Central Tribal University of Andhra Pradesh
Vizianagaram, A.P

SYLLABI
Department of Biotechnology
School of Sciences

Ph.D. Program in Biotechnology
(Effective from 2025-26)

COURSE LAYOUT

A) Common Courses (06 credits)

Course Code	Title	Nature	Credit
PHD 801	Research Publication Ethics	Compulsory	02
PHD BIT 802	Research Methodology	Compulsory	04

B) Discipline Specific Courses (04 credits)

Course Code	Title	Nature	Credit
PHD BIT 803	Instrumentation in Biotechnology	Compulsory	03
PHD BIT 811	Lab Work	Compulsory	01

C) Research Theme -Specific Courses (05 credits)

Course Code	Title	Nature	Credit
PHD BIT 821	Clinical and Molecular Biology	Elective	03
PHD BIT 841	Research Plan proposal	Compulsory	02

Total Credit(A+B+C) =15

Duration of the entire course = 6 month (i.e., one semester)

Course: Research &Publication Ethics
Course code: PHD 801
Rationale: This course will provide thorough and in-depth knowledge about basics of philosophy of science and ethics, research integrity a, publication ethics. Hands on session are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, impact factor, etc.) and plagiarism tools will be introduced in this course

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs./Week	Tutorial Hrs./Week	Lab Hrs/Week	Hrs/Week	Credits	Internal Marks			External Marks		
					T	CPE	P	T	P	
2	-	-	-	2	20	20	-	60	-	100

C**PE** - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content **W** - Weightage (%), **T** - Teaching hours

Sl. no	Topics	W	T
1	**Unit 1 Philosophy and Ethics -** Introduction to Philosophy: Definition, nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgments and reactions	12	03
2	**Unit 2: Scientific conduct:** Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconduct: Falsification, fabrication and Plagiarism (FFP), Redundant Publications: Duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data.	12	05
3	**Unit 3: Publication Ethics:** Publication Ethics: definition, introduction and importance, basic practices/standards setting initiatives and guidelines: COPE, WAME etc, Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviour, and vice versa types, Violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, predatory publishers and journals	25	07
4	**Unit-4: Open Access Publishing –** Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder/Journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc	25	04
5	**Unit 5: Publication Misconduct- Group discussions:** 1) Subject specific ethical issues, FPP, authorship 2) Conflict of interest 3) Complaints and appeals: examples and fraud from India and abroad, **Software tool**: Use of plagiarism software like Turnitin, urkund and other open software tools	12	04
6	**Unit-6: Databases and Research Metrics –** Databases: Indexing databases, citation databases: Web of science, Scopus, etc., Research Metrics-Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index, alti metrics.	14	07

Reference Books

1.	Bird, A.(2006). Philosophy of Science. Routledge.
2.	Macintyre, Alasdair (1967) A Short History of Ethics. London.
3.	P.Chaddah,(2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865 National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009).On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press
	After Learning the Course, the students shall be able to:
	Define and formulate meaningful research problems. Understand research misconduct and predatory publications. Understand, publication ethics, and responsible research conduct.

Course: Research Methodology

Course code: PHD BIT 802

Rationale: This course will provide thorough and in-depth knowledge about principles of research based scientific learning, competence in modern research design and ethical responsibility. This course aims to transform a learner into a thoughtful, critical, ethical, and innovative researcher, capable of advancing knowledge, fostering collaborations, leading academic excellence, and addressing complex global challenges through high-impact research contributions.

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
					Internal Marks			External Marks		
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Hrs/Week	Credit	T	CPE	P	T	P	
4	-	-	-	4	20	20	-	60	-	100

C**PE** - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content **W** - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	**Unit-1: Fundamentals of Research Methodology**-Meaning, nature, scope & significance of research Motivation and objectives of research, Types of research: Basic, applied, clinical, qualitative & quantitative., Positivism and Post- positivistic approach to research. Methods of Research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods., Research process & planning: literature review, hypothesis formulation	**25**	**13**
2	**Unit 2: Research Problem & Research Design:** Characteristics of a research problem, Sources & selection of research problems, Concepts of variables, assumptions & limitations. Research design: need, principles & classifications, Sampling design: probability & non-probability sampling, Experimental designs & validity.	**25**	**12**
3	**Unit-3: Data Analysis, Interpretation & Report Writing** Data types, data collection methods, questionnaires & surveys. Measurement scales, reliability & validity. Overview of statistical tools, biostatistics basics: Measures of central tendency & dispersion instruments/software, Probability distributions (Binomial, Poisson, Normal), t-test, χ^2-test, ANOVA, Regression & Correlation tools, Qualitative data analysis: thematic & content analysis, Interpretation: precautions & methods. Microsoft Excel, Prism and SPSS software, ONOS; One nation one subscription.	**30**	**15**
4	**Unit-4: Research Integrity, IPR** - Intellectual Property Rights (IPR): patents, copyrights, trademarks, Indian and International patent laws, licensing & technology transfer, Patent databases, patent filing basics, WIPO overview.	**20**	**8**

Reference Books

1.	**Research Methodology: Methods & Techniques.** By Kothari, C.R. &Garg
2.	**Research Design: Qualitative, Quantitative & Mixed Methods Approaches** By Creswell, J. W

Course Outcome

After Learning the Course, the students shall be able to:
Define and formulate meaningful research problems. Develop appropriate research design and methodologies. Analyse and interpret quantitative and qualitative data. Write and present scientific reports and research papers independently. Understand patent laws, publication ethics, and responsible research conduct.

Course: Instrumentation in Biotechnology

Course code: PHD BIT 803

Rationale: This course will provide thorough and in-depth knowledge about principles and instrumentation of major analytical tools in biotechnology. The syllabus discusses core instrumentation such HPLC, microscopy, ELISA and biophysical techniques. It enhances students' capabilities for higher academic pursuits, laboratory operations, and biotechnology-based innovation.

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
					Internal Marks			External Marks		
Lecture Hrs./Week	Tutorial Hrs./Week	Lab Hrs./Week	Hrs./Week	Credit	T	CPE	P	T	P	
4	-	-	-	4	20	20	-	60	-	100

CPE - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content **W** - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	**Unit-1: Fundamentals of instrumentation.** Preparation of buffers, use of pH meter, estimation of proteins, enzyme assays, preparation of cell / tissue homogenates, cell culture (sub-culturing and storage), centrifugation, thermal cycler (regular and real-time), gel documentation system, Microscopy-Light microscopy, resolving power & optics, Electron microscopes: SEM, TEM instrumentation, Fixation, staining	19	13
2	**Unit 2: Immunological and Histochemical Techniques**.Antibody generation: polyclonal & monoclonal, RIA, ELISA reader, Incubator shaker, Laminar flow, Nanodrop, Western blotting, immunoprecipitation instruments, Flowcytometry: principle, gating & applications, Immunofluorescence microscopy: equipment & detection, *In situ* molecular detection: FISH	27	11
3	**Unit-3: Biophysical Tools &Techniques** UV–Vis, Fluorescence, Circular Dichroism, ESR & NMR spectroscopy, Light scattering instruments, Mass spectrometry systems, Surface Plasmon Resonance (SPR) X-ray diffraction and NMR-based structural study setups,	29	13
4	**Unit-4: Chromatography Techniques**, Chromatography -TLC, Paper, HPLC, Gas chromatography, Size exclusion, Affinity chromatography	25	11

Reference Books

1.	**Principles and Techniques of Biochemistry and Molecular Biology** By Wilson and Walker
2.	**Molecular Biology of the Cell** By Alberts et al.
3.	**Molecular Cloning: A Laboratory Manual** By Sambrook and Rusell

Course Outcome

After Learning the Course, the students shall be able to:

Learn buffer preparation, cell culture, standard molecular biology techniques. Apply immunological and histochemical methods for detection, quantification, and localization of biomolecules. Operate advanced light and electron microscopy systems for cellular and ultrastructural analysis, and utilization of chromatographic techniques. Integrate appropriate experimental techniques for designing and interpreting biotechnology research studies.

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Course: Lab work

Course code: PHD BIT 811

Rationale: This laboratory course provides hands-on training in essential molecular biology, protein analysis, spectroscopic, and chromatographic techniques required for modern biotechnology research. It enables scholars to generate, analyze, and interpret experimental data related to nucleic acids, proteins, and biomolecular interactions. The course strengthens experimental competence, analytical skills, and research preparedness essential for Ph.D.-level investigations in biotechnology.

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
					Internal Marks			External Marks		
Lecture Hrs./Week	Tutorial Hrs./Week	Lab Hrs./Week	Hrs./Week	Credit	T	CPE	P	T	P	
-	-	2	-	1	-	-	-		50	50

CPE - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content **W** - Weightage (%), **T** - Teaching hours

Sr.	Topics	T
1	**Nucleic Acid Extraction** Isolation of Genomic DNA from Animal/Plant Cells, Extraction of Total RNA from Tissues	
2	**Gene Amplification and Analysis-** Polymerase Chain Reaction PCR, RT PCR, qPCR, Multiplex PCR, Agarose gel Electrophoresis, Southern and Northern Blotting	
3	**Protein expression & Analysis-** SDS-PAGE, Western Blotting, ELISA, Immunoprecipitation & Co-IP for Protein–Protein Interaction	
4	**Spectroscopy-** UV-Vis, CD spectroscopy, Fluorescent Spectroscopy, MS, IR, NMR	
5	**Chromatographic Techniques-** Thin layer Chromatography, Paper Chromatography, HPLC, Gas Chromatography	

Reference Books

1.	**Molecular Cloning: A Laboratory Manual** By Michael R. Green & Joseph Sambrook
2.	**Laboratory Manual of Molecular and Cell Biology** By Karen H. Bennet
3.	**Techniques in Molecular Biology: A Practical Approach** By J. M. Graham & David Rickwood

Course Outcome

After Learning the Course, the students shall be able to: Extract high-quality DNA/RNA using appropriate chemical and enzymatic methods. Design primer sets and optimizes PCR conditions for specific gene targets. Extract proteins and quantify using standardized methods while preventing degradation. Evaluate spectroscopic data and correlate structural parameters with biomolecular function.

Course: Clinical and Molecular Biology

Course code: PHD BIT 821

Rationale: This course provides an integrated understanding of the molecular mechanisms underlying human diseases, linking genetic alterations to pathophysiology. It equips students with knowledge of modern molecular diagnostic tools and biomarkers essential for disease detection and prognosis. The course introduces advanced therapeutic and regenerative strategies, preparing learners for translational research and clinical applications in biotechnology.

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs./Week	Tutorial Hrs./Week	Lab Hrs./Week	Hrs./Week	Credits	Internal Marks			External Marks		
					T	CPE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

CPE - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content **W** - Weightage (%), **T** - Teaching hours

Sr.	Topics	W	T
1	**Unit-1: Molecular Basis of Disease Pathogenesis-** Genetic mutation and types, DNA damage and repair mechanism, role of protooncogenes and Tumour suppressor genes (p53, pRb), viral integration and mutation induction, bacterial pathogenesis, host pathogen interaction and antimicrobial resistance	22	9
2	**Unit 2: Pathophysiology of Human diseases**: Monogenic disorders (Cystic fibrosis, sickle cell anaemia, Huntington's disease, Chromosomal disorders (Down, Turner and Klinefelter), Viral disease (HPV, Hepatitis), Bacterial disease (Tuberculosis, Typhoid) Parasitic (Malaria, dengue), Neurogenerative (Alzheimer's, Parkinson's), Use of animal models (wild type and genetically modified) for studying human diseases	27	6
3	**Unit-3: Molecular Diagnostics & Biomarke**r -PCR variants & qPCR in diagnostics Digital PCR, Immunodiagnostics: ELISA, CLIA, DNA Microarrays Flow Cytometry, DNA Probes & Hybridization Assays, DNA sequencing (NGS), Microscopy & Histopathology: Biopsy/tissue staining,	29	11
4	**Unit-4: Regenerative therapies & Clinical Research Applications** RNA based Molecular therapeutics: siRNA, mRNA., miRNA gene therapy, Immunotherapy (CAR-T cell therapy), CRISPR/Cas9 gene editing, Gene delivery systems (Viral. Non-viral vectors), Methodology to conduct clinical research / public health research: sample collection, processing, interpretation, and reporting of clinical and public health research data.	22	10

Reference Books

1.	**Molecular Biology of Cell** By Alberts et al.
2.	**Principles of Molecular medicine** By Jameson et al.
3.	**Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications** By Lela Buckingham & others

Course Outcome

After Learning the Course, the students shall be able to: Demonstrate expert knowledge of molecular basis of diseases. Apply and critically evaluate modern clinical diagnostics and therapeutic strategies. Integrate molecular biology tools in clinical and translational research.

Course: Research Plan proposal

Course code: PHD BIT 841

Rationale: This course is designed to equip Ph.D. scholars with the conceptual, methodological, and ethical framework required to develop a scientifically sound, feasible, and original research proposal in Biotechnology. The course culminates in the preparation and presentation of a detailed Ph.D. research plan, aligned with UGC regulations and institutional research priorities.

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme			Total
Lecture Hrs./Week	Tutorial Hrs./Week	Lab Hrs./Week	Hrs./Week	Credit	Research proposal document	CPA	Proposal Presentation and viva	
2	-	-	-	2	15	10	25	50

CPE - Continuous Performance Evaluation (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Reference Books

1.	**Research Methodology: Methods and Techniques** By Kothari, C.R.
2.	**How to Write and Publish a Scientific Paper** By Day, R.A. & Gastel, B.
3.	**UGC Regulations for Ph.D. Programmes** (latest)
4.	**COPE & ICMR Guidelines on Research Ethics**
5	Peer-reviewed journals in Biotechnology (as relevant to research area)

Course Outcome

After Learning the Course, the students shall be able to:

Develop a comprehensive and defendable research plan
Critically analyse existing literature and identify research gaps
Select appropriate experimental designs and methodologies
Incorporate ethical, biosafety, and data management considerations

****The End****