WOMEN UNIVERSITY MARDAN

Contents

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M.Phil. Biotechnology

1st Year

Following is the list of M. Phil courses, and four subjects of 12 credit hours will be offered in the each semester in the 1st Year of M.Phil during Course work.

List of Courses:

1. **BIOT-701:** Advances in Biotechnology
2. **BIOT-702:** Recent Trends in Molecular Diagnostics
3. **BIOT-703:** Advances in Environmental Biotechnology
4. **BIOT-704:** Advances in Pharmaceutical Biotechnology
5. **BIOT-705:** Advances in Bioinformatics
6. **BIOT-706:** Advances in Immunology and Immunogenetics
7. **BIOT-707:** Advances in Fungal Biotechnology
8. **BIOT-708:** Advances in Protein Engineering
9. **BIOT-709:** Advances in Health Biotechnology
10. **BIOT-710:** Advances in Agriculture Biotechnology
11. **BIOT-711:** Advances in Industrial Biotechnology
12. **BIOT-712:** Advances in Virology
13. **BIOT-713:** Advances in Genomics, Proteomics and
14. **BIOT-714:** Advances in Animal Biotechnology
15. **BIOT-715:** Recent Trends in Microbial Enzyme Technology
16. **BIOT-716:** Recent Trends in Food Biotechnology
17. **BIOT-717:** Advances in Recombinant DNA Technology and Genetic Engineering
18. **BIOT-718:** Adnavces in Oncology
19. **BIOT-719:** Advances in Fermentation Technology
20. **BIOT-720:** Biosafety and Waste Managment

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2nd Year

3rd Semester		
Codes	**Subject**	**Credit Hours**
	Research	06
Total		**06**

4th Semester		
Codes	**Subject**	**Credit Hours**
	Research	06
Total		**06**

Total Credit Hours: 30

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Details of MPHIL Biotechnology Courses

BIOT-701 ADVANCES IN BIOTECHNOLOGY (3+0)

Objectives:

Advances in Biotechnology offers a broad sense of understanding on how modern biotechnology is developed to improve the quality of through the use of microbes and microbial communities by pollution abatement to mitigation of climate change, bioenergy, biomaterial to enzyme and drugs discovery. The students will gain an understanding in both scientific knowledge of designing and producing novel biologics, and business challenges including regulatory issues.

Course Outline:

High Capacity vectors for Genetic Engineering, DNA sequencing Methods and next Generation Sequencing, RNA Interference Applications in the treatment of Cancer Metagenomics: The Exploration of unculturable Microbial World, Genome Editing, Biosensors, Recent advances in Stem Cell Research, Immunotechnology, 4D printing and Tissue Engineering, Future of Biotechnology Companies: A Global Perspective

Recommended Book List

1. Indu Ravi, Mamta Baunthiyal, Jyoti Saxena. 2014. Advances in biotechnology.
2. Ali Osman. 2018. Recent Advances in Biotechnology.
3. HN Thatoi, BB Mishra.2013. Advances in Biotechnology.
4. Ashok Pandey, Ranjna Sirohi, Christian Larroche, Mohammad Taherzadeh. 2022. Current Developments in Biotechnology and Bioengineering.
5. Neelu N. Nawani, Madhukar Khetmalas, P.N. Razdan, Ashok Pandey. 2014. Advances in Biotechnology.

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BIOT-702 Recent Trends in Molecular Diagnostics (3+0)

Objectives:

The objectives of Recent trends in molecular diagnostics is to familiarize students with molecular diagnostic technologies, and increase the intuition and understanding of computational methods used to analyze molecular diagnostic data, building the students' abilities to interpret molecular diagnostic testing and to integrate results into clinical decision making.

Course Outline:

Trends of molecular diagnostics in clinical bacteriology, Identification and drug-susceptibility testing of microorganism, Phenotype -based methods, Genotyping techniques and their applications (forensic analysis, transplants, farmacogenetics); Microfluidics and Nanotechnology, Qualitative and quantitative techniques for gene expression analyses, and for microbial/viral detection and identification, in order to provide information for diagnosis, prognosis, therapy and monitoring of therapy efficacy (including real time PCR, ddPCR, Next Generation Sequencing); Molecular cytogenetic applied to the detection of cryptic chromosomal aberrations; Techniques for analysis of DNA methylation defects (tumours, imprinting defects), Microarray based Techniques, Mass Spectrometry, Sequencing based Technology, Mutations detecting Techniques, Karyotyping technology Strengths and limitations of karyotyping, Fluorescence in situ hybridization technology FISH technique, FISH analysis/interpretation.

Recommended Book List

1. Mousumi Debnath, Godavarthi, B.K.S Prasad, Prakash S. Bisen. 2010. Molecular Diagnostics: Promises and Possibilities.
2. George P. Patrinos. 2017. Molecular Diagnostics.
3. Pongali Raghavendra, Thammineni Pullaiah. 2018. Advances in Cell and Molecular Diagnostics.
4. Jim F. Huggett, Justin O' Grady. 2014. Molecular Diagnostics. Current Research and Applications.
5. George P. Patrinos, Wilhelm Ansorge, Phillip B. Danielson. 2016. Molecular Diagnostics.

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BIOT-703 Advances in Environmental Biotechnology (3+0)

Objectives:

The Environmental Biotechnology course aims to introduce and elaborate the fundamental concepts and applications of biotechnology in all aspects of environment including its protection, restoration and sustainability. Considering the rising challenges of climate change, energy and environmental crisis, this course will emphasize upon the recent development of biotechnology for harnessing microbial potential in environmental applications.

Course Outline:

Microbial diversity of environment: Microbes in air, water, waste water and soil; Introduction, distribution, sampling techniques and identification. Microbes of extreme environment. Microorganisms as bio-indicators in the environment, Role of microorganisms in element cycles – different cycles. Ecological impacts of microbes - Symbiosis (Nitrogen fixation and ruminant symbiosis) - Microbes and Nutrient cycles - Microbial communication system - Quorum sensing – Microbial fuel cells - Prebiotics and Probiotics – Vaccines

Microbes in the degradation of wastes, Bioremediation: Its role in Environmental management, advantages and disadvantages. Control of pests and diseases by microorganisms, Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides. Microbes in metal extraction, mineral leaching and mining, copper extraction by leaching and microbes in petroleum product formation.

Methods of water sampling for pollution analysis: Biofilms in treatment of waste water: Biofilm development and biofilm kinetics, aerobic biofilms. Bioreactors for waste water treatments: Reactor types and design, Reactors in series - Different types of water sampling tools and it uses – Geomicrobial transformations – Biomobilization of silicon, phosphate, nitrogen – Geomicrobiology of fossil fuel, methane, peat, coal and petroleum

Practical aspects of genetic engineering with microorganisms from extreme environment: Use of extremophilic microorganisms in waste treatment and methane production from agro industrial wastes - Production of enzymes like cellulase, proteases, amylases - Alcohol and acetic acid production – Biocomposting and Biomining - Alternate fuels: Source and mechanism of various biofuel production

Metagenomics: Environmental Genomics, ecogenomics or community genomics, the study of genetic material recovered directly from environmental samples and future applications in bioremediation - Genetically modified organisms and Biosafety- a general account

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Recommended Book List

1. Raman Kumar, Anil Kumar, Sharma, Sarabjeet Singh Ahluwalia. 2017. Advances in Environmental Biotechnology.
2. Naga Raju Maddela, Luz C Garcia Cruzatty, Sagnik Chakraborty. 2021. Advances in the Domain of Environmental Biotechnology.
3. Marian Petre. 2013. Environmental Biotechnology.
4. Jeyabalan Sangeetha, Devarajan Thangadurai, Muniswamy David, Mohd Azmauddin Abdullah. 2016. Environmental Biotechnology.
5. Sanket J. Joshi, Arvind Deshmukh, Hemen Sarma. 2021. Biotechnology for Sustainabl;e Environment.

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BIOT-704 Advances in Pharmaceutical Biotechnology (3+0)

Objectives:

The course exposes students to various topics in biotechnology, including the pharmacist's role in biotechnology, criteria for regulatory approval for biotechnology drugs, technology in genetic engineering and its application to pharmacy and tissue culture and in understanding the various techniques in biotechnology and their applications in the manufacturing of biopharmaceuticals and biomedical research.

Course Outline:

Scientific principles for biotechnology in pharmaceutical product development, Advanced biotechnology in novel drug development, Technologies used for recombinant protein production, Technologies for monoclonal antibody productions and their therapeutic applications, Mechanisms how vaccine works and approaches of novel vaccine development, Commonly used gene therapy vectors and their applications, Mechanisms of using RNA for the treatment of human diseases, Advanced technologies for genome editing and their potential application in treatment of human diseases, Advantages and challenges in applying stem cell mediated therapy, the mechanisms of exosome production and its potential for therapeutic application, Organization & processes in biotechnology and pharmaceutical industry for their operations and research and development including regulatory issues, Challenges and opportunities in development of biologicals and drugs in the pharmaceutical and biotechnology industry

Recommended Book List

6. Jayanta Kumar Patra, Amitesh C. Shukla, Gitishree Das. 2020. Advances in Pharmaceutical Biotechnology.
7. Muhammad Sajid Hamid Akash, Kanwal Rehman, Kanwal Irshad, Shuqing Chen. 2023. Pharmaceutical Biotechnology in Drug Development.
8. Vyas Kumar. 2011. Pharmaceutical Biotechnology.
9. Daan J.A. Crommelin, Robert D. Sindelar, Bernd meibohm. 2019. Pharmaceutical Biotechnology.
10. Kokate, Jalalpure, Hurakadle. 2013. Textbook of Pharmaceutical Biotechnology.

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BIOT-705 Advances in Bioinformatics (3+0)

Objectives:

The course in Advanced Bioinformatics gives you a better understanding of the bioinformatic methods and algorithms used in different types of analyses and of the way data and results are presented. The course will provide the necessary skills needed to perform large-scale analyses, for example assembly and annotation of genomes, analysis of gene expression and constructing phylogenetic trees.

Course Outline:

Introduction of biological sequences: DNA, RNA, protein, genome, different types of genes, evol phylogenetic analyses, sequence databases using bioinformatic tools algorithms and models used by tools, Linux/Unix, working in a command-line environment, Assemble a genome using shorter sequences, available techniques, advantages and disadvantages of the different techniques, different sequencing formats, Population genomics and quantitative genomics, Gene expression analysis, ethics and databases.

Recommended Book List

1. Vijai Singh, Ajay Kumar. 2021. Advances in Bioinformatics.
2. Simona Alibrandi. 2020. Advances in Bioinformatics.
3. Dongqing Wei, Qin Xu, Tangzhen Zhao, Hao Dai. 2014. Advances in Structural Bioinformatics.
4. Luigi Donato, Simona Alibrandi, Rosalia D' Angelo, Concetta Scimone, Antonina Sidoti, Alessandra Costa. 2020. Advances in Bioinformatics, Biostatistics and Omic Sciences.
5. Jaoa C. Setubal, Waldeyr Mendes Silva. 2020. Advances in Bioinformatics and Computational Biology.

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BIOT-706 Advances in Immunology and Immunogenetics (3+0)

Objectives:

This course is designed to put into perspective the traditional technologies and the most advanced techniques of immunology, to study the immune system and its application to different areas of bioscience research, diagnostics and biotechnology.

Course Outline:

Antibodies: understanding of different strategies for specific antibody production in vivo and in vitro evaluation of their specificity, the different approaches to obtain polyclonal and monoclonal antibodies and purification. **Flow Cytometry:** knowledge of flow cytometer technology and its potential for multiple biological assays, for the expression of cellular markers, cell cycle phases, apoptosis, production of soluble factors (cytokines and chemokines), activation and cell proliferation cytotoxicity, cell viability, production of free radicals, etc. **Advanced Techniques in Immunology**: **Functional analysis of lymphocytes**: knowledge of techniques for measuring the functional capacity of T and B lymphocytes Proliferation, cytotoxicity, cytokine production, intracellular Ca2+, immunoglobulin production. PCR techniques applied to Immunology: knowledge of the techniques of PCR, RT-PCR, in situ-PCR and real-time PCR in the application to the analysis of gene expression, genetic polymorphisms and rearrangements of immunoglobulin genes and T cell receptors. **Immunobiotechnology:** This module is designed to introduce the student the most demanding applications directly from knowledge of the immune system, such as vaccines and other therapeutic tools to modulate the immune response. **Vaccines and Convergent Technologies**: To determine the molecular mechanisms involved in the generation and use of vaccines, and the biological basis of its modulation. Identification of main problems in obtaining highly efficient vaccines with broad spectrum. Understanding physic al-chemical technologies applied to the study of immunological parameters, microsystems, nanotechnology, surface functionalization, biocompatible materials, bionanosensores. **Experimental Immunomanipulation**: design experiments that lead to specific or general handling of the cellular and molecular components of the immune system and for choosing the most appropriate models and methods for obtaining their goals by manipulating the immune system. **Immunopharmacology** : knowledge of current uses of components of the immune system to specific therapies, such as cytokines, monoclonal antibodies and the search for therapeutic targets for these reagents. **Animal models for in research in Immunology**: To provide students with the knowledge of the key animal models for the study of immunology and immunopathology. **Autoimmunity**: autoimmune and inflammatory diseases, Organ-specific and systemic autoimmunedideseases. Mechanisms of autoimmunity. Practical laboratory diagnostic methods applied to these pathologies. **Neuroimmunology**: interaction between the immune system and nervous system.

Nervous system diseases caused by malfunction of the immune system, Multiple sclerosis as a paradigm. **Immunohematology and transplantation**: Update of knowledge in solid organ and stem cells transplantation from various sources, Bone marrow, umbilical cord blood, Immunology of pregnancy. Practical laboratory diagnostic methods applied to these pathologies. **Immunodeficiency and AIDS**: Primary Immunodeficiencies, Acquired immunodeficiency. Biology of retroviruses. Immune response to HIV, AIDS, Potential vaccines. Practical laboratory diagnostic methods applied to these pathologies. **Allergy** : humoral and cellular basis of the allergic response. Allergens. Treatment of allergic diseases. Public health significance. Practical laboratory diagnostic methods applied to these pathologies.

Recommended Book List

1. Muneeb Rehman, Azher Arafah, Md. Niamat Ali, Shafat Ali. 2021. Immunogenetics: A Molecular and Clinical Overview.
2. Alt. Frederick W. 2009. Advances in Immunology.
3. Jagat Kanwar. 2012. Recent Advances in Immunology to Target Cancer, Inflammation and infections.
4. Raj Bajwa. 2022. Advances in Clinical Immunology, Medical Microbiology, Covid-19 and Big Data.
5. Jorge Morales-Montor. Volume 1 and 2. 2022. The innate Immune system in Health and disease.

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BIOT-707 Advances in Fungal Biotechnology (3+0)

Objectives:

This course is intended for advanced learning about the impact of fungi on human health, nutrition and drug discovery. The course may be of particular interest to students involved in the study of food science and nutrition; animal and health sciences; microbiology; pharmacology; and plant pathology.

Course Outline:

Introduction of fungi: Basics of morphology and biochemistry, Theories about disease. Introduction to fungal systematics, phylogeny, and identification. Special topic, taxonomy and toxins. Mycoses: history, concepts, classification of Mycoses: superficial and subcutaneous Mycoses: dimorphism, General groups for mycophagy and special projects, Fungi in folklore and history of Mycoses. Antifungal drugs, Fungi as food: "mycophagy" Fungi in food and drink, fermentations Fungi and food safety, spoilage and introduction to mycotoxins, Fungal toxicology – mushroom poisons. Fungal toxicity – mycotoxins Fungi, allergy and indoor air quality. Hallucinogenic fungi and hallucinogens Fungi as pharmaceuticals: traditional medicine, antibiotics. Fungi as pharmaceuticals: statins and immune suppressants Special topic, Cryptococcus and its treatment

Recommended Book List

1. Tulasi Satyanarayana, Sunil K, Deshmukh, B.N. Johri. 2017. Development in Fungal Biology and Applied Mycology.
2. Amritesh, Chandra Shukla. 2022. Applied Mycology.
3. Vijay Rani Rajpal, Ishwar Singh, Shrishall S. Navi. 2022. Fungal Ecology and Control Management.
4. Marcela C. Pagano. 2016. Recent Advances on Mycorrhizal Fungi.
5. Pankaj Kumar Chaurasia, Shashi Lata Bharati. 2020. Research advances in the fungal World.

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BIOT-708 Advances in Protein Engineering (3+0)

Objectives:

Upon successful completion of this course, students shall be able to compare different expression systems for recombinant protein/enzyme production, evaluate different protein/enzyme separation techniques, analyze the advantages and disadvantages of various molecular modification techniques for recombinant protein/enzyme purification, distinguish the theory of directed evolution and rational design for enzyme engineering, evaluate a number of in vitro DNA mutation technologies and differentiate selection and screening for directed enzyme evolution.

Course Outline:

Visualizing protein structures (PyMOL), Protein folding and stability, Strategies to engineer more stable proteins, Molecular mechanics approach to modeling, How enzymes catalyze reactions, Site-directed mutagenesis, Strategies to engineer faster enzymes, Measuring enzyme selectivity, Strategies to engineer more selective enzymes, Modeling selectivity (conformations & molecular dynamics), Single amino acid substitutions – error prone PCR, Single amino acid substitutions – saturation mutagenesis, Multiple amino acid substitutions – stepwise combinations, Multiple amino acid substitutions – simultaneous changes, Recombination methods – limitations, homology, Genome mining approaches, Protein expression, Metabolic engineering.

Recommended Book List

1. Etienne Derat and Shina Caroline Lynn Kamerlin. 2022. Computational Advances in Protein Engineering and Enzyme Design.
2. Brian Kuhlman and Philip Bradley. 2019. Advances in Protein Structure Prediction and Design.
3. Huimin Zhao, Sang Yup Lee, Jens Nielsen, Gregory Stephanopoulos. 2021. Protein Engineering: Tools and Applications.
4. S. Y. Lee, J. Nielsen, G. Stephanopoulos. 2021. Protein Engineering.
5. Timir Tripathi, Vikash Dubey. 2022. Advances in Protein Molecular and Structural Biology Methods.

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BIOT-709 Advances in Health Biotechnology (3+0)

Objectives:

The aim of advances in health biotechnology is the prevention, diagnosis and treatment of diseases. The principles of health biotechnology are applied in pharmacology, gene therapy, stem cells and tissue engineering.

Course Outline:

Recombinant DNA Technology, Genetic basis of Diseases, Immunopathology, Infectious Diseases, Pharmacogenomics, Drug designing, Vaccines, Diagnostic Tools for Diagnosis of Diseases, CRISPR-CAS Technology.

Recommended Book List

1. Mumtaz Anwar, Riyaz Ahmad Rather, Zeenat Farooq. 2022. Fundamentals and Advances in Medical Biotechnology.
2. Debmalya Barh. 2022. Biotechnology in Healthcare.
3. Rajneesh Prajapat, M. Kasturi, B. Manivannan, Anita Mishra. 2021. Fundamentals of Medical Biotechnology.
4. Pankaj K. Bhowmik, Saikat K. Basu, Aakash Goyal. 2009. Advances in Biotechnology.
5. Firdous Alam Khan. 2017. Biotechnology in Medical Sciences.

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BIOT-710 **Advances in Agriculture Biotechnology** **(3+0)**

Objectives

This subject focuses on modern and cutting-edge techniques used in cell culture and tissue engineering, genome editing, transformation and transgenesis, rapid breeding and selection and synthetic biology to address contemporary issues in sustainable agriculture. It will also help in critically appraise the essential principles, technologies, and applications of biotechnology as applied to sustainable agriculture, distinguish the advantages and disadvantages of using biotechnology in agriculture and interpret the national and international regulatory framework of agricultural biotechnology.

Course Outline

Introduction, Plant Molecular Markers, Phyto-hormones; types and application in biotechnology, Cell and Tissue Culture, Protoplast Culture, Soma clonal Variation as breeding tool, Somatic Hybridization, Plant Transformation, Chloroplast Transformation, Biofertilizers, Microbial Transformation of Carbon, Nitrogen, Phosphorus and Sulphur, Biological Nitrogen Fixation, Plant Microbe Interaction, Biotic and abiotic stress tolerance, Biosafety and concerns.

Recommended Book List

1. Dinesh Kumar Srivastava, Ajay Kumar Thakur, Pankaj Kumar. 2021. Agricultural Biotechnology: Latest Research and Trends
2. Allen O'Conner. 2020. Agricultural Biotechnology
3. Anjali Priyadarshini, Prerna Pandey. 2018. Bio catalysis and Agricultural Biotechnology: Fundamentals, Advances, and Practices for a Greener Future.
4. Arie Altman and Paul M Hasegawa. 2012. Plant Biotechnology and Agriculture: Prospects for the 21st Century
5. C. Neal Stewart Jr. 2012. Plant Biotechnology and Genetics: Principles, Techniques and Application.

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BIOT-711 Advances in Industrial Biotechnology (3+0)

Objectives

The aim of this subject is to provide fundamental insights of the principles, practice and key concepts relevant to industrial biotechnology and build a foundation for more advanced studies in bioprocess technology. On successful completion of this subject, students should be able to describe the fundamental biological and engineering principles for production of proteins, metabolites and cells and devices and apparatuses and understand the principles for engineering design of key unit operations and other functional operations such as bioreactor cultivation and chromatographic separation of bioproducts and analytical instruments.

Course Outline

Biotechnology, applications of industrial biotechnology; Microbial biomass, microbial enzymes and metabolites production, screening methods and their storage; Industrial Fermentations: Types; Fermentation Systems; Design of a Fermenter; Antifoams Sterilization; Industrial Products and Process: Microbial enzymes, Fuels and industrial chemicals; Biotransformation: transformation processes, the Isolation, preservation and improvement of Industrially Important Micro-Organisms; Use of recombination systems, protoplast fusion techniques; Bio-based renewable resources.

Recommended Book List

1) Debabrata Das, Soumya Pandit. 2021. Industrial Biotechnology.
2) Mark Warner Pe. 2019. Industrial Biotechnology Commercialization Handbook: How to Make Proteins Without Animals and Fuels or Chemicals Without Crude Oil.
3) Mark Anthony Benvenuto. 2019. Industrial Biotechnology.
4) Christoph Wittmann, James C. Liao. 2017. Industrial Biotechnology: Products and Processes.
5) Nduka Okafor. 2016. Modern Industrial Microbiology and Biotechnology.

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BIOT-712 **Advances in Virology** **(3+0)**

Objectives

This advanced virology subject has been designed with the aim to explore the biology and pathogenesis of medically significant viruses at the cellular and molecular level. The subject will also study how viruses can be used in the biotechnology industry and gene based therapeutic lines to treat disease as well as will focus on the technology used in the current diagnostic virological laboratory and recent advances in the recognition of pathogen and disease epidemiology.

Course Outline

Virus Structure; Viral Classification; Viral Genome (Genome organization of DNA and RNA viruses, salient features of viral genome); Virus Replication, Replication strategies of ssDNA, dsDNA, dsDNA-RT, +ssRNA, -ssRNA and dsRNA viruses; Viral Pathogenesis (Overview of mechanism of virus mediated diseases); DNA and RNA Transforming Viruses (Viral mediated oncogenesis with some example of RNA and DNA transforming viruses); Virus-Host Interactions (Host defense against viruses, Viral strategies to overcome host defense); Antiviral Drugs and Vaccines (Rationales of antiviral drugs, Type of antiviral vaccines), viruses as gene delivery vector.

Recommended Book List

1) Jennifer Louten. 2022. Essential Human Virology
2) Dennis Bamford, Mark Zuckerman. 2021. Encyclopedia of Virology.
3) Jane Flint, Vincent R. Racaniello, Glenn F. Rall, Theodora Hatziioannou, Anna Marie Skalka. 2020. Principles of Virology, Volume 1: Molecular Biology, 5th Edition.
4) Douglas D. Richman, Richard J. Whitley, Frederick G. Hayden. 2020. Clinical Virology
5) Margaret Kielian, Thomas Mettenleiter, Marilyn Roossinck. 2018. Advances in Virus Research.

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BIOT-713 Advances in Genomics Proteomics and Metabolomics (3+0)

Objectives

The course is planned to acquaint the students with structural and functional genomics, proteomics and metabolomics. This course will emphasis on the theory of "omics" and deliver knowledge about the current and advance practices used in omics research.

Course Outline

Introduction to omics and genomics; DNA databases; genome sequencing and annotation, next generation sequencing, Human genome project, Genome mapping and organization; Gene discovery- Expressed Sequencing Tags (ESTs) ; Chromosome walking; Structural variation in the genomes; Sequence polymorphism in genome and SNPs; Techniques: microarrays, Serial analysis of gene expression (SAGE); Proteomics: Introduction to proteomics; Protein databases; Proteomics technologies: 2D gel electrophoresis, mass spectrometry, Yeast 2-hybrid system, Tandem affinity purification, protein microarray; protein sequencing; Protein linkage mapping; Strategies for protein identification; Protein modifications and proteomics; Application of proteome analysis to drug and biomarker discovery; Interaction Proteomics; Metabolomics: Introduction to metabolomics; Metabolic pathway resources; KEGG; Biocarta; Nuclear magnetic Resonance Spectroscopy and Mass spectrometry in metabolomics.

Recommended Book List

1) Ana Valéria Colnaghi Simionato. 2021. Separation Techniques Applied to Omics Sciences: From Principles to Relevant Applications.
2) Paban K. Agrawala, Poonam Rana. 2021. Epigenetics and Metabolomics
3) Babak Arjmand. 2019. Genomics, Proteomics, and Metabolomics: Stem Cells Monitoring in Regenerative Medicine.
4) Jose Horcajadas, Jaime Gosalvez. 2018. Reproductomics: The -Omics Revolution and Its Impact on Human Reproductive Medicine.
5) Debmalya Barh, Kenneth Blum, Margaret A. Madigan. 2016. OMICS: Biomedical Perspectives and Applications**.**

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BIOT-714 **Advances in Animal Biotechnology** **(3+0)**

Objectives

The main objective of this subject is to advance knowledge on cloning vectors and their practices in gene cloning technologies and principles of cloning strategies and screening analysis of Re-combinations. To apply principles of Biotechnology concepts in veterinary sciences i.e. production of transgenic animals, Artificial insemination, Invitro fertilization, Embryo transfer technology, Medicine, Gene transfer techniques.

Course Outline

Introduction to animal biotechnology, Animal genes and genomes, Gene expression and regulation, gene editing, enzymes used in gene cloning, stem cell therapies, vaccine technology, reproductive technologies, reproductive cloning, production of transgenic animals and applications, Gene transfer methods for mammalian cells and animal transgenics, DNA technologies and bioinformatics, somatic cell nuclear transfer, DNA technologies, protein technologies and bioinformatics, DNA Diagnostics, the use of ELISAs for protein diagnostics, cell culture, knock out mouse model, preparation of animal disease models, biotechnology in animal breeding and ethics

Recommended Book List

1) Heiner Niemann, Christine Wrenzycki. 2022. Animal Biotechnology 1: Reproductive Biotechnologies.
2) Ashish S. Verma, Anchal Singh. 2020. Animal Biotechnology: Models in Discovery and Translation.
3) R. Sasidhara. 2019. Animal Biotechnology.
4) Jogdand, S.N. Gene Biotechnology. 2019. Himalaya Publishing House.4thEd.
5) A.K. Srivastava. Animal Biotechnology. 2018. Oxford & IBH Publishing Co Pvt Ltd.

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BIOT-715 Recent Trends in Microbial Enzyme Technology (3+0)

Objectives

This course aims to give students an idea of the wide range of enzyme applications in paper, leather, textile and food industries. At the end of this course, students will have gained an appreciation of the immense scope for use of enzymes in industry as well as technology employed for their effective production, purification and expression.

Course Outline

General review of enzyme nature and functions; Enzyme assays; Quality of enzyme preparations; Applied biocatalysis; Reactions catalyzed by enzymes; Enzymes as processing aids and final products: detergent industry, textile industry, leather tanning industry, petroleum industry, enzymes as feed additives. Case studies in the application of biocatalysts for the production of biochemicals: high fructose syrup, glucose production, aspartame, L-Lysine; Immobilized biocatalysts: cross-linking with glutaraldehyde, adsorption on carriers, covalent attachment, granulation, gel entrapment, membranes, immobilized viable cells; Enzyme production, isolation and purification; Enhancing enzyme expression and designing for improved properties.

Recommended Book List

1) Pankaj Bhatt. 2022. Industrial Applications of Microbial Enzymes.
2) Ramesh C. Ray, Cristina M. Rosell. 2021. Microbial Enzyme Technology in Food Applications.
3) Immobilized Enzyme: Principles and Applications, edited by N. M. Nhut. 2016. Delve Publishing LLC.
4) Industrial Biotechnology, edited by D. Thangadurai and J. Sangeetha. 2016. Apple Academic Press.
5) Industrial Biotechnology: problems and remedies, I.S. Thakur. 2013. IK International Publishing House.

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BIOT-716 **Recent Trends in Food Biotechnology** **(3+0)**

Objectives

The general objective of this course is to give students an understanding of new advances in food biotechnology. On completion of this course the students will be able to understand the importance/role of microorganisms in food processing, preservation and waste management and understand the basic molecular biology techniques involved in food biotechnology.

Course Outline

Introduction, Background and history of biotechnology (Biotechnology, food biotechnology, recent advances and trends, use and issues of genetically modified organisms in food); **Principles of microbiology and fermentation technology:** fermentation (types, equipment), factors affecting the fermentation, control of fermentation conditions, fermentation kinetics, Stoichiometry, Bioreactors, Solid state bioprocessing and transformation; **Application of Biotechnology to Food Products:** Yeast based products (Alcoholic beverages, industrial alcohols, baker's yeast, bread and related products), Bacteria based fermented products, dairy, meat and fish, vegetable, vinegar and organic acids, bacterial biomass, Mold based products, Other microbial based products: Enzymes, sweeteners, flavors, amino acids and vitamins; **Food Safety and Regulatory Requirements** (Food Safety, Safety evaluation of novel food products and genetically modified foods)

Recommended Book List

1) Ajit Varma. 2022. Biology and Biotechnology of Quinoa: Super Grain for Food Security
2) Perry Johnson-Green. 2018. Introduction to Food Biotechnology
3) Alexandru Mihai Grumezescu, Alina Maria Holban. 2018. Advances in Biotechnology for Food Industry.
4) Mohammed Kuddus. 2018. Enzymes in Food Biotechnology: Production, Applications, and future Prospects.
5) Chetan Sharma, Anil K. Sharma, K. R. Aneja. 2016. Frontiers in Food Biotechnology.

WOMEN UNIVERSITY MARDAN

BIOT-717 Advances in Recombinant DNA Technology and Genetic Engineering (3+0)

Objectives

The aim of this course is to provide fundamental insights of the principles, practice and key concepts relevant to genetic engineering. The students will be able to describe the molecular mechanism of restriction enzyme and its use in biotechnology and strong knowledge of techniques employed in recombinant DNA technology and its applications.

Course outline

Enzymology of Genetic manipulation, Genome Editing, Cloning Vectors and Method of Transformations, Techniques and tools (restriction enzymes) used in genetic engineering, Transgenic organisms for biotechnological application and gene therapy; Mutagenesis: Knock-in, Knock-out, conditional knock-outs; Gene Isolation Approaches, Gene expression, Regulation of gene expression, cDNA arrays, gene silencing by RNAi; bacterial and yeast one, two and three hybrids; Molecular diagnostics: blotting techniques, ELIZA, FISH; Applications of genetic engineering

Recommended Book List

1) Isil Aksan Kurnaz. 2021. Techniques in Genetic Engineering
2) T. A. Brown, 2020. Gene Cloning and DNA Analysis: An Introduction 8th Edition, Kindle Edition
3) Farrukh Jamal. 2020. Genetic Engineering: A Glimpse of Techniques and Applications
4) Rakesh S. Sengar, Amit Kumar, Reshu Chaudhary, Ashu Singh. 2018. Advances in Molecular Techniques
5) Ho Nam Chang. 2018. Emerging Areas in Bioengineering.

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BIOT-718 **Advances in Oncology** **(3+0)**

Objectives

The aim of the course is to enable students to acquire specialized theoretical and practical knowledge of cancer biology, from basic research to clinical applications of research findings. The course will enable the students to:

- Understand the cellular, genetic and molecular basis of cancer.
- Learn the research methodologies used in cancer research.
- Attain knowledge to pursue a research career in the field of Oncology.

Course Outline

Basics of Carcinogenesis (Molecular and cellular hallmarks of cancer); Tumor Development (development: initiation, progression, invasion and metastasis); Tumor Microenvironment (Tumor surrounding blood vessels, immune cells, fibroblasts, signaling molecules and the extracellular matrix (ECM); Causes and Risk Factors of Cancer; Cancer Causing Viruses (RNA and DNA oncogenic viruses and mechanism of cell transformation); Cancer Related Genes (Tumor suppressor genes and oncogenes (P53, PRb, MyC, RAS etc) Role of P53 (Apoptosis, DNA damage and repair); Oncogenic Signaling Pathways (RTK/ RAS/MAP-Kinase, PI3K/Akt signaling, Wnt/ β-catenin, Notch signaling, cell cycle); Cancer Epigenetics; Diagnosis of Cancer (Histological, molecular and genetic diagnosis of cancer); Cancer Therapeutics (Chemotherapy, radiotherapy and Immunotherapy gene therapy, stem cells therapy); Molecular Oncology Research Skills.

Recommended Book List

1) Antonio Russo, Marc Peeters, Lorena Incorvaia, Christian Rolfo. 2021. Practical Medical Oncology Textbook
2) The American Cancer Society. 2018. The American Cancer Society's Oncology in Practice: Clinical Management
3) Kerr DJ, Haller DJ, van de Velde CJH, Baumann M. 2016. Oxford Textbook of Oncology. 3rd Edition. Oxford University Press, UK.
4) Weinberg RA. 2014. The Biology of Cancer. 2nd Edition. New York: W. W. Norton & Company, USA.
5) Gary S. Stein, Kimberly P. Luebbers. 2019. Cancer Prevention, Early Detection, Treatment and Recovery

WOMEN UNIVERSITY MARDAN

BIOT-719 **Advances in Fermentation Technology** **(3+0)**

Objectives

The main aim of this course it to study the strategy and making of fermenter and limitations to be observed and controlled in fermentation process. It will also helps to gain knowledge about the principle of sterilization essential for fermentation and the cell growth, maintenance and product formation and evaluate the kinetics and mechanism of microbial growth.

Course Outline

Introduction to fermentation (History and development; General requirements of fermentation processes; Isolation, preservation and improvement of industrially important micro- organisms). **Preparation of microorganisms (microbial cells) for fermentation:** Development of inoculate for industrial fermentations; Kinetics of microbial growth and death; Air and media sterilization, **Basic design of fermenter and its types:** Basic design and construction of fermenter and ancillaries; **Types of fermentation process:** An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry solid-substrate fermentation; **Measurement of Parameters:** Measurement and control of bioprocess parameters Analysis of batch, fed-batch and continuous bioreactions; Bioreactor configuration - batch, continuous stirred-tank, tubular, plug flow, packed bed, air lift, fluidized bed. **Biorectors and types:** General considerations in the design of a bioreactor; Specialized bioreactors; Pulsed, fluidize photobioreactors. Biological system parameters; Processes involving microbial flocs; Bioreactors containing microbial films; Basic concept of scale-up of bioreactors. **Microbial Bioreactors:** Stability of microbial reactors; Mixed microbial populations; Bioreactor design and optimum operations – Mixing characteristics; Residence time distribution, Concentration distribution and Temperature distribution; Biological system parameters.

Recommended Book List

1) Byong H. Lee. 2021. Advanced Fermentation and Cell Technology
2) Rosa María Martínez-Espinosa. 2020. New Advances on Fermentation Processes
3) Arindam Kuila, Vinay Sharma. 2018. Principles and Applications of Fermentation Technology
4) Peter Stanbury, Allan Whitaker, Stephen J. Hall. 2016. Principles of Fermentation Technology
5) Advances in fermented foods and beverages by Wilhelm Holzapfel. 2015.

WOMEN UNIVERSITY MARDAN

BIOT-720 Biosafety and Waste Management (3+0)

Objectives

The aim of this subject is to acquaint students with the biosafety and biosecurity principles, procedures and technologies, that how to deal the biological samples and how security can be provided to biological agents. It also deals with the principles and applications of waste management.

Course Outline

Introduction to biosafety, Bio-risk assessment, Biosecurity, introduction to the management of infectious materials/waste; various types of infectious material and methods of their handling and disposal; laboratory and hospital acquired infections - possible sources and causes; hazardous microorganisms; basic containment rules and laboratory contamination levels, control measures; guidelines for workers in microbiology and pathology labs, and post-mortem rooms; rules for safe conduct during field work and outdoor activities; risk assessment including recognition of hazards; competence and elimination of hazards; collection of data, etc.; risk group personnel and their education, training and monitoring; radiation hazards and disposal of radioactive waste.

Recommended Book List

1. Reynolds M. Salerno. Jennifer Guadioso, 2015. Laboratory Biorisk Management: Biosafety and Biosecurity.
2. Dawn P. Wooley, Karen B. Byers. 2017. Biological Safety: Principles and Practices, 5th Edition.
3. Jeffrey Ryan, Jan Glarum. 2008. Biosecurity and Bioterrorism, 1st Edition.
4. Jeffrey Ryan. 2016. Biosecurity and Bioterrorism, 2nd Edition.
5. LaGrega et al. 2001. Hazardous Waste Management. 2nd Edition; McGraw- Hills.
6. McDougall et al. 2001. Integrated Solid Waste Management: A Life Cycle Inventory. 2nd Edition; Blackwell Publishers.