Anex.-III

Course contents PhD (Biotechnology)

INSTITUTE OF BIOTECHNOLOGY

BAHAUDDIN ZAKARIYA UNIVERSITY MULTAN

Proposal for PhD Biotechnology

Eligibility

2) **M.Phil./M.Sc.(Hons) Degree (18 years of education) in Biological Sciences (Botany Zoology)/ Agriculture/ Biomedical/ Biochemistry/ Bioinformatics/ Pharmacy/ DVM/Animal Husbandly or equivalent disciplines from HEC recognized university.**

3) **Minimum first Division/ B grade or 3.00 CGPA in the highest degree earned.**

Sr. No.	Course Code	Course Title	Credit Hours
1.	IBTPhD-1	Biodegradation of Environmental Pollution	3
2.	IBTPhD -2	Human Molecular Genetics	3
3.	IBTPhD -3	Molecular Immunology	3
4.	IBTPhD -4	Medical Biochemistry	3.
5.	IBTPhD -5	Enzymatic and Industrial Biotechnology	3
6.	IBTPhD -6	Recent Advances in Plant Biotechnology	3
7.	IBTPhD -7	Protein Engineering and Proteomics	3
8.	IBTPhD -8	Molecular Virology *	3
9.	IBTPhD-9	Principles and Practice in Biosafety	3
10.	IBTPhD -10	Genomics	3
11.	IBTPhD-11	Bioinformatics	3
12.	IBTPhD-12	PhD Thesis and Research	6

SCHEME OF STUDIES FOR PHD BIOTECHNOLOGY

IBT-PhD-1 Biodegradation of Environmental Pollutant

Introduction, Chemical composition and properties of soil minerals, Natural soil forming processes affecting soil pollutants such as acidification, clay migration, redox processes and leaching including interactions between abiotic and soil biochemical processes, Toxicity and impact of pollutants, Metabolic detoxification, Microbial metabolism, Science / Environmental Science, Science / Life Sciences / Biology / Microbiology, Technology & Engineering / Environmental / General, Xenobiotic metabolism, chemical, microbiological, and molecular analyses of sediments and/or waters, contaminant assessment, enriclimtent culture establishment, gene probing, PCR amplification, cloning, microbe identification based on 16S rRNA sequence determination, metabolite profiling, and microarray analyses, alkane biodegradation both in natural and in engineered systems, Microbial Degradation of Polychlorophenols, Degradation of Chloroorganic Pollutants by White Rot Fungi, Bacterial Decolorization and Degradation of Azo Dyes, Biodegradation of the Explosives TNT RDX and HMX, Biodegradation of Mono Aromatic Hydrocarbons by Fungi, Bacterial Degradation of High Molecular Weight Polynuclear Aromatic Hydrocarbons, Microbial Degradation of246 Trinitrotoluene Application to Explosives Sensor, Biodegradation of Military Explosives RDX atid HMX, Microbial Degradation of Dye Containing Wastewater, Bacterial Degradation of Petroleum Hydrocarbons, Polyurethane Biodegradation, Microbial Degradation of Plastics and Water Soluble Polymers.

Recommended Books

1. Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer, 07-0ct-2011-Science – 483 pages.
2. Marquita K. Hill, Understanding Environmental Pollution, Cambridge University Press, 22-Apr-2010 -Science - 585 pages.
3. Vishal Shah Emerging environmental technologies, Springer, 03-Nov-2008 - Science - 174 pages, Volume 1.
4. Hatice Atacag Erkurt, M. (CON) Arshad, U. C. (CON) Banerjec, Biodegradation of Azo Dyes, Springer, 0l-jun-2010 - Science - 215 pages.

IBT-PhD-2 Human Molecular Genetics

Introductions, Mendelian Inheritance, General Background, -categories of genetic diseases, - population frequencies, -modes of inheritance, - Mitosis, Meiosis and Gametogenesis, - Pedigree Construction, -Modes of Inheritance; Autosomal Dominant Inheritance, -heterozygous affected phenotype, - Punnett square, -pedigree, -variable expressivity, -late onset, -high recurrent mutation rate, -incomplete penetrance, - autosomal recessive, -inheritance, -introduction, -carrier probabilities in a pedigree, - effects of consanguinity; X-linked dominant inheritance, - Punnett square, -pedigree, -lethality in males, -X-linked recessive inheritance, -pedigree, -Punnett square, -Bayesian probability, -new mutations in genetic lethals, -sex limited inheritance, -mitochondrial inheritance, -Imprinting; Chromosomal Inheritance, -Importance, -Karyotype, - Chromosome Replication, -Autosomal Chromosomal Abnormalities, -meiotic nondisjunction, -mitotic nondisjunction, -Robertsonian translocation, -isochrome formation; Sex Chromosome Abnormalities, -Lyon hypothesis, -Barr bodies, - Turner syndrome, -Klinefelter syndrome, -XYY and XXX syndromes, -Non-Meiotic; Chromosome Abnormalities, -Inversions, -Ring Chromosomes, -Translocations (non-Robertsonian), [Uniparental Disomy; Multifactorial Inheritance, -Importance, Regression to the mean, -Polygenic Inheritance, -The Multifactorial Model, Concordance, -Threshold Model of Disease, -Degree of Relationship and Genes in Common, -Two Threhold Diseases, -Severity of Disease and Recurrence Risk, -Multiple Affected Offspring and Recurrence Risk, -Consanguinity, -Hallmarks of Multifactorial Inheritance; Linkage and Mapping, -Introduction, -X-linkage, Autosomal Linkage; POPULATION GENETICS, -Introduction, -Gene and Genotype, -Frequencies, -Codominant Alleles, -Hardy-Weinberg Equilibrium, -Assumptions, -Calculating frequencies, -Evidence ;that it applies to humans,-Exceptions to Hardy-Weinberg Assumptions, -Effect of recurrent mutation, -Effect of selection against the recessive phenotype, -Balance between selection and recurrent mutation, -Balanced polymorphism,

-Non-random mating, -Small populations, -X-linked loci, population genetics; lod scores; malformation/deformation syndromes and sequences; cancer genetics.

Recommended Books

1. Tom Strachani & Andrew P, 1999, Human Molecular Genetics 2, 2nd edition SBN-10: 0471530612.
2. Peter Sudbery, Ian Sudbery, 2009, Human Molecular Genetics, ISBN 0132051575.
3. Kenneth W. Adolph , 1996, Human Molecular Genetics, Volume 8, Pages 3-500 ISBN:978-0-12-044310-9.

IBT-PhD-3 Molecular Immunology

Molecular and cellular basis of Innate Immunity and adaptiye immunity. Structure and functional significance of Antibodies and Antigens. Molecular mechanism of Antigen processing and the molecules involved; Major Histocompatibility Complex (MHC I, II and III), Antigen Processing Cells and presentation to T lymphocytes, antigen receptors and accessory molecules of T lymphocytes. Molecular phenomena of maturation, activation, and regulation of Lymphocytes. Lymphocytes Development and the Rearrangement (VDJ recombination pathway) Signaling pathways for activation of T and B lymphocytes activation and antibody Production Molecular mechanism of Immunological tolerance Functional significance of Cytokines Molecular integration of Humoral and Cell mediated immunity Clinical Immunology; Immunity to microbes, Transplantation Immunology, Tumor Immunology, Diseases caused by immune responses: Hypersensitivity and Immediate hypersensitivity, Congenital and Acquired Immunodeficiencies Laboratory techniques commonly used in immunology

Recommended Books:

1. Cellular and Molecular Immunology Abdul K Abbas, Andrew H Lichtman, Shiv Pillai, Saunders Elsevier, 6th edition: 2007.
2. Immunology, Thomas J Kindt, Richard A Goldsby, Barbara Anne Osborne, Janis Kuby, WH Freeman & Company; 4th edition: 2000.
3. Fundamental Immunology William E Paul, Lippincott Williams and Wilkins, 6lh edition: 2008.
4. Immunology-Introductory Textbook Nandini Shetty, New age international (P) Limited, Publisher; 2nd edition 2005.

IBT-PhD-4 Medical Biochemistry

Biochemistry and Medicine, Chemistry of Carbohydrates, Lipids, Nucleotides, Proteins and amino acids and their metabolism. Cell and Cellular organelles including Biological membranes; Membrane Channels and Pumps, Functional characteristics of Plasma proteins and Prostagliandins, Biological oxidation, Water and electrolytes Balance and Imbalance, Acid Base Balance and Imbalance, Gluconeogenesis & Control of the Blood Glucose, Cholesterol Synthesis, Transport, & Excretion, Chemistry of Haemoglobulin and Haemoglobinopathies and Synthesis and catabolism of Heme, DNA replication and repair, Protein synthesis and regulation of gene expression, Digestion, absorption, integration and metabolism of Carbohydrates, Lipids, Proteins and aminoacids, Metabolism of Starvation, Porphyrins & Bile Pigments, Inherited disorders of porphyrin metabolism, Biochemical basis of detoxification, Mechanism of action and metabolic role of Hormones, Synthesis of Vitamins and metabolism of Minerals and Trace elements, Radioactivity: Radioisotopes in Medicine, Diet and Nutrition, Biochemistry of cancer, Medical Biochemical techniques, Integration of Metabolism—the Provision of Metabolic Fuels, Biochemistry and clinical diseases; Vasopressin deficiency, Thromboses prevention, Hemophilia, Digitalis and congestive • heart failure, Multidrug resistance and cystic fibrosis, Lactose intolerance, Galactose toxicity, Phosphatase deficiency and lactic acidosis, Mitochondrial diseases, Steatorrhea in liver disease, Diabetic ketosis, Inherited defects of the urea cycle (hyperammonemia), Inborn errors of amino acid degradation, Pellagra, Gout, Disruption of lipid metabolism as the cause of respiratory distress syndrome and Tay-Sachs disease, Rickets and vitamin D, Burkitt lymphoma and B-cell leukemia, Thalassemia, Diphtheria, Regulating body weight, Color blindness, Use of capsaicin in pain management, Myosins and deafness, Carbonic anhydrasc and osteopetrosis, Use of isozymes to diagnose tissue damage, Metabolism of Xenobiotics.

Recommended Books:

1. Lehninger Principles of Biochemistry Michael M Cox, David L Nelson, WH Freeman and Company; 5th edition: 2008.
2. Biochemistry, Jeremy M Berg, John **L** Tymoczko, Lubert Stryer, WH Freeman & Company; 5th edition: 2008.
3. Harper's Illustrated Biochemistry, Robert K Murray, Daryl K Granner, Peter A Mayes, Victor W Rodwell, Lange medical Books/McGraw-Hill; 26th edition: 2003.
4. Medical Biochemistry at a Glance, Ben Greenstein, Adam Greenstcin, Blackwell Science; 2nd edit on: 2006.

IBT-PhD-5 Enzymatic and Industrial Biotechnology

Introduction: Scope of Biotechnology and Industrial Microbiology. Implications of Molecular biology and bioinformatics in industrial biotechnology. Metabolic pathways for synthesis of Industrial products. Industrial micro-organisms. Fermentation media and fermentation process. Downstream processing and product recovery. Scale Up and Scale Down of Fermentation Processes. Production of Microbial insecticides. Production of fermented food. Food additive and supplements. Fuel and industrial Chemicals. Production of antibiotics and anti-tumour agents. Production of vaccines. Treatments of waste in Industry

Recommended Books

1. Modern Industrial microbiology and Biotechnology by Okafor N (2007) Science publishers, British Isles, Scotland, Great Britain.
2. Industrial Microbiology: An introduction by Waites MJ et al (2001) Blackwell Science Ltd London.
3. Practical Fermentation Technology by McNeil and Harvey (2008) John Wiley and Sons, England.

IBT-PhD-6 Recent Advances in Plant Biotechnology

Plant Biotechnology from Inception to present, What is Plant Biotechnology, Tracing the evolution of classical plant biotechnology, New development in Agriculture and industry, Risk and benefit associated with Plant Biotechnology, Tissue culture and its application, GM crops, herbal products, medicinal plants and natural habitats. Gene and genome analysis, Recombinant DNA technology: Gene Targeting (GT). Molecular marker and its application. Transgenic technologies: Production and analysis of transgenic crops; gene insertion studies; gene silencing; factors affecting gene expression; post-translational analysis; molecular farming; field trial analysis; commercialisation of modified crops; safety and regulatory affairs Functional genomics: bioinformatics; gene function studies for applied uses Comparative genomics: applications to crop species; use of current crop databases Physiological studies: pathways relevant to an application; secondary metabolites; manipulations of physiology for stress resistance - abiotic and biotic stress resistance including salinity and drought stress. Development of salt resistance plant using plant biotechnology. Most pathogen interaction and role of plant biotechnology for developing resistant corps.

Recommended Books

1. Introduction to Plant Biotechnology, Second Edition. H.S Chawla ISBN: 1-57808-228-5. 2002.
2. Plant Biotechnology and Transgenic Plants. Kirsi Marja-Oksman-Caldently. Wolfgang H. Barz. ISBN: 0-203-91084-2, 2002
3. Applied Plant Biotechnology. V.L. Chopra 2005.

IBT-PhD-7 Protein Engineering and Proteomics

Protein Engineeri ig in Basic and Applied Biotechnology. Phage Display Systems for Protein Engineering. Cell Surface Display Systems for Protein Engineering. Cell-Free Display Systems for Protein Engineering. Library Construction for Protein Engineering. Computer Graphics, Homology Modeling, and Bioinformatics. Engineering of Therapeutics Protein. Protein Engineering in Vaccine Development. Molecular Bioscreeningin Onecology. Protein engineering in Agriculture with special reference to *Bacillus thuringiensis*. Multiple Sequence Alignment as a Guideline for Protein Engineering Strategies. Prediction of Protein-Protein Interaction Based on Structure. ; Evolution of transport proteins and mechanism of apoptosis repression. Enzyme and pathway engineering for suicide gene therapy. Protein splicing and its applications

Recommended Books

1. Genetic engineering: Principles and methods (Vol 23) Editors Anderson et al (2001) KLUWER ACADEMIC PUBLISHERS.
2. Protein Design Methods and applications Edited by Gucrois R (2006) Humana Press New Jerssey
3. Protein Engineering and design Edited by Park and Cochran (2010) Taylor and Francis Group
4. Protein Engineering in Industrial Biotechnology edited by Albcrghina L (2005) Hardwood Academia publisher.

IBT-PhD-8 Molecular Virology

History of Virology and culture methods; Methods used in virology; Virus Structure including Virions. Virus Genomes and replication. Transcription and Transposition, Types of virus with special reference to HIV and Hepatitis. Evolution and Epidemiology;. Virus infection. Antiviral Agents, Vectors, and Vaccines Interferons. Antiviral chemotherapy. Viral Vaccine.

Recommended Books

1. Prirciples of molecular virdlogy (4^{lh} Edition) Cann AJ (2005) Elsevier, London
2. Virology: Principles and Applications by Carters and Saunders (2007) John Wil ?y and Sons, West Sussex, England
3. Fundamentals of molecular Virology by Acheson NH (2001) Lippincott Wil|iams & Wilkins.

IBT-PhD-9 Principles and Practice in Biosafety

Risk Assessment, Introduction to Pathogenic Microbiology, Human Source Materials & Mammalian Cell Lines Research Animals & Allergens Laboratory acquired and related infections (Historical and contemporary perspectives); Laboratory Biosafety criteria and rationale; Pathogen Movements across boundaries; Microbiological Waste Product; Principles and Practice of Sterilisation; Personal Protective Equipment; Health Factors for the Laboratory workers; Biocontainment - Purpose design and selection; Theory and Practices of Fumigation; Safety Management - Responsibilities and Accountabilities

Biosecurity Accidents and Incidents - reporting, monitoring, investigating and preventing

Facility and equipment monitoring and evaluation.

Recommended Books

1. Bioethics and biosafety in biotechnology by V. Sree Krishna.

IBT-PhD-10 Genomics

Syllabus: Concept of the genome and genome analysis, Application of molecular markers to plant breeding, application of genomic information to plant breeding and plant biotechnology, Genome structure and function, Comparative genomics, Molecular cytogenetics, Plant gcrmplasm collection, Molecular phylogeny. Comparative genomics, the analysis and comparison of genomes from different species, comparing genomes: sequence similarity, gene location, the length and number of coding regions, the amount of noncoding DNA in each genome, and highly conserved regions Use of computer programs that can line up multiple genomes and look for regions of similarity among them. Use of BLAST to perform similarity searches on all available sequence data, how to use BLAST, Sequence similarity searching using NCBI BLAST available through Gene Gateway, an online guide for learning about genes, proteins, and genetic disorders.

Recommended Books:

1. Genomic Technologies: Present and Future.

IBT-PhD-11 Bioinformatics

Functional genomics comparative genomics, DNA microarray, computer aided drug designing (ligand and receptor based), molecular docking, protein-protein interaction , network and database, molecular dynamics simulation, biological, networks, transcriptome, metaboloinics.

Recommended Books:

1. Schulze S. Kremer Latest Ed. Advances in Molecular Bioinformatics. Netherland Printing.

2. S. C. Rastogi, Namita Mendiratta, Parag Rastogi Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, PHI Learning Pvt. Ltd

3. Bioinformatics: Sequence and Genome Analysis. David W. Mount. CSHL Press, 2001