

Noakhali Science and Technology University

Syllabus for the Department of Microbiology

for

Postgraduate Courses (MS)

Session: From 2013-2014 and Onward till notified

Published by

Noakhali Science and Technology University

Noakhali-3814, Bangladesh.

DEPARTMENT OF MICROBIOLOGY
Noakhali Science and Technology University

Postgraduate (MS) Syllabus
For the Session 2013-2014 and onward till notified

The Department offers a full-time two semesters MS course in Microbiology. The courses aim to give detailed knowledge and understanding of important aspects of Microbiology, as currently applied in industry, food, health and medical sciences, environment management, biotechnology.

A 4-year B.S. (Honours) degree in Microbiology or an equivalent degree is required as an entry qualification for students intending to study for the MS degree. Students will take a total of 32 credits for the MS degree. Each credit of theoretical course consists of at least 12 lecture-hours. There will be two groups of students: Group A (General Group) and Group B (Thesis Group). Students of the both groups will undertake and appear at written examinations in the six 3-credit theoretical courses as of their choices, a 2-credit Critical Review Writing, 2-credit Seminar Presentation and a 2-credit viva-voce will be included. For the Group A – a 5-credit project and a 3-credit laboratory training in research laboratories and/or in industry will also be included. The Group B students will undertake a 8-credit dissertation. For the theory courses the continuous assessment will be made through a set of in-course examinations (25% marks), class participation (5% marks) and course final examinations (70% marks). During the progress of courses the students of both groups will deliver at least one seminar related to their training or research works. The students should also attend a series of seminars on relevant topics arranged by the department. The department will provide all laboratory facilities to the students and often students might be sent to other research laboratories for carrying out their part of research work with which the department has collaborative research projects. The completion, submission and evaluation of dissertation/projects/practical/seminar/internship and other matters will be followed as per guideline approved by Noakhali Science and Technology University.

Course Information

M.S. Year 1 Term I	Course Code	Course Title	Credit
	MBPG1101	Environmental Biotechnology	3
	MBPG1103	Advanced Molecular Genetics	3
	MBPG1105	Immunopathology and Vaccine development	3
	MBPG1107	Microbial Enzyme and Protein Biotechnology	3
	MBPG1109	Molecular Epidemiology and Biostatistics	3
	MBPG1111	Management and Control of Microbiological Safety of Foods	3
	MBPG1113	Biomass and Biofuel	3
	MBPG1115	Molecular Oncology and Virology	3
	MBPG1117	Extremophiles and Novel Biological Products	3
	MBPG1119	Pharmaceutical Biotechnology	3
MBPG1121	Research Methodology & Scientific Writing	3	
Total			18

M.S. Year 1 Term II	Course Code	Course Title	Credit
	MBPG1102	Practical I (Group A)	1
	MBPG1104	Practical II (Group A)	1
	MBPG1106	Practical III (Group A)	1
	MBPG1108	Project/ Laboratory Training in Research Lab/ Industry (Group A)	5
	MBPG1110	Dissertation (Group B)	8
	MBPG1112	Critical Review Writing (Group A & B)	2
	MBPG1114	Seminar Presentation (Group A & B)	2
MBPG1116	Viva Voce (Group A & B)	2	
Total			14

1. **Environmental Risk and Risk assessment:** Risk, risk for human and animal health; toxicity and safety of food quality; drug resistance of pathogens, risk for agriculture and environment; effect of biodiversity; alteration of nutrition value; persistence of transgenes in transgenic organisms, susceptibility of non targeted organism; unpredictable genes in environment; Risk assessment- the concept of risk assessment; the process of risk-assessment; microbiological risk assessment.
2. **Non-culturable Microorganisms in the Environment:** Concept of viable but non-culturable cells (VBNC); present status of VBNC; molecular methods of detection and identification of VBNC.
3. **Xenobiotic Degrading Bacteria and Their Catabolic Genes in Bioremediation:** In situ analysis of microbial community and activity in bioremediation; DNA- and RNA-based methods of microbial community analysis in bioremediation, genetic finger printing techniques, genetic engineering of microorganisms for degradation of xenobiotics.
4. **Aerobic and Anaerobic Growth Biotechnologies:** Fundamentals of Anaerobic digestion in suspended growth reactor; microorganisms involved; control and optimization; Anaerobic digestion of solid waste and sludge; Activated sludge; Activated sludge with nitrification and denitrification; Extended aeration; Oxidation ditch; Trickling filter; Denitrification filter.
5. **Biomining Technology:** Recovery of metals from mining and industrial wastes; Recovery of metals from waste streams by sulfate-reducing bacteria; Recovery of phosphate and ammonia by iron-reducing and iron-oxidizing bacteria.
6. **Value-Added Products from Organic Wastes:** Production of enzymes, organic acids, flavors, polysaccharides, biodegradable plastics, animal feed, dietary fiber, pharmaceuticals, gibberellic acid, chemical and fuel from organic wastes

Books Recommended:

1. Wastewater Microbiology, 2nd Ed.- Wiley GB
2. Microbial Biotechnology- Glazer AN & Nikaido H
3. Environmental Microbiology- Maier RM, Pepper II & Gerba CP
4. Biotreatment System, Vol 2- Wise DL
5. Nonculturable Microorganisms in the Environment- Colwell RR & Grimes DJ
6. Molecular Approaches to Environmental Microbiology- Pickup RW & Saunders JR
7. Microbial Ecology- Atlas RMA & Bartha R
8. Textbook of Environmental Biotechnology- Mohapatra PA, 2006; I.K. International

1. **Regulation of Gene Expression in Eukaryotes:** Spatial and temporal regulation- ways of regulating eukaryotic gene expression; controlled transcription of DNA, alternate splicing of RNA, cytoplasmic control of mRNA stability; induction of transcriptional activity by environmental and biological factors. Molecular control of transcription; Gene expression and chromosome organization- molecular organization of transcriptionally active DNA, gene splicing, DNA methylation and imprinting, gene amplification; Activation and inactivation of whole chromosome.

2. **Studying Gene Expression and Function:** Transcription of cloned gene, Identifying protein binding sites on a DNA molecule, Identifying and studying the translation product of a cloned gene: hybrid-release translation (HRT) and hybrid-arrest translation (HART). Analysis of protein by *in vitro* mutagenesis; Studying protein-protein interaction phage display, yeast two hybrid system.
3. **Human Genetic Disorders and Gene Therapy:** Tag-Sachs mutation; Huntington's disease; Cystic fibrosis. Somatic cell gene therapy and germ-line therapy; Gene function interruption therapy: antisense RNA and ribozyme; Therapeutic use of anti-sense oligonucleotide: pre-transcriptional and post-transcriptional inactivation of RNA; Gene therapy and cancer; Ethical issues raised by gene therapy.
4. **Genetic Principles of Cell Signaling:** Extra-cellular signal molecule and their receptors, Operation of signaling molecules over various distances, Sharing of signal information, Cellular response to specific combinations of extra cellular signal molecules; NO signaling by binding to an enzyme inside target cell, Nuclear receptor ; Ion channel linked, G-Protein-linked and enzyme-linked receptors, Remembering the effect of some signal by cells.
5. **Signaling Through G-protein-linked Cell Surface Receptors:** cAMP and G-protein kinase (PKA) in mediating effects of cAMP, Inositol phospholipids signaling pathway, Ca²⁺ as a intracellular messengers, role of Ca²⁺/calmodulin-dependant protein kinases in mediating actions of Ca²⁺, Regulation of ion channels by G-proteins, desensitization of G-protein-linked receptors.
6. **Signaling Through Enzyme Linked Cell Surface Receptors:** Receptor tyrosine kinases, Activation of Ras, Ras cycles between active and inactive states, signals from activated Ras to a cascade of protein kinases including MAP-kinases, PI 3-kinase/protein kinase B signaling pathway, Insulin receptor acts through PI 3-kinase pathway, Cytokine receptors and the JAK-STAT pathway, Two component signaling pathway of bacterial chemotaxis. TGF Signaling pathways Activated type ITG α receptors phosphorylate Smad transcription factors, Smad signaling via negative feedback loop, TGF α signaling and abnormal cell proliferation.

Book Recommended

1. Genetics: From Genes to Genomes. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM & Veres RC.
2. Gene Cloning and DNA Analysis: An Introduction - Brown TA.
3. Principles of Genetics - Snustad DP & Simmons MJ.
4. Gene VII. - B. Lewin
5. Molecular Biology of the cell – B. Albers et al.

MBPG 1105 Immunopathology and Vaccine Development

3 C

1. **Inactivation and activation of biologically active molecules:** Mechanism of antibody mediated inactivation and activation (hormone, receptor, ligand); Neutralizing antibodies-cause and effect, Protective functions of inactivation antibodies.
2. **Cytotoxic and cytolytic reactions:** mechanism, Immunohematologic Diseases, Acquired autoimmune haemolytic disorders: Haemolytic reaction to drugs, Leukocytes (Agranulocytosis), Platelets, Cytolytic skin diseases, Protective and pathologic effects in infectious diseases.

3. **Granulomatous reactions:** Nature of granulomatous ; T-cell factors for modulation of granulomas, granulomatous diseases; infectious disease-bacterial and parasitic.
4. **Antibody engineering:** Antibody gene cloning; Recombinant antibody gene expression; Applications of engineered antibodies.
5. **Vaccines:** Designing, development and mode of actions of vaccines: Killed vaccine, Attenuated vaccines; Subunit vaccines, Conjugate vaccines; Edible vaccines, DNA vaccines, and other vaccines, Vaccination program.
6. **Vaccines strategy:** Experimental vaccines for Botulism; Anthrax; Malaria; Pneumonia; Cholera; Typhoid; Hepatitis; and Cancer vaccines (diagnosis and immunotherapy).
7. **Toxicology:** Origin and scope of toxicology, toxicologic evaluation, Metabolism of toxic substances toxicology, different toxic agents, environmental toxicology, application of toxicology.

Books recommended:

1. Immunology: Immunopathology and Immunity – S. Sell and E. E. Max
2. Bacterial Pathogenesis: A molecular Approach – A.A Salyers and D.D Whitt.
3. Molecular Immunology – B.D. Hames and D.M Glover.
4. The Microbial Challenge : Human Microbe Interaction – R I Krasner
5. Journals: Infection and Immunity, ASM Press, USA. Immunology Today, Elsevier Trends Journals, UK.

MBPG 1107 Enzyme & Protein Biotechnology

3 C

1. **Introduction:** Enzyme production strategies, Down stream processing, Industrial enzymes, Characteristics of bulk and fine enzymes, Eco-friendly enzymes.
2. **Enzyme Overproduction:** Introduction, Expression in bacteria, yeast, and baculovirus. Enzyme stabilization.
3. **Industrial/Technical application of enzymes:** Industrial approach to enzyme production; development of new enzymes preparation; biochemical applications of enzymes; Enzymes in food industry, feed industry, Enzymes in detergents, Enzymes in leather industry, Enzyme in textile industry, Enzymes in Pulps and paper industry, Enzymes in starch processing, Enzymes as diagnostic reagents. enzymes in the antibiotics; miscellaneous uses of biocatalysts.
4. **Protein Sources:** The range of industrially significant proteins and their applications; Recombinant versus non-recombinant proteins; Microorganisms, plants and animal tissue as sources of protein;
5. **Recombinant protein technology and Protein Engineering:** Basic concepts of recombinant protein technology; Techniques in recombinant protein production and protein engineering (gene cloning, finding genes, DNA libraries, site directed mutagenesis, knockout mouse, tissue culture).
6. **Conformational Stability of Protein:** *In vitro* and *In vivo* stability, stability of proteins in solution, denaturation mechanism, renaturation.

Books Recommended

1. Protein Biotechnology. Walsh G and Headon D.
2. Protein Biotechnology: Isolation, Characterization and Stabilization. Frank F.
3. Protein Engineering: Principles and Practice. Cleland JF & Craik CS.
4. Hand Book of Enzyme Biotechnology. Wiseman A.
5. Biotechnological Applications of Proteins and Enzymes. Bohak Z & Sharon N.
6. Genetics: A conceptual approach, Benjamin A. Pierce
7. Protein Expression. Higgins and Hames
8. Handbook of Enzyme Biotechnology, Edited by Alan Wiseman.
9. Biotechnology, vol 9. (Production of enzymes as Feed, P. 72) H.J. Rehm and G. Reed, VCH, Newyork, Tokyo.
10. Biotechnology, vol 5a. (Enzymes for industrial applications, P 189) H.J. Rehm and G. Reed, VCH, New York, Tokyo.

MBPG 1109 Molecular Epidemiology and Biostatistics

3 C

1. **Epidemiology:** Basic concepts and definition, determinants of disease, quantification of disease events in population, types of epidemiological study.
2. **Infection Control & Prevention:** Epidemic versus endemic; Steps in epidemiologic evaluation; Role of the laboratory in epidemiologic evaluation: Potential problems related to laboratory activities in epidemiologic investigations.
3. **Infection control epidemiology and clinical microbiology:** Infection control epidemiology and its methods, steps in epidemiological evaluation, role of laboratory in epidemiologic evaluations, problems related to laboratory activities in epidemiological investigations.
4. **Epidemiologic Analysis:** Criteria for evaluating typing system; Phenotypic techniques: biotyping, antimicrobial susceptibility testing, serotyping, bacteriophage typing; multilocus enzyme electrophoresis (MLEE); Genotypic techniques: plasmid analysis, restriction enzyme analysis (REA) of chromosomal DNA, Southern blot analysis of restriction fragment length polymorphisms (RFLPs), pulse-field gel electrophoresis (PFGE) of chromosomal DNA, typing system applying polymerase chain reaction (PCR); PCR-based detection of restriction sites, & nucleotide sequence analysis; Molecular typing of specific organisms; Application of microbial typing system; Implementing a molecular epidemiology laboratory.
5. **Correlation and Regression in Biostatistics:** Calculation of correlation coefficient from ungrouped series; Regression; Calculation of regression coefficient (b); regression line; standard deviation of the Y measurement for the regression line.
6. **Designing and Methodology of an Experiment or a Study:** Steps and methodology; format for presentation of any research work.
7. **Computer Application in Biostatistical Analysis: An SPSS Manual**

Books Recommended

1. Bacterial Pathogenesis: A Molecular Approach, 3rd edition. Salyers AA & Whitt DD.
2. Principles of Bacterial Pathogenesis. Groisman E.

3. Virulence Mechanisms of Bacterial Pathogenes. Brogden KA *et al.*
4. Mechanism of Microbial Diseases. Schaechter M & Engelberg NC
5. Manual of Clinical Microbiology, 7th edn. Murray PR, Baron EJ, Pfaller MA, Tenover FC & Tenover RH.
6. Methods in Biostatistics, 7th Edition, BK Mahajan

MBPG 1111 Management and Control of Microbiological Safety Foods and Pharmaceuticals

3 C

1. **Introduction:** Concept of food safety in the context of microbiological hazards; importance of safe food for health, manufacture of safe food, microbiological criteria for food safety, microbiological indicator of safe food.
2. **Microbiological Criteria for Food Safety:** Objectives and principles for establishment and application of microbiological criteria for foods; Food sampling plans- concept of probability and principles of sampling; Categories of sampling plans - variable plans and attribute plans; Sample handling and analysis; Microbiological limits for food safety.
3. **Microbiological Risk Assessment:** Objectives and basic frame of food safety; Risk assessment- purpose, hazard identification; Exposure assessment; Hazard characterization; Risk characterization; Reporting system; Risk management- risk assessment policy and risk profiling, risk communication.
4. **Application of Microbiological Risk Assessment:** Food standards and specifications; *Salmonella* in dried milk, *Listeria monocytogenes* in sausage, *Escherichia coli* in frozen raw ground beef, and aflatoxin in peanut.
5. **Investigation and Control of the Outbreak of Food-borne Diseases:** Objectives, personnel involved in the investigation and control; Materials required for investigation and control; Field investigation and laboratory testing; Interpretation of results; Appropriate preventive measures.
6. **Food Safety Regulations and Regulatory Agencies:** Regulations in international and national trade of foods; Codex Alimentary Commission (CAC), ICMSF; World Health Organization (WHO); Sanitary and phytosanitary measures (SPS); Technical barrier to trade (TBT); Food laws and enforcement agencies- BSTI, FDA.
7. **Quality assurance:** Implementation & monitoring of GMP, in process control, quality control, validation

Books Recommended

1. The Microbiology of Safe Foods. Stephen JForsythe
2. Microorganisms in food 7; Microbiological testing in food safety management – ICMSF series, editorial committee, R.B Tompkin
3. Sanitation of Food Processing. Troller JA.
4. Food Microbiology -- Frazier and D.C. Westhoff
5. Modern Food Microbiology -- Banwart
5. Biotechnology, vol. 9. Rehm H-J and Reed G.
4. Quality Control in the Food Industry, vol. 4. Herschdoerfer SM.

- 1. Introduction:** Importance of biomass and fuel energy; Fuels from natural sources; Basic bioenergy interconversion; Formation of biomass and its conversion to fuel; biofuel cell for generation of electricity and light.
- 2. Potential Biomass for Fuel Production:** Types and availability of natural biomasses: Land crops, aquatic plants and waste materials; Animal manures; Production of desirable biomass; Advantages and problems in utilization of different biomass for fuel generation; Pretreatment of biomass for fuel production, Photobiological energy, Electricity from microbial system, Microalgae energy: new generation for fuel.
- 3. Bioconversion of Biomass to Methane:** Biomass composition and methane production; Synthesis of methane under natural conditions; Potential microbes involved in methane generation; Man-made processes: Methane from sanitary landfills, sewage, farm, industrial wastes & energy crops; Reactor design; Utilization of the methane as fuel.
- 4. Production of Fuel Ethanol from Biomass:** Potential biomass and microorganisms for ethanol production; Problems in production of ethanol from agro-industrial wastes; Development of technology of fermentation; Ethanol production from molasses by yeast; Ethanol production from cellulose by rumen bacteria; Ethanol production by *Zymomonas mobilis*; Genetic engineering of yeast to ethanol substrate range, osmolarity and tolerate to high ethanol, Future prospects of the industrial alcohol as biofuel.
- 5. Production of Hydrogen from Biomass:** Potential substrates and microorganisms; Natural biosynthesis of hydrogen under natural habitats; Cell-free system and combined system for production of hydrogen. Recent trends in production of biogas from organic wastes.
- 6. Biodiesel from Microorganisms and Crops:** Potential microorganisms and crops for biodiesel production; Strategies to engineer microbes and crops for biofuel generation; Algae as a potential biodiesel; Major types, applications and problems associated with the production of biodiesel crops.

Books Recommended

1. Food, Feed and Fuel from Biomass. Chahal DS.
2. Biotechnology: Principles and Applications. Higgins IJ, Best DJ & Jones J.
3. Biotechnology : Bioprocessing – H.J. Rehm and G. Reed, vol.3.
4. Manual of Industrial Microbiology and Biotechnology Arnold L. Domain and Julian E. Davies
5. Biotechnologies and Renewable Energy – Murray Moo- Young, Sadiq Hosnain, Jonathan Lamptey
6. Advances in Biotechnological Progress – Avshalom Mizrahi, Antonius L. Van Wezel, vol. 3.

- 1. Persistence of Viruses:** Patterns of virus infections; Mechanisms of viral persistence; Persistence of HSV, EBV & HIV in humans.
- 2. Molecular basis of viral pathogenesis:** Molecular & genetic determinants of virulence, virulence genes, host cell's genetic system & other factors influencing pathogenesis, strategies used by viruses to facilitate their replication & expression.

3. **Virus Evolution & Emerging Viruses:** How do viruses evolve? Emerging viruses; Emergence of Dengue, Japanese encephalitis, Ebola virus infection in Bangladesh etc.; prevention and control of its epidemic.
4. **Oncology:** General concepts and terminologies. Development of cancer; role of cell cycle restricts point and signaling systems. Spread of cancer; mechanism of metastasis. Physical and chemical factors contribute to cancer development, cancer therapy.
5. **Oncogenic viruses:** Different types of oncogenic viruses. Viral oncogenes, molecular mechanisms of transformation by DNA and RNA viruses; viral transformation by activation of cellular signaling pathways and viral transformation via cell cycle control pathways.
6. **Cancer Therapy:** Antibody (recombinant) therapy, Virotherapy, Immunotherapy etc.

Books Recommended

1. Virology. Feilds
2. Principles of Virology. :molecular biology, pathogenesis and control – Flint, Enquist, Krug, Racaniello⁹ and Skalka
3. Fundamentals of virology – B.N. Fields
4. Molecular virology - D.R. Harpar, D.R. Harper and Kinchiption
5. Molecualr Oncology – Ian Tannock, Richard Hill, Robert Bristow, Lea Harrington.

MBPG 1117 Extremophiles and Novel Biological Products

3 C

1. **Extreme Environment and Microbial Life:** The extreme environments and microbial adaptations to extreme environments; Extreme environment as a resource for novel microorganisms and biological products; Microbial biodiversity in extreme environments; importance of extremophiles and their applications in biotechnological processes.
2. **Hyperthermophiles and Psychrophiles:** Biotops, isolation, and classification of hyperthermophiles; Physiology and biochemical basis of their heat stability and adaptation. The habitats, isolation, and characteristics of psychrophiles; physiology and mechanisms of their adaptation to the extreme environments. Biotechnological significance of hyperthermophiles and psychrophiles.
3. **Life at High Pressure in Deep-sea and Halophiles:** Deep-sea habitats; Collection, cultivation and characterization of piezophilic microorganisms; their adaptation to extreme pressure. Hypersaline environment; characteristics, classification and adaptation of halophiles to the extreme environments. The biotechnological potential of piezophiles and halophiles.
4. **Acidophiles and Alkaliphiles:** Characteristics of eukaryotic, mesophilic and thermophilic acidophiles; their interactions in acidic environments; novel acidophiles, acid stable proteins and gene transfer systems. Isolation and classification of alkaliphilic microorganisms; cell wall, and genetic analyses, and bienergetics of alkaliphilic microorganisms.
5. **Anaerobic Extremophiles:** Extreme habitats, characteristics, adaptation and biotechnological exploitation of methanogens. Anaerobic and metal resistant microbes- characteristics and potential for the control and bioremediation of toxic metal pollution. Anaerobic non-methanogenic extremophiles- characteristics, categories, potential biotechnological applications.

6. **Extremozymes:** Extreme environment as a resource of microbial enzymes; screening strategy for novel enzymes; starch processing enzymes, cellulose hydrolysing enzymes, xylan degrading enzymes, proteolytic enzymes; chitin hydrolysing enzymes, DNA processing enzymes, and other thermoactive enzymes of biotechnological interests.
7. **Space microbiology:** Aims and objectives of space research; life detection methods; evidence of metabolism, photosynthesis (autotrophic and heterotrophic), ATP production, phosphate and sulphur uptake.

Book Recommended

1. Extremophiles - Microbial life in Extreme Environments. K. Horikoshi and W.D. Grant.
2. Microbial Growth and Survival in the Extreme Environments. Brock TD.
3. Microbial Life in Extreme Environments. Kushner DJ.
4. Biotechnology: A Multi-Volume Comprehensive Treatises, vol. 10 (Special Processes). H-J Rehm and G Reed.
5. Microbiology of Extreme Environments – C. Edward.
6. Microbes in Action: Concept and Application in Microbial Ecology. Lynch JM & Hobbie JE.
7. Biodiversity: Measurement and Estimation - DL Hawks worth.

MBPG 1119 Pharmaceutical Biotechnology

3 C

1. **Drug development:** Drug discovery. Impact of genomics, proteomics and related technologies upon drug discovery. Microbial transformations; transforming new molecular entities into drug. Application of biotechnology in drug development. Biological drug development and approval; pre-clinical and clinical trials.
2. **Techniques involved in the production of biopharmaceuticals:** Recombinant DNA technology; animal cell culture; hybridoma technology.
3. **Therapeutics based on biotechnology:** Interferons and interleukins; hormones and growth factors: insulin, somatostatin, somatotropin, erythropoietin; therapeutic enzymes; DNase I, alginate lyase, tissue plasminogen activator (tPA); nucleic acid therapies.
4. **Antimicrobial peptides:** Background, structure and physico-chemical properties, basis of selective toxicity, mechanism of interaction with cell membrane, membrane permeabilization mechanism, barrel-stave mechanism, toroid-pore mechanism, carpet mechanism, Prospects and problems of antimicrobial peptide use in clinical practice, resistance, toxicity in humans, future directions of research towards enhanced efficacy and reduced toxicity to human cell, engineered anti-bacterial agents based on microbial peptide structure and function—agents that would augment immunity, potency, increase efficacy of conventional antibiotics and minimize resistance emergence in bacterial pathogens.
5. **Therapeutics Use:** Enzyme based therapeutics, Therapeutic antibody, Nucleic acid based therapeutics.

Books recommended:

1. P. F. Stanbury & A. Whitaker: Principles of fermentation technology, Pergamon Press
2. B.P. Nagori & Roshan Issari: Foundations in Pharmaceutical Biotechnology
3. Sambamurthy. K: Text Book of Pharmaceutical Biotechnology.
4. S. S. Kori: Pharmaceutical biotechnology.
5. S. S. Purohit et al.: Pharmaceutical Biotechnology, 2007

MBPG 1121**Research Methodology & Scientific Writing****3 C**

1. Fundamentals of Research: Principles, Characteristics and Types (application, objectives, and inquiry mode)

2. The Research Process:

Step 1 - Background/Introduction: Formulating the research problem

Step 2 - Reviewing the literature: Critical analysis of the literature selected in context to your research

Step 3 - The Formulations of Objectives: Constructing concepts, hypotheses and specific objectives

Step 4 - Materials and Methods: Sample design and collection, Experimental analysis sequentially according to the specific objectives

Step 5 - Results: Collecting and plotting the data (tabulated, graphical or illustrative fashion)

Step 6 - Discussion: Qualitative (main themes, assign codes, classify responses, integrate themes and responses) and quantitative data analysis (manual and using a computer)

Step 7 - Conclusion: Impacts; Future perspectives

3. Evaluation of Time Frame:

Step 1 - Project design, Reviewing the literature, and Formulations of objectives

Step 2 - Conduction of experiments

Step 3 - Data plotting and analysis

Step 4 - Writing research report/thesis/manuscript and submission

4. Preparing a Research Proposal

Major Parts: Title, Background (and Motivation), Objectives, Methodologies, Expected results and outcomes

Additional Parts: Time frame, Funding source(s), Present research related to research plan

Merely Contain: References, Appendices

5. Writing a Regular Manuscript/Scientific Article (chronological order):

Title Page, keywords, abbreviations, funding source(s), conflict of interests, etc., Abstract, Introduction, Materials and Methods, Results, Discussion, Recommendations, Acknowledgement (if any), References (chronological order/author's surname), Figures, Tables, Appendices (if any), Ethical Considerations, Computing and Statistical data analysis, Plagiarism

Books Recommended:

1. Dawson, Catherine, 2002, *Practical Research Methods*, New Delhi, UBS Publishers' Distributors,
2. Kothari, C.R., 1985, *Research Methodology-Methods and Techniques*, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, *Research Methodology-A Step-by-Step Guide for Beginners*, (2nd.ed), Singapore, Pearson Education

Group A: General

Practical Courses

MBPG 1102

1 C

1. Characterization and cultivation of aerobic and anaerobic bacteria.
2. Isolation, enumeration and characterization of bacteriophage from drain water.
3. Isolation of TMV & infecting plants.
4. Virus culture in embryonated chicken eggs.
5. Determination of growth curve of bacteria.
6. Isolation, purification and characterization of enzymes (protein) by polyacrylamide gel electrophoresis.
7. Isolation, purification and Characterization of bacterial plasmids by Agarose gel electrophoresis.
8. Agro bacterium manipulated gene (plasmid) transfer.
9. Animal and plant cell/tissue culture for enzymes/antibiotic/Plant secondary metabolites.
10. Separation of biomolecules by column chromatography.

MBPG 1104

1 C

1. Determination of BOD/COD of water. Determination of total alkalinity of water. Determination of Chlorine in water. BSTI specification of drinking water/Standard qualitative analysis of water.
2. Soil and seed borne pathogens (Bacteria & fungi), microbial decomposition, microbial heavy metal immobilization.
3. Effect of substrate conc., pH, temperature and NaCl conc. on enzyme activity.
4. Enzyme isolation, purification (including NH_4SO_4 ppt) and separation by polyacrylamide gel electrophoresis.
5. Determination of MIC & MBC/MFC of an antimicrobial agents. LD_{50} of antimicrobial agents, Antibiotic & vitamin assay.
6. Serological identification of unknown organisms by agglutination test, immunodiffusion test, Haemagglutination test, ELISA, complement fixation test, VDRL test.

MBPG 1106

1 C

1. Microbiological analysis of food products. Isolation, purification & identification of *E. coli*, *Salmonella*, *Shigella*, *Streptococcus* & *Staphylococcus* from foods.
2. Microbiological examination and content of dairy products & drink, & selected foods, yogurt production, Microbial analysis of Milk.
3. Serological diagnosis of Mycoplasmosis and Salmonellosis of chickens.
4. Microbiological analysis of stool, urine, blood, skin, throat & mouth.
2. Determination of bacterial toxin. Contamination test of pharmaceutical products. Vaccine & antibiotic production.

MBPG 1108 (Project works): Any one of the following fields

5 C

1. Antimicrobial Agents
2. Food and Fishery, and Drinking water Microbiology
3. Environmental Microbiology
4. Enzyme Biotechnology
5. Fermentation Technology
6. Industrial Microbiology
7. Immunology
8. Virology
9. Microbial Biotechnology
10. Clinical Microbiology
11. Molecular Biology
12. Soil Microbiology

Group B: Thesis

MBPG 1110	Dissertation	8 C
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Group A and B

MBPG 1112	Critical Review Writing	2 C
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MBPG 1114	Seminar Presentation	2 C
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MBPG 1116	Viva Voce	2 C
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