GUJARAT BIOTECHNOLOGY UNIVERSITY

ACADEMIC DEPARTMENT

GBU/ADM/Ph.D./Academic Calendar/ Date:24/01/2025

NOTIFICATION

Subject: ACADEMIC CALENDAR of Ph.D. Coursework

Reference:

1. **Approved e sarkar note GBU/Adm/e-file/265/2024/0905/Admin dated 21st January 2025**
2. **Approved MoM of PhD Admission Committee dated 23rd January 2025**

The Academic calendar for Ph.D. Spring (Even) Semester 2025 Ph.D. course is notified as under:

S.No	Semester I – [January to May] [PhD AY2024-2027]		
1	30.01.25	Thursday	Start date
2	20.01.25 to 24.01.25		Sports week
3	03-03-25 to 05-03-25		Cultural week
4	21.05.2025	Thursday	Departmental specific course-Assessment
5	22.05.2025	Friday	Analytical Techniques-Assessment
6	23.05.2025 (10:00 am)	Friday	Research Methodology- Assessment
7	23.05.2025 (02:00 pm)	Friday	Research and Publication Ethics- Assessment
6	24.05.25	Saturday	End of Semester

Semester	Total teaching weeks
	17

- The **COURSE STRUCTURE** will be as under:

Subject Code	Name of course	Credits	Marks
PCRM	Research Methodology (RMT)	04	100
PCAT	Analytical Techniques	02	50
PCRE	Research and Publication Ethics	02	50
PC (ABT/MBT/ PBT/EBT/IBT)	Departmental specific course	04	100

• **AWARD OF GRADE**: A Ph.D. scholar must obtain a minimum of 55% of marks or its equivalent grade in the UGC 10- point scale in the course work in order to be eligible to continue in the program and submit the dissertation/thesis.

- A maximum of two chances shall be given to the scholar for clearing the coursework, failing to which may lead to cancellation of admission.

- **<u>The assessment of COURSE WORK will be as under:</u>**

Subject code	**Assessment Pattern** **Method of exam:** Written examination		**Marks**
PCRM	**Research Methodology**	Objective questions (60 marks), 1 mark 30, 2 marks 15	100
PCAT	**Analytical Techniques**	MCQ 30 marks, Short notes 20 marks	50
PCRE	**Research and Publication Ethics**	MCQ 30 marks, Short notes 20 marks	50
PC (ABT/MBT/ PBT/EBT/IBT)	**Departmental specific course**	Objective questions (60 marks), 1 mark 30, 2 marks 15	100

- The credits earned for completed coursework may be transferred from one institution to another through the Academic Bank of Credits
- The Coursework will commence from **30th January 2025**.

<u>The detailed PhD Degree course work is as follows:</u>

PhD Degree course

Research Methodology- 4 Credit

Course coordinator: Dr Chirayu Desai and Dr. Vishal Suthar

Unit I Overview of the research (AB, CD, JR, RR)

Objectives of research – Understanding research and its importance. Types of research, research approaches and an overview of the research process. Criteria of a good research project, Importance of critical thinking in designing the research problem/project. Research topic/problem selection process. Methods of scientific enquiry – formulation of hypotheses and testing – research questions and literature review.

Unit II Statistical approach and data analysis for research (NK, NS)

Basic Statistical applications: Binomial, Poisson, Normal, Exponential, Weibull and Geometric Distributions. Regression and Correlation Analysis

Sample size determination & sampling techniques; probability and non-probability-based sampling. Bayesian and non-Bayesian statistics, ROC curve analysis

Large Sample Tests and Small Sample Tests: Student–t-test, F-test and χ2 test, Analysis of Variance and Covariance, Multivariate Analysis Techniques, etc. and their applications in research.

Unit III Application of computational tools for research (DP, SP, RN)

Application of basic functions of MS word, MS Excel, MS Power point in day to research activity, Use of MS Excel for data analysis, Use of MS PowerPoint and special software for preparation of scientific figures and graphical abstract such as sigma plot, biorender, etc.

Unit IV Research writing & Presentation (AK, GS, CD, SP)

Features of scientific literature: primary, secondary, tertiary, and grey literature, research databases and literature surveys, Identification of scientific publications (ISBN, ISSN, DOI), literature collection, literature citation, bibliometric measures (Impact factor & h-index) and prior art search for patenting, copyright and trademark. Developing a research proposal, components of research proposal, drafting research proposal, Research report writing and thesis writing, Scientific research paper and review writing, Elements of presentation: Preparation, Visual and Delivery. Scientific poster preparation and presentation skills, Reference management tools such as Endnote, Mendeley etc.

Unit V Research, Innovation & Entrepreneurship (GJ. RR & SPS)

Role of basic and translational research, examples of translational research, Research & development in industry. Industry and academic joint research – Bridging the gap. Technology Readiness levels (TRL). Start-up Incubators - Concepts – start-up ecosystem- government start-up initiatives, Intellectual Property Rights – Copy right laws – Patent rights.

Research and Publication Ethics- 2 Credit

Corse coordinator: Dr. Sangram Lenka and Dr. Sudhir Singh

Unit I General philosophy and ethics (IP, JR, NS)

General principle and philosophy of ethics, nature, scope, concept and branches of ethics, moral philosophy, nature of moral judgements and relations, role of national and international law for biotechnology, case studies of scientific misconducts.

Unit II Publication ethics (NT, CD, AK)

Publication ethics: introduction and importance, types of plagiarism, best practices to avoid plagiarism, Publication misconduct with case studies, Violation of publication ethics, authorship and contributor ship, Conflicts of interest, Predatory publishers and journals.

Unit III Safety and regulatory process in biological research (SaP, SP, SR, JR)

Basics of laboratory safety and risk associated in biological research, various protective measures for biological research such as PPE, emergency equipment, lab safety equipment etc. Biosafety guidelines and RCGM, human and animal ethics.

Unit IV Tools and methods to detect scientific misconduct. (NK, IP, SP)

Use of plagiarism detection software like Turnitin, Urkund and other open-source software tools, Detection of AI based writeup, Indexing databases.

Bioanalytical techniques-2 Credit

Corse coordinator: Dr. Ravindra Pal Singh and Dr. Imran Pancha

Unit I Use of microscopy in biological research (AB, AR, RN, JR)

Basics of microscope, Different types of microscopes and its application in biological research, Light microscopy: bright-field microscopy, phase-contrast microscopy, Fluorescence microscopy, Confocal microscopy; Electron microscopy: Scanning & Transmission electron microscopes

Unit II Use of spectroscopy in biological research (BM, KM, DP, GJ)

Basics and history of spectroscopy, Different types of spectroscopy and its application in biological research, UV-Vis spectroscopy, infrared spectroscopy, CD spectroscopy, fluorescence spectroscopy, NMR, mass spectrometry, Raman spectroscopy.

Unit III Use of chromatography in biological research (RP, GJ, KM, IP)

Basics of chromatography, Different types of chromatography and its application in biological research, paper and thin layer chromatography, gel permeation chromatography, ion exchange chromatography, affinity chromatography, gas chromatography, high performance liquid chromatography and variants.

Unit IV Use of basic molecular biology and analytical techniques (KK, GS, RK, SPS)

SDS and Native PAGE, Agarose gel electrophoresis, molecular cloning, real time PCR, DNA sequencing, ELISA, Immunoblotting, flow cytometry and cell sorting (FACS), Cell transformation and cultures, ITC and BLI, genome editing technique.

Unit V Bioinformatics (NS & DP)

Basic bioinformatics with multi-omics-related software, python, R, CLC genomics, Discovery studio etc.

Department specific course-4 Credit

PhD course Fundamentals of Animal Biotechnology

Theory

1. Introduction to Animal Biotechnology
- Overview of biotechnology in animal sciences
- Historical development and milestones
- Economics of animal biotechnology

2. Cell Biology Basics
- Cell structure and function
- Cell culture techniques
- Genetics and Molecular Biology

3. Principles of genetics and inheritance
- DNA structure and replication

- Gene expression and regulation
- Recombinant DNA technology

4. Transgenic Animals
- Creation and applications of transgenic animals
- Techniques for gene insertion and manipulation
- CRISPR mediated genome editing
- Embryo micromanipulation technology

5. Cloning
- Principles of animal cloning
- Techniques such as somatic cell nuclear transfer (SCNT)
- Applications and ethical considerations

6. Stem Cell Biology
- Introduction to stem cells and their properties
- Differentiation and reprogramming
- Applications in regenerative medicine and animal breeding

7. Genomic Technologies
- Genome sequencing and analysis
- Genomic selection and marker-assisted breeding

8. Bioethics and Regulatory Aspects
- Ethical considerations in animal biotechnology
- Regulations governing the use of biotechnological techniques in animals

9. Applications of Animal Biotechnology
- Improvement of livestock productivity and health
- Animal infectious diseases diagnostic strategies and therapeutics
- Vaccine technology
- Biomedical applications, including disease modeling and drug development
- Conservation efforts and preservation of endangered species

10. Emerging Trends and Future Directions
- Recent advancements in animal biotechnology
- Potential future applications and challenges

Practical Lab Sessions

Hands-on experience with techniques such as PCR, gene cloning, IVEP, cell culture, and genetic modification (if facilities permit)

Case Studies and Discussions

PhD Course work: Department of Medical Biotechnology

Module 1: Biosensors (9 hours)

- Diagnostics and Biosensors: Importance and Applications (1 Hour)
- Current Landscape of In Vitro Diagnostics (1 Hour)
- Molecular Recognition Elements and Their Types (1 Hour)
- Transduction Mechanisms (2 Hours)
- Analytical Parameters of Biosensors (1 Hour)
- Future Directions in Diagnostics (1 Hour)
- Target Product Profiles for Diagnostic Assays and Devices (2 Hours)

Module 2: Disease Biology (9 hours)

- Introduction to Disease Biology, homeostasis, communicable and non-communicable diseases (1 hour)
- Inherited disorders, Complex diseases and genetic susceptibility, Epigenetics and disease inheritance (2 hours)
- Immunology and Autoimmune Diseases: Immune system overview, Mechanisms of immune tolerance and autoimmunity, Immunotherapy and its applications (2 hour)
- Cardiovascular Diseases: Atherosclerosis and coronary artery disease, Hypertension and heart failure, Novel therapies and preventive strategies (2 hours)
- Prognostic and diagnostic biomarker discovery (1 hour)
- Animal models in non-communicable disease research (1 hour)

Module 3: Cancer and Neurodegenerative Disorders

- Fundamentals of tumour biology: 2 hours
- Cancer Chemotherapy: 2 hours
- Exploring Cellular Dynamics: From Cytoskeleton to Cancer Therapy: 3 hours
- Exploring Autophagy in Health and Disease: 2 hours

Module 4: RNA World (9 hours)

- 1. Introduction to RNA and RNA binding proteins: 2 hours
- 2. Epigenetics and chromatin Regulations: 2 hours
- 3. Stochastic gene expression and its advantages- 2 hour
- 4. Advancement in RNA sequencing -2 hours
- 5. Spatial transcriptomics -1 hour

Module 5: Drug Discovery and Development (9 hours)

- 1. Target Identification: 2 hours
- 2. Hit Discovery Process: 2 hours
- 3. High Throughput Screening: 2 hours
- 4. *In vitro*, *in vivo* and *ex-vivo* processes: 2 hours
- 5. Ethical Considerations: 1 hour

Advanced Plant Biotechnology

Course Description:
The course is designed to familiarize students with the concepts of plant growth and development, and the modern approaches that are used in plant biotechnology research.

Learning outcomes:
Upon completion of the course, a student should be able to:

1. Develop an understanding of the key elements of plant growth and regulation, and associated pathways/ mechanisms.
2. Design and implement a systematic approach to address key challenges in agriculture.

Course contents:

I. *Plant Physiology and Development*
   a. Introduction to plant physiology and development: photosynthesis, nutrition, respiration, transportation, seed dormancy, germination
   b. Signalling and gene regulation in plants concerning abiotic stress
   c. Soil health and associated microbiome

II. *Molecular Plant Pathology*
   a. Introduction to plant pathogens and biotic stress
   b. Mechanisms of plant immunity and defense response
   c. Signaling and gene regulation in plants concerning biotic stress

III. *Agrigenomics*
   a. Genetics and genomics to enhance crop production
   b. Molecular markers: introduction and applications [PCR and hybridization methods, simple sequence repeat (SSR), single nucleotide polymorphism (SNP), quantitative trait locus (QTL)]
   c. Plant Breeding technologies: introduction, methods, and applications
   d. High throughput phenotyping and Genotyping technologies
   e. Speed breeding: technique, methods, and applications
   f. Genetic gain, Genomics-assisted breeding (GAB), Genotype by environment.
   g. Molecular evolution and phylogenomics

IV. *Plant Tissue Culture*
   a. History, approaches, controlled growth conditions, and media composition
   b. Organ culture: techniques and applications
   c. Somatic embryogenesis and artificial seeds: techniques and applications
   d. Micrografting & Micropropagation: techniques and applications

e. Meristem culture: techniques and applications
f. Plant cells as biofactories: techniques and applications

V. *Plant Molecular Biotechnology*
   a. Regulation of gene expression: transcriptional and post-transcriptional
   b. Agrobacterium: introduction and applications
   c. Genetic engineering: introduction and evolution of genome editing, methods of plant transformation, analysis of transgenic plants, functional characterization, and applications in agriculture
   d. Forward and reverse genetic approaches
   e. Genetically modified crops: background, biosafety, regulation, and concerns

Environmental Biotechnology (EBT) Department

Course Code and Title: Ecosystem Sustainability and Circular Bioeconomy

Learning Outcomes:

1. To understand and apply concepts of interrelationships between biotic and abiotic components of ecosystems, biogeochemical and nutrient cycling.
2. To critically evaluate various approaches for ecosystem sustainability and interpret different analytical methods to study ecosystems and their function.
3. To understand the salient features of microbial ecophysiology and chemical biology driving environmental interactions and biotransformations.
4. To understand and apply various concepts of ecosystem restoration, climate change and sustainable development goals.
5. To interpret and evaluate approaches in biovalorization of wastes through biorefinery approaches.
6. To understand and create a circular bioeconomy-based framework for waste management and resource recovery.

UNIT 1: Microbes and Ecosystems

i. Cell and molecular evolution w.r.t evolution of ecosystem: GOE, endosymbiosis, Miller-Urey, Oparin-Haldane, RNA World, genes-first, Punctuated equilibria, Substitution Rate Model

ii. Major bio-geo-chemical processes and nutrient flux dynamics (C, N, P, S, Fe, Redox elements, ions)

iii. Genetic circuits and pathways/enzymes and energetics for (in)organic pollutants biodegradation

iv. Importance of key physiology (SLIME, Syntrophism, chemo lithotrophic, methanogenic/trophic, ANAMMOX, ANME types, etc.), sporulation and other forms

v. Case study on biotransformation, biodegradation, bioprecipitation, & their connection to ecosystem ecology and application (biomaterials-Biochars)

vi. Biomolecules in environment (eDNA, Proteins/peptides and Enzymes, Secretome, Metabolites including Quorum sensing, Lipids and their structures)

vii. Geomicrobial-analytical techniques (X-ray: EDX, XRF, XRD, XANES, XPS, Plasma, SEM-TEM, FTIR, RAMAN, SIP, FRET, Spectral, & Genomics and Metagenomics based community analyses)

UNIT 2: Ecosystem Restoration Biotechnology

Sustainable Development Goals; Climate change theories and impacts; Carbon sequestration concepts; and Ocean acidification issues.

Ecological restoration - concepts and approaches: Lake, River, Landscape, Marine and Others.

Sampling Techniques; Sample Transportation Concepts; and Sample storage concepts.

Synthetic biology approaches; Applications of biopolymers; and Multi-'omics' analysis.

UNIT 3: Waste Biovalorization and Circular Bioeconomy

Concepts of waste biorefinery and sustainable closed-loop framework of circular bioeconomy approaches, classifications of different types of bio-waste, an overview of different types of biorefineries, various bio-valorization processes for conversion of bio-waste into industrially relevant products such as biofuels, biopolymers, pigments, biofertilizers, nanomaterials, platform chemicals, techno-economic analysis and environmental impact of biorefinery. Technology readiness levels and scalability of various biorefinery approaches.

PhD Course work: Industrial Biotechnology

Unit 1: Industrial microbiology

Basics of industrial microbiology, Microbial diversity and phylogenetics, Exploration of microbial diversity for the production of various industrially relevant compounds, Adaptation of microbes to various environments and its industrial relevance Microbial physiology and metabolism

Unit 2: Bioreactor Technology

Types of bioreactors such as CSTR, Air lift bioreactor, Bubble column reactor, Packed bed, Photobioreactor etc., Basics of thermodynamics, mass heat transfer for bioreactor engineering, various types of production processes using bioreactor such as batch, fed-batch and continuous process

Unit 3: Metabolic engineering

Basics of metabolic engineering and systems biology, Concepts and various strategies used for the strain engineering, Details about various cloning techniques, microbial host, Flux balance analysis

Unit 4: Enzymology

Application of enzymes in industrial biotechnology, Purification and characterization of enzymes, Enzyme kinetics, Enzyme engineering and its application in recent development in industrial biotechnology

Unit 5: Bioprocess optimization

Application of bioprocess optimization in industrial biotechnology, Upstream processes, Downstream processes, One factor at a time and various statistical optimization techniques, Primary technoeconomic analysis, Life Cycle assessment

*NOTE: **75% attendance** is mandatorily required for coursework classes.

This order is issued after obtaining approval of competent authority

Deputy Registrar

Copy To: All concerned