

University of Dhaka



Faculty of Biological Sciences

Syllabus for the Degree of MPhil and PhD in Microbiology

Sessions: 2018-19 and onwards



Department of Microbiology

University of Dhaka

Dhaka 1000

Bangladesh

UNIVERSITY OF DHAKA
DEPARTMENT OF MICROBIOLOGY

**Syllabus for the Degree of Master of Philosophy (MPhil) and Doctor of Philosophy (PhD) in
Microbiology, Sessions: 2018-19 and onwards**

The Department of Microbiology was established in 1979 under the Faculty of Biological Sciences, University of Dhaka (DU), and is currently located in the Science Complex Building. The Department started its journey offering Master of Science (MSc) degree programme in Microbiology to a few competent students having a BSc (Honours) degree in Biochemistry, Botany, Pharmacy, and Soil Science, from Dhaka University and MBBS degree from recognized Medical colleges. The Department steadily gained reputation in teaching and research at home and abroad, and able to establish the necessity of graduate and post-graduate microbiologists in both industry and academia. It prompted the opening of the Undergraduate (Honours) programme in the academic session of 1988-89. The Department also offers specialized courses with research facilities in Post-Graduate levels such as MS, MPhil and PhD.

The Department follows state-of-the-art teaching pedagogy with special emphasis on research and practical works. Teaching in the classrooms is facilitated with multimedia and other necessary supports. The Department has a rich seminar library with a large collection of reference books and journals. It possesses several research laboratories with modern equipment, facilities and service systems. The faculty and the researchers of this department have been regularly publishing their research findings in the high impact national and international journals. The Department of Microbiology has already earned a place as a centre of excellence in the field of Microbiology, Molecular Biology and Biotechnology research in Bangladesh. Various research groups are working in collaboration with the top research organizations at home and abroad.

Title of the Programme: Degree of Master of Philosophy (MPhil)
Degree of Doctor of Philosophy (PhD)

Duration of the Programme: Two-Year MPhil Degree
Four-Year for PhD (Regular)
Five-Year for PhD (Part-time)

Level: Postgraduate

Medium of Instruction: English

Eligibility for Admission: Students will be admitted to the MPhil or PhD Degree programme as per the existing Ordinance and regulations of the University of Dhaka, and the policy of the Faculty of Biological Sciences and Department of Microbiology, University of Dhaka. The Department may re-fix the minimum requirement for admission to the programmes from time to time with approval from the authority.

Distribution of Marks: Students of both the MPhil and PhD shall undertake and appear at written examinations of total 200 marks in the Four Unit (i.e. 50 marks for each Unit) or Eight Credits (i.e. 25 marks for each Credit) of the theoretical courses as of their choices and the oral examination of 100 marks (4 Credits) at the end of the first year (First Part) of their admission, and the pass mark in the first year examination is 50% on an average for the written papers and 50% for the oral examination (viva

voce). For the MPhil degree, students shall complete the research work and present at least one seminar in the Second Part (during 2nd Year), and for the PhD degree, students shall complete the research work and present at least two seminars in the Second Part. The students having MS degree with 4-year BS/BSc (Honours) degree in Microbiology from Dhaka University or equivalent degree from other institutions, directly enrolled for PhD programme may be exempted from the theoretical courses and the oral examination in their First Part. The completion, submission and assessment of Thesis, Seminar presentation and other matters will be followed as per regulations and guidelines approved by the University of Dhaka.

Course Information

Course Number	Course Name	Marks	Credit
First Part			
MPG 601	Environmental Biotechnology	50	2.0
MPG 602	Advanced Molecular Genetics	50	2.0
MPG 603	Immunopathology and Vaccine Development	50	2.0
MPG 604	Bioprocess Engineering and Technology	50	2.0
MPG 605	Enzyme and Protein Biotechnology	50	2.0
MPG 606	Advanced Bioinformatics	50	2.0
MPG 607	Epidemiology of Infectious Diseases	50	2.0
MPG 608	Microbial Food Safety Management	50	2.0
MPG 609	Bioenergy and Biofuel Technology	50	2.0
MPG 610	Molecular Virology and Oncology	50	2.0
MPG 611	Extremophiles and Novel Biological Products	50	2.0
MPG 612	Pharmaceutical Biotechnology	50	2.0
MPG 613	Viva-voce	100	passed
Second Part			
Seminar Presentation			
Thesis (MPhil/ PhD)			
Thesis defense (MPhil/ PhD)			

First Part

MPG 601 Environmental Biotechnology

Marks: 50

Credits: 2.0

- 1. Environmental Hazards and Risk Assessment:** Classification and characterization of environmental hazards; Biological hazards- Viable but non-culturable (VBNC) cells as potential environmental hazards; Molecular methods of detection and identification of VBNC; Risk assessment- concept, process and microbiological risk assessment.
- 2. Biotechnology of Wastewater and Industrial Effluent:** Use of microorganisms, enzymes and immobilized cells in wastewater and industrial effluent treatment; Potential application of recombinant DNA technology in waste treatment.
- 3. Bioremediation of Organic Pollutants:** Biodegradation of organic pollutants- mechanisms and factors affecting biodegradation, and degradation of different organic pollutants; Bioremediation- in situ and ex situ bioremediation technologies; Bioremediation of oil spills and phytoremediation; Use of GMO in bioremediation; Biological treatment of waste gas- biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.
- 4. Microorganisms and Metal Pollutants:** Properties and effects of metals; classification, speciation and sources of metals; Metal bioavailability in the environment; Effects of metal toxicity on microbial cells, mechanisms of microbial metal resistance and detoxification; Health hazards due to metal pollution and pesticide; Bioremediation of arsenic and chromium in Bangladesh context.
- 5. 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, and genetic finger printing techniques.
- 6. Preventive and Environmental Biotechnology:** Innovation of novel bioprocesses; Microbial insecticides- bacteria, fungal and viral pesticides in pest management; Microbial biopesticides- biology and applications of *Bacillus thuringiensis* (Bt) in pest control.

Recommended Books

1. Wastewater Microbiology - Bitton G., Wiley and Sons Inc.
2. Microbial Biotechnology: Fundamentals of Applied Microbiology - Glazer AN & Nikaido H, Cambridge University Press
3. Environmental Microbiology - Maier RM, Pepper II & Gerba CP. Academic Press
4. Biotreatment System, Vol 2- Wise DL, CRC Press
5. Nonculturable Microorganisms in the Environment - Colwell RR & Grimes DJ. ASM Press
6. Molecular Approaches to Environmental Microbiology - Pickup RW & Saunders JR, Prentice Hall
7. Microbial Ecology: Fundamentals and Application - Atlas RMA and Bartha R. Benjamin/ Cummings Science Publishing
8. Textbook of Environmental Biotechnology - Mohapatra PA, I.K. International Publishing House, New Delhi
9. Biodegradation and Bioremediation - Alexander M.
10. Wastewater Treatment for Pollution control - Arceivala

MPG 602 Advanced Molecular Genetics**Marks: 50****Credits: 2.0**

1. **Eukaryotic genome:** Introduction to the size, structure and organization of eukaryotic genes and genomes, functional significance of a genomes organization and chromatin-structure. Mitochondrial genome and Chloroplast genome.
2. **Regulation of Gene Expression in Eukaryotes:** Spatial and temporal regulation of 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, DNA methylation and imprinting, gene amplification; Activation and inactivation of whole chromosome; Gene silencing and position effects.
3. **Studying Gene Expression and Function:** Transcription analysis of cloned gene, Identifying and studying the translation product of a cloned gene: hybrid-release translation (HRT) and hybridarrest translation (HART); Studying protein-protein interaction by phage display, yeast two hybrid system.
4. **Human Genetic Disorders and Gene Therapy:** Monogenetic disorders, multifactorial disorders, chromosome disorders, and mitochondrial inheritance disorder; 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.
5. **Signaling Through Ion-channel Linked Cell Surface Receptors:** Voltage-gated channels, Ligand-gated channels, NMDA Receptors, GABA receptors, 5-HT receptors, IP₃ receptor, Nicotinic acetylcholine receptors, Neurotransmitters, and their applications; 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, signals from activated Ras to a cascade of protein kinases including MAP-kinases, PI3 kinase/protein kinase B signaling pathway; Cytokine receptors, and the JAK-STAT pathway. Two-component signaling pathway of bacterial chemotaxis; TGF signaling pathways; Smad signaling via negative feedback loop, TGF α signaling, and abnormal cell proliferation.

Recommended Books

1. Genetics: From Genes to Genomes - Hartwell L, Hood L, Goldberg M, Reynolds A and Silver L, McGraw-Hill Education
2. Gene Cloning and DNA Analysis: An Introduction - Brown TA, John Wiley & Sons Ltd., West Sussex.
3. Principles of Genetics – Gardner EJ, Simmons MJ and Snustad DP, John Wiley & Sons
4. Gene VII. - B. Lewin, Oxford University Press
5. From genes to clones, EL Winnacker, Panima publishing corporation, New Delhi

MPG 603 Immunopathology and Vaccine Development**Marks: 50****Credits: 2.0**

1. **Inactivation and Activation of Biologically Active Molecules:** Mechanism of antibody mediated inactivation and activation; Inactivation: direct inactivation, indirect inactivation, receptor modulation, ADCC; Activation: conformational stabilization, increased binding affinity, receptor

selection, buffering, receptor activation, Examples of antibody mediated inactivation and activation: hormones, insulin (diabetes mellitus), thyroid hormone (thyroid disease), chorionic gonadotropin, estrogen, progesterone, prolactin (infertility), erythropoietin (aplastic anaemia); Receptor's: insulin receptor (diabetes mellitus), TSH receptor (hyperthyroidism).

- 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 and Inflammation:** T-cell factors for modulation of granulomas; Granulomatous hypersensitivity reactions; Progression of granulomas; Infectious diseases (tuberculosis), Leprosy, Protective functions of granulomatous reactions, interaction of immune and nonimmune defense mechanisms, major immune defense mechanisms for infectious disease; Evasion of immune defense mechanisms.
- 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).

Recommended Books

1. Immunology: Immunopathology and Immunity - S Sell and EE Max, Medical Dept. Harper & Row
2. Bacterial Pathogenesis: A molecular Approach - BA Wilson, AA Salyers, DD Whitt and ME Winkler ASM Press, Washing, DC, USA
3. Molecular Immunology - BD Hames and DM Glover, Oxford University Press
4. The Microbial Challenge: Human Microbe Interaction- RI Krasner, ASM Press, Washing, DC, USA.
5. Kuby Immunology - JA Owen, J Punt, SA Stranford and PP. Jones, W. H. Freeman and Company.
6. Vaccine Design: Innovative Approaches and Novel Strategies- R Rappuoli and F Bagnoli, Caister Academic Press.
7. Advanced Vaccine Research Methods for the Decade of Vaccines – F Bagnoli and R Rappuoli, Caister Academic Press.
8. Vaccines - SA. Plotkin, WA Orenstein and PA Offit, Elsevier Inc.

MPG 604 Bioprocess Engineering and Technology

Marks: 50

Credits: 2.0

- 1. Concept and General Features:** Concepts, importance and steps in development of bioprocess; Applications- biopharmaceuticals, specialty products and industrial chemicals and environmental-management aids; Bioprocess unit operations- upstream and downstream processing; Development of microbial processes; Bioprocess regulatory constraints.
- 2. Upstream Processing:** Inoculum development- growth, aseptic inoculation and sampling; Media formulation and preparation; Growth and product formation - batch, semi-batch, fed-batch and continuous cultures, substrate utilization, yield of biomass, productivity; Scaling up of fermentation process.
- 3. Downstream Processing:** Strategies to recover and purify products; Separation of insoluble products- filtration, centrifugation, and other recent developments; Separation of soluble

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products- two-phase/multiphase and liquid-liquid extraction methods; Cell disruption- physical, chemical and enzymatic methods; Purification- precipitation, microfiltration/ultra-filtration, dialysis, reverse osmosis, adsorption and chromatography; Drying and crystallization.

- 4. Bioreactor Engineering and operation:** Dynamic modeling for bioprocesses; Applications of tube, packed bed, fluidized bed, cyclone and trickle flow bioreactors; Process operation, monitoring and control; Scale-up and scale-down procedures- laboratory, pilot and large scale bioreactors; Aseptic conditions- sterilization of bioreactor, media and air; Mass transfer in bioreactor-gasliquid exchange; oxygen transfer, heat transfer and aeration/agitation.
- 5. Applications of Organisms in Bioprocess:** Isolation and screening organisms, enrichment and specific screening for the desired product; Improvement of selected organism- strategies of improvement for primary and secondary metabolites, mutation, protoplast fusion, and recombinant DNA technology; Problems associated with strain improvement organisms and biosafety; Preservation and maintenance of cultures.
- 6. Advances and Challenges in Bioprocess Technology:** Sustainable waste management; Biotreatment of industrial effluent and underground water; Biorefinery; Biobanking of microbes; Bioleaching of metals, Biocatalysts; Value added food, feed, fertilizer, fuel and fiber from renewable resources; nanobiosynthesis, Market perspectives- cell to sell.

Recommended Books

1. Bioprocess Engineering: an introductory engineering and life science approach – K.G. Clarke, Woodhead Publishing
2. Bioprocess Technology: Fundamentals and Applications. Stockholm KTH
3. Advances in Bioprocess Technology – P Ravindra, Springer
4. Biochemical Engineering Fundamentals - Bailey and Ollis, Tata McGraw Hill, N.Y.
5. Advances in Biochemical Engineering - TK Bhosh, A Fiechter and N Blakebrough, Springer Verlag Publications, N.Y.
6. Bioprocess Engineering Kinetics, Mass Transport, Reactors, and Gene expressions – W.F. Veith, John Wiley and Sons.
7. Bioseparation: Down-stream processing for Biotechnology - PA Belter, EL Cussler and WS Hu, John Wiley and Sons, N.Y.
8. Separation process in Biotechnology – JA Asenjo, Marcel Dekkar, N.Y.
9. Bioprocess Engineering Principles - Doran, Acad. Press, London.
10. Bioreaction Engineering Principles- Nielsen, J. and Villadsen, Plenum press, N.Y.

MPG 605 Enzyme and Protein Biotechnology

Marks: 50

Credits: 2.0

- 1. Industrial and Technical Application of Enzymes:** Enzymes in food and feed industry, Enzymes in detergents, Enzymes in leather industry, Enzyme in textile industry, Enzymes in pulps and paper industry. Enzymes in starch processing, Enzymes in fuel production, Enzymes as diagnostic reagents.
- 2. Conformational Stability of Protein:** Enzyme stabilization, *In vitro* and *In vivo* stability, stability of proteins in solution, denaturation mechanism and renaturation.
- 3. Protein Sources:** Recombinant versus non-recombinant proteins; Microorganisms, plants and animal tissue as sources of protein.

4. **Overproduction of Enzymes:** Large-scale industrial enzyme/protein production, Expression in *E. coli*, bacteria, yeast, and baculovirus.
5. **Recombinant Protein Technology and Protein Engineering:** Basic concepts of recombinant protein technology, Techniques in enzyme/protein engineering (gene cloning, finding genes, DNA libraries, site directed mutagenesis, knockout mouse, tissue culture).

Recommended Books

1. Protein Engineering and Design - SJ Park and JR Cochran
2. Proteins: Biotechnology and Biochemistry - G Walsh, Wiley Publishers
3. Fundamentals of Protein Biotechnology, CRC Press. 1990
4. Protein Engineering Handbook- S Lutz and Uwe Theo Bornscheuer
5. Protein biotechnology- G Walsh & D Headon, John Wiley & Sons, Chichester
6. Protein biotechnology: Isolation, characterization and stabilization – F Franks, Humana Press, Totowa, New Jersey
7. Protein Engineering: Principles and Practice - JL Cleland and CS. Craik, Wiley-Liss.
8. Protein Expression: A Practical Approach - SJ Higgins and BD Hames, Oxford University Press. New York
9. Biotechnology of Microbial Enzymes: Production, Biocatalysis and Industrial Applications- G Brahmachari, Academic Press
10. Enzymes in Industry: Production and Applications- W Aehle, WILEY-VCH
11. Industrial Enzymes: Structure, Function and Applications - P Julio, MacCabe, Andrew P. Springer

MPG 606 **Advanced Bioinformatics**

Marks: 50

Credits: 2.0

1. **Genome Biology:** Genomes to life; Mapping Genomes: Genetic and Physical Maps; Importance of genome project; Microbial genome: whole genome sequencing of microbes: virus, bacteria & fungi; Human Genome Project (HGP); Human epigenome, microbiome, connectome project.
2. **Next Generation Sequencing (NGS):** NGS Methods; NGS technologies/ platforms; experiment types and applications; Workflows for various NGS experiments; Basics of NGS data analysis; Various file formats such as FASTQ, SAM, VCF, BED
3. **Comparative and Functional Genomics:** Functional annotation; Gene ontology; Microarray: Basic principle; Gene chips; Handling processed microarray data; Clustering of genes based on their expression level; Pathway analysis and building gene/protein regulatory network.
4. **Computational Proteomics:** Overview on LC-MS/MS; Peptide mass fingerprinting; Proteomics databases, Application of stable isotope labeling of amino acid in cell culture (SILAC) technology for quantitative proteomics.
5. **Emerging Techniques in Bioinformatics:** The cutting-edge techniques evolving in the field of bioinformatics available from the current literature

Recommended Books

1. Genetics: From Genes to Genomes. Hartwell L, Hood L, Goldberg M, Reynolds A and Silver L, 4th edition, McGraw-Hill Education

2. Introduction to Genomics, Arthur M. Lesk, 2nd edition, Oxford University press
3. Next-Generation DNA Sequencing Informatics, Stuart M. Brown, CSH Laboratory Press
4. Biotechnology: Genomics and Bioinformatics, Rehm H-J & Reed G, 2nd edition, vol. 5b.
5. Genomes 3. Brown TA, 3rd edition, Garland Science
6. Metagenomics for Microbiology, Izard & Rivera, Elsevier

MPG 607 Epidemiology of Infectious Diseases

Marks: 50

Credits: 2.0

1. **Infectious bacterial Diseases:** Pathogenesis of Bacterial ulcer, Anthrax, Listeriosis, Meningitis, Chlamydia and Plague
2. **Infectious parasitic Diseases:** Pathogenesis of Malaria, Leishmaniasis, Filariasis
3. **Emerging microbial infections:** Diseases of current local and global concern
4. **Disease Outbreak Investigation and Response:** Identification and investigation of outbreaks.
5. **Molecular epidemiologic typing systems of bacterial pathogens:** Importance of Epidemiologic Typing, Criteria for evaluating typing system; Phenotypic and genotyping techniques for typing of bacterial pathogens.
6. **One Health concept in disease control:** Understanding One Health concept. Deterministic and multicausal model of disease. One health concept in controlling infectious diseases.

Recommended Books

1. Applied Epidemiology: Theory to practice: Ross C. Brownson, Diana B Petitti, 1998. Oxford University Press
2. Disease Management: A Systems Approach to Improving Patient Outcome. 2001. Warren E. Todd, David B. Nash, MD. Wiley Publications
3. Disease Control Priorities in Developing Countries. 2006. Dean T. Jamison, Joel G. Breman, Anthony R. Measham, Oxford University Press
4. Communicable Disease Control Handbook. 2008. Jeremy Hawker, Norman Begg, Iain Blair. 2nd edition. Blackwell Publishing
5. Epidemiology. Leon Gordis, 2014. 5th edition. Saunders, Elsevier
6. Epidemiological research methods. Don McNeil. 1996. John Wiley and sons

MPG 608 Microbial Food Safety Management

Marks: 50

Credits: 2.0

1. **Food Safety Management Systems (FSMS):** Concept, elements and challenges of FSMS; Food hazards- biological, chemical and physical hazards; Food and personal hygiene; Hygienic design in food premises and food equipment; Ethics in food safety management.
2. **Microbiological Hazards in Food Supply Chains:** Microbiological hazards and safety management in domestic, import and export food supply chains - fruits and vegetables, poultry and eggs, livestock and meat, milk and dairy products, and fish and shellfish.
3. **Preventive Management of Food Production:** Primary production – natural and GM crops, Good Agricultural Practice (GAP), Sanitary and Phytosanitary (SPS); Secondary production- Good Hygiene Practice (GHP), Good Manufacturing Practice (GMP), HACCP plan.

4. **Microbiological Food Safety Analysis and Surveillance Systems:** Food safety laboratory supports; Food safety analysis- safety assessment, management and communication; Investigation of microbiological food borne disease outbreaks and surveillance systems.
5. **Food Safety Regulations and Enforcement:** National legislation and enforcing agency; Safety of domestic, import and export foods; Roles of national, regional and international organizations/agencies.
6. **Food Safety Inspection:** Traditional inspection systems; Categorization of risk foods; Risk based food safety inspection systems; Food labeling and claims; Food safety alert.

Recommended Books

1. The Microbiological Safety and Quality of Foods (vol 1) – BM Lund, TC Baird-Parker and GW Gould; Aspen Publications
2. Advances in Microbial Food Safety (vol 1 & 2) – J Sofos, Woodhead Publishing
3. Food Safety and Protection – VR Rai and JA Bai; CRC Press
4. Food Safety Management Programs: Applications, best practices and compliances – D Newslow; CRC Press
5. Food Safety Management- Y Mutarjemi and H Lelieveld; Elsevier
6. Food Safety Risk management– FAO of the UN, Food Safety & Quality Series No. 4. 2017

MPG 609 Bioenergy and Biofuel Technology

Marks: 50

Credits: 2.0

1. **Perspectives of Bioenergy and Biofuels:** Concept, principles and development of technologies; Bioenergy resources and interconversions; Opportunity and constrains; Environmental, economic and social concerns; Conversion of biomass to biofuels; Generations and types of biofuels.
2. **Feedstocks for Bioenergy and Biofuels:** Types, availability and pretreatment of feedstocks- sugar, starch, lignocellulosic, plant oils and animal fats, and bio-waste materials; Sustainable feedstocks for advanced bioenergy and biofuel for developing countries.
3. **Fuel Ethanol from Biomass:** Biomass and recent development in manufacturing technology; Process design, trends and integration of opportunities; Technological, economic and energy issues for bio-ethanol production from biomass wastes.
4. **Bioconversion of Biomass to Methane:** Synthesis of methane under natural conditions; Biomass composition and methane production; Potential microbes involved in methane generation; Manmade processes- methane from sanitary landfills, sewage, farm, and industrial wastes.
5. **Generation of Biohydrogen:** Biosynthesis of hydrogen under natural habitats; Renewable hydrogen from biomass; Metabolic process and engineering; Potential substrates and biological systems- dark fermentation, photobiological and combined systems.
6. **Biodiesel from Crops and Microbes:** Biodiesel production by using- potential crops, microorganisms, algae and trans-esterification process; Strategies to engineer microbes and crops for biofuel generation; Algae as a potential oil generator for biodiesel.
7. **Biofuel Cells:** Bioluminescence and its applications; Fuel cells- conversion of organic matter to secondary fuels; Biofuel cells for electricity- enzyme-based, direct glucose-based, microbial based and mammalian biofuel cells.

Recommended Books

1. Biofuels and Bioenergy – J Love and JA Bryant, Wiley and sons Inc.
2. Bioenergy and Biofuels – O Konur, CRC Press
3. Biomass for Biofuels – K Bulkowska, ZM Gusiatin, E Klimiuk, A Pawlowski, T Pokoj, CRC Press
4. Algal Biofuels – L Pereira, CRC Press
5. Biotechnology: Principles and Applications. Higgins IJ, Best DJ & Jones J.
6. Biotechnologies and Renewable Energy – Murray Moo-Young, Sadiq Hossain, Jonathan Lamptey

MPG 610 Molecular Virology and Oncology

Marks: 50

Credits: 2.0

1. **Persistence of Viruses:** Mechanisms of viral persistence; Persistence of HSV and EBV.
2. **Viruses of Special Interest and Recent Outbreaks:** Dengue and chikungunya virus; Ebola and Nipah virus infection; Other important viruses of recent epidemics.
3. **Molecular Oncology and Tumor Biology:** Causes of cancer; Cancer related genes including oncogenes with their normal cellular function, mutagenesis and consequences of their mutant state in cancer.
4. **Spread of Cancer:** Tumor progression and metastasis; Interaction between malignant and normal cells.
5. **Tumor Suppressor Genes:** Definitions and functions of tumor suppressor genes, their normal cellular function and mutations; Pathways of Rb and p53 in cancer.
6. **Oncogenic Viruses:** Different types of oncogenic viruses; Viral oncogenes; Molecular mechanisms of transformation by DNA and RNA viruses
7. **Major Treatment Principles of Cancer;** surgery, radiotherapy, hormonal treatment, and biological therapy; Novel and developing treatment strategies; Ethics; Palliative treatment; Physical and chemical factors contribute to cancer development.

Recommended Books:

1. Fields Virology. David M. Knipe and Peter M. Howley. Philadelphia, PA, USA. Lippincott Williams & Wilkins, 2013.
2. Principles of Virology: molecular biology, pathogenesis and control – Flint, Enquist, Krug et al. ASM press, Washington DC. 3
3. Molecular Oncology – Ian Tannock, Richard Hill, Robert Bristow, Lea Harrington- McGraw-Hill International Editions
4. Molecular Biology of Cancer- Mechanisms, Target and Therapeutics, Lauren Picorino, Oxford University Press.
5. The Biology of Cancer- Weinberg, Robert A, Taylor & Francis, London

MPG 611 Extremophiles and Novel Biological Products

Marks: 50

Credits: 2.0

1. **Extremophiles and Extremolytes:** Extreme environments, types and diversity of extremophiles; extreme environments as resources for microbial extremolytes as novel biological products; Applications of extremophiles in biotechnological processes.

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2. **Potentials of Deep-sea Habitats and Microbial Halophiles:** Deep-sea habitats, Hypersaline environments; halophilic properties of microbes. Biotechnological potential of piezophiles and halophiles.
3. **Hyperthermophiles and Psychrophiles:** Biotopes, isolation, and classification of hyperthermophiles; Habitats, isolation, and characteristics of psychrophiles; Biotechnological applications of cold-adapted bacteria.
4. **Acidophiles and Alkaliphiles:** Characteristics of eukaryotic, mesophilic and thermophilic acidophiles; acid stable proteins. Isolation and classification of alkaliphilic microorganisms.
5. **Biotechnological applications of Anaerobic Extremophiles:** Characteristics and biotechnological exploitation of anaerobic and metal resistant microbes, bioremediation of toxic metal pollution.
6. **Extremozymes as Novel Extremolytes:** Sources of natural extremozymes; Screening strategy for novel extremozymes, thermoactive enzymes of biotechnological interests.
7. **Extremophiles and Their Innovative Applications:** Search for extra-terrestrial life; Applications in food processing, biofuel research, recovery of metals, implications of radiation resistant extremolytes; Smart therapeutics.

Recommended Books

1. Extremophiles - Microbial life in Extreme Environments. Horikoshi K and Grant WD. Wiley-Liss, New York
2. Microbial Growth and Survival in the Extreme Environments- Brock TD.
3. Biotechnology: Multi-volume comprehensive treaties, vol. 10 (Special processes). Rehm HJ & Reed G. Vch Verlagsgesellschaft Mbh, Germany
4. Microbiology of Extreme Environments – Edward C. McGraw Hill, New York
5. Extremophiles: Sustainable Resources and Biotechnological Implications- Singh OV. John Wiley & Sons, New York
6. Extremophiles: Where It All Began - Horikoshi K. Springer, Berlin
7. Extremophiles Hand book - Horikoshi K. Springer, Berlin

MPG 612 Pharmaceutical Biotechnology

Marks: 50

Credits: 2.0

1. **Biopharmaceuticals from Cloned Genes:** Problems with the production of recombinant protein in *E. coli* and eukaryotic systems- yeast and filamentous fungi, animal cells and live animals and plants.
2. **Drug Discovery and Development:** Drug pre-discovery and discovery; Combinatorial chemistry and rational drug design; Genomics, bioinformatics and proteomic approaches for drug discovery; Drug development, biotechnological improvement, trials and approval.
3. **Techniques in Production of Biopharmaceuticals:** Advantages and disadvantages with different production systems- bacteria, plant and animal cells for biotechnological drugs.
4. **Recombinant Therapeutic Antibodies:** Antibodies using hybridoma technology and engineered monoclonal antibodies; Hybrid human-mouse monoclonal antibodies; Antibody fragments-antigen-binding single protein chains, Peptide combinations and peptide-colicin adduct; Combinatorial libraries of antibody fragments and full-length antibodies; Shuffling CDR sequences; Dual-variable-domain antibodies; Immunotoxins and anticancer antibodies.

5. **Nucleic Acids as Therapeutic Agents:** Antisense RNA and DNA technology; Ribozymes and deoxyribozymes; Chimeric RNA–DNA molecules, Initiating RNA interference (RNAi) and their applications; Engineering antibody genes against viruses and cancer; Nucleic acid delivery and gene therapy against autoimmune disorders and cancers.

Recommended Books

1. Pharmaceutical Biotechnology: Concepts and Applications - G Walsh. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex
2. Pharmaceutical Biotechnology: Fundamentals and Applications - Crommelin DJA, Sindelar RD & Meibohm B. Informa Healthcare, New York
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA - BR Glick, JJ Pasternak and CL Patten. ASM Press, American Society for Microbiology, Washington DC
4. Microbial Biotechnology: Fundamentals of Applied Microbiology - AN Glazer and H Nikaido. Cambridge University Press, Cambridge
5. Gene Cloning and DNA Analysis: An Introduction - Brown TA. Wiley & Sons Ltd., West Sussex
6. Bailey & Scott's Diagnostic Microbiology - BA Forbes, DF Sahm and AS Weissfeld, Mosby, St. Louise
7. Bacterial Pathogenesis: A Molecular Approach - BA Wilson, AA Salyers, DD Whitt and ME Winkler. ASM Press, American Society of Microbiology, Washington DC
8. Foundations in Pharmaceutical Biotechnology - BP Nagori and R Issarani, PharmaMed Press Pvt Ltd, Andhra Pradesh
9. Text Book of Pharmaceutical Biotechnology - K Sambamurthy and A Kar, New Age International Ltd., Publishers, New Delhi
10. Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs - Rodney Ho, Wiley

MPG 613 Viva-Voce

Credit: Passed

The oral examination is designed to assess the student's aptitude and potential to ultimately perform as an independent microbiologist. The pass mark is 50%.

Second Part

Thesis

The Department will provide all laboratory facilities to the students for the Thesis works. The students may also avail the opportunity to work in other reputed research laboratories for carrying out part of their works. Upon completion of the works, the MPhil/ PhD student will prepare a thesis based on his or her own research findings. This document will be reviewed by the respective supervisor(s) before submission for Final Evaluation by externals and defended in a final examination. The students will also submit a prescribed submission form provided by the Department. It is expected that students should present their works in scientific meetings/ conferences and prepare manuscripts for publication in peer-reviewed scientific journals.

Seminar Presentation

During the progress of the programme, the students of both MPhil and PhD shall deliver at least one and two seminars, respectively related to their thesis work. It is expected that the students should participate in research seminars and other scientific seminars arranged by the Department throughout their tenure in the postgraduate programmes.