and solid state fermentation. Components of CSTR – types of fermentors (Tower, cyllindroconical and airlift) – batch fermentation – continuous fermentation. Downstream process – intracellular and extracellular product separation. Liquid extraction, Precipitation and floatation.

Unit – III

Fermentor design – body construction – mass transfer – oxygen transfer – effect of viscosity – scale-up process. Production of beverages – beer and wine – vitamin B12, and Riboflavin – antibiotics – penicillin and streptomycin – production of enzymes – amylase and proteases and immobilization techniques. Single cell protein – baker's yeast, spirulina, red algae, and details of mushroom development.

Unit – IV

Clinical uses of antimicrobial drugs, Microbial spoilage and preservation of pharmaceutical products, Sterilization of pharmaceutical products, Applications of microorganism in the pharmaceutical sciences.

Unit – V

Role of precursors and steering agents in production of antibiotics, vitamins and enzymes. Antiseptics-disinfectants their standardization and Quality control of Pharmaceutical products – Indictable, IV fluids and pyrogen testing.

Reference Books

1. Stanbury, P.F., Whittaker, A. and Hall, S.J., 2009. Principles of fermentation technology, 2nd edition, Pergamon press.
2. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton, A., 2001 Industrial Microbiology: An Introduction, 2nd edition, Sinavos association, Ino Sundeland.
3. Cassida, J.E., 2007. Industrial Microbiology, New Age International
4. Presscott and Dunn, S., 2009. Industrial Microbiology. Agrobios publishers
5. Pepler, H. J. and Pearlman, D. 2009. Microbial Technology, Vol 1 and 2, Elsevier press.
6. Belter, P.A., Cussler, E.L. and Hu, W.S., Bio separation, 2011. Downstream processing for Biotechnology, John Wiley and Sons, N.Y.

PAPER IV – C- MEDICAL MICROBIOLOGY

Unit I

Morphology, cultural, biochemical characterization, pathogenicity, lab diagnosis and treatment of gram positive bacteria - *Staphylococci*, *Streptococci*, *Bacillus sp*, *Cornebacteria*, *Mycobacterium*. Gram negative bacteria – *Enterobacteriaceae*, *Neisseria*, *Vibriosis*, *Campylobacter* and *Helicobacter*.

Unit II

Characteristics and classification of fungi, Mycotic disease, pathogenesis and diagnosis of – Superficial mycosis: Pityriasis versicolor, tinea nigra, dermatophytoses. Subcutaneous mycosis: Mycetoma, Sporotrichosis, rhinopododiosis. Systemic mycosis: Histoplasmosis, Blastomycosis. Opportunistic mycosis: Candidiasis, Aspergillosis. Immunity to fungal diseases.

Unit III

General characteristics, pathogenesis, lab diagnosis and treatment of viruses: *Adenoviruses*, *Pox viruses*, *Hepatitis viruses*, *Human retroviruses*, *Tumor viruses*, *Rabies viruses*, *Herpes viruses*, *Rhino viruses*, *Influenza viruses*, *Measles* and *mumps viruses*.

Unit IV

General characteristics and classification of parasites. Life cycle, mode of infection, pathogenesis, transmission, Laboratory diagnosis of Intestinal amoebae - *Entamoeba histolytica*, *E. coli*. Free living amoebae -*Naegleria fowleri*, *Acanthamoeba* spp. Intestinal and genital flagellates - *Giardia*, *Trichomonas*. Blood and tissue flagellates - *Leishmania donovani*, *Trypanosoma cruzi* and *Trypanosoma brucei* complex. Haemosporina - Malarial parasites. Coccidian - *Toxoplasma*, *Cryptosporidium*.

Unit V

General characteristics, classification and mode of action of antibiotics: Chloramphenicol, Tetracycline, Ampicillin, Gentamycin and Rifampicin. Amphotericin B, Nystatin, Thiocarbomates and Flucytosine. Amantadine, Ribavirin and Acyclovir. Metronidazole, Chloroquine and Pentamidine.

Reference Books

1. Ananthanarayan. R. And Paniker C.K. Text Book of Microbiology, Orient Longman, 2009..
2. Greenwood, D. Slack R.B and Peutherer J.F (2012). Medical Microbiology, 18th Edn Churchill Livingstone, London.
3. L C. Norkin (2010) Virology: Molecular Biology and Pathogenesis , American Society for Microbiology
4. Morag. C, and M.C. Timbury, (1994) Medical virology (10th Edition), Churchill Livingston, London.
5. Chander.J (2009). A text book of Medical mycology. Interprint, New Delhi.
6. Parija S.C (2013). Textbook of Medical Parasitology, Protozoology and Helminthology. (4th Edition). All India Publishers and distributors, Medical Book Publisher, New Delhi.

7. Parija, S.C, (2004). Text Book of Medical Parasitology – Protozoology and Helminthology. (2nd Edition). All India Publishers and Distributors, Medical Book Publisher, New Delhi.
8. Prescott, L.M., J.P. Harley and D.A. Klein, (2003). Microbiology (5th Edition) McGraw Hill, New York.

PAPER IV- D - FOOD MICROBIOLOGY

Unit-I

Food Microbiology-Introduction: Types of microorganisms in food – sources of contamination (Primary sources) – factors influencing microbial growth of food (extrinsic and intrinsic).

Unit-II

Study of fermented and process of food: principles of food preservation- methods of preservation. Physical - (irradiation, drying, heat processing, chilling and freezing etc.). Chemical - sodium benzoate class I and II, Food sanitation.

Unit-III

Spoilage and contamination of food– fruits, vegetables, cereals, Sugar products, meat and meat products, milk and milk products, fish and sea foods – spoilage of heated and canned foods.

Unit-IV

Food borne disease: Bacterial: *Staphylococcus*, *Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella* (b) fungal: Mycotoxin, including aflatoxins (c) viral: Hepatitis (d) Protozoa – Amoebiasis.

Unit-V

Dairy microbiology: Fermented milk products – Butter, Butter milk, Sour cream, Yoghurt, Cheese, Kefir, Koumiss, Taette and Tarhama.

Reference Books

1. Adams , M.R. and M.O Moss., 2008. Food Microbiology , the Royal Society of Chemistry, Cambridge.
2. Doyle , M.P. 2005. Handbook of Hygiene Control in the Food Industry. 1st Edn. Woodhead Publishing
3. Frazier, W.C and Westhoff D.C 2013. Food Microbiology. TATA McGraw Hill Publishing Company Ltd. New Delhi.
4. Jay, J.M.2013. Modern Food Microbiology. 7th Edn. CBS Publishers and Distributors, New Delhi.